МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

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АВТОМОБИЛИ И ЭКСПЛУАТАЦИЯ АВТОМОБИЛЬНОГО ТРАНСПОРТА

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Содержит учебные материалы по автомобильной тематике.

Учебное пособие подготовлено на кафедре иностранных языков и предназначено для студентов, обучающихся по направлениям 190600 «Эксплуатация транспортно-технологических машин и комплексов», 190700 «Технология транспортного производства»

ПРЕДИСЛОВИЕ

Представлены тексты, содержащие информацию о строительстве дорог и автомобилях, а также различные коммуникативные упражнения, способствующие развитию навыков разговорной речи по предложенной тематике.

Пособие состоит из 2-х частей: часть I предназначена для аудиторной работы на занятиях по дисциплине «Иностранный язык в профессиональной и научной сферах» (Практикум), которая введена в учебные планы в связи с разработкой программ обучения по госстандартам III поколения; часть II содержит тексты и задания для самостоятельной проработки.

ВВЕДЕНИЕ

Учебное пособие разработано в соответствии с требованиями подготовки специалистов, умеющих общаться на английском языке в профессиональной и научной сферах. Оно предусматривает обучение согласно требованиям новых программ, составленных в соответствии с госстандартами III поколения.

Часть I состоит из 4-х разделов, включающих тексты по тематике строительства автомобильных дорог, списки ключевых слов, упражнения лексико-грамматического характера, предусматривающие не только проверку понимания прочитанного, но и подготавливающие студентов к общению по избранной специальности и профилю вуза в форме диалога и монолога (доклада, сообщения).

Часть II содержит тексты для самостоятельной проработки. Они посвящены истории создания автомобилей, характеристике автомобилей различных марок и особенностям современных автотранспортных средств. Эти тексты можно предложить как самостоятельные индивидуальные задания с целью получения необходимой информации и дальнейшего представления в виде рефератов, устных и письменных переводов, пересказов на английском и русском языках. Их можно использовать при подготовке к выступлениям на конференциях и при сдаче индивидуальных заданий в виде презентаций.

Авторы выражают благодарность рецензентам – кандидату педагогических наук, доценту, зав. кафедрой иностранных языков Пензенского филиала Академии материально-технического обеспечения Сергиевской И.Л. и кандидату филологических наук, доценту кафедры иностранных языков ПГУАС Козиной Т.А.

PART I.
ROADS AND THEIR CONSTRUCTION

Unit 1. ROADS

I. Изучите следующую лексику.

1) motor road – автомобильная дорога
2) road sign – дорожный знак
3) highway – автомагистраль
4) primitive road – неулучшенная грунтовая дорога
5) natural – естественный
6) passable – проходимый
7) carriageway – проезжая часть
8) proper – должный
9) drainage – осушение, водоотвод, дренаж
10) stable – прочный, устойчивый, стабильный
11) surfacing – покрытие
12) traffic – движение
13) speed – скорость
14) improve – улучшать
15) driving – вождение автомобиля
16) affect – воздействовать
17) super-elevation – подъем виража на закруглениях дороги
18) curve – кривая, дуга
19) gradient – уклон
20) width – ширина
21) landscape – пейзаж, ландшафт, местность
22) slow traffic road – дорога для тихоходного транспорта
one-way motor road – дорога с движением в одном направлении
two-way fast traffic road – дорога, позволяющая двустороннее скоростное движение
23) infect to – сочетаться
24) long-sight distance – большое расстояние видимости
25) stopping – стоянка
26) length – длина, отрезок
27) overtaking – обгон
28) fit into – приспосабливаться, вписываться
29) secure – обеспечивать
30) car – автомобиль
31) service – обслуживание
repair service – ремонт
maintenance service – обслуживание

32) reflector indicator – указатель с катафотами
33) guard post – предохранительный столб
guard barrier – предохранительный барьер
ferro-concrete guard post – железобетонный предохранительный столб
34) inspection pit – смотровой колодец
35) carriageway – проезжая часть

II. Подберите определение к английскому термину, пользуясь табл.1 и информацией из текста.

Т а б л . 1

1. Primitive roads	a) They have a specially constructed stable carriageway with a road surface of an improved type.
2. Seasonal roads	b) They are natural roads where no construction work is made.
3. Permanent roads of local transport	c) They have a specially constructed carriageway, proper drainage being made.
4. Permanent motor-car roads	d) They have a specially constructed stable carriageway, proper drainage and road surfacing traffic all the year round.
5. The slow traffic road	e) It requires long-sight distances for safe stopping but no additional lengths for overtaking.
6. One-way motor road	f) It affects the width, surface, and super-elevation; the degree of permissible curves and gradients.
7. The two-way fast traffic road	g) It inflects to the landscape and serves local needs.
8. Traffic speed	h) It requires both long-sight distances and over-taking lengths.

T E X T 1

Roads

Answer the questions:

Part 1

1. For what purpose is major road-building work going on all over Russia at present?
2. What do the highways comply with?
3. What cities do well-appointed highways connect Moscow with?

Part 2

1. What represents the important means of transportation in our country?

2. What types can roads be classified into according to their technical characteristics?



Part 1

Every year thousands of kilometers of new highways are put into service. At present major road-building work is going on all over Russia, so as to secure all-the-year-round transport links between cities, villages and industrial centers. Car tourists and the need to ensure ready approach to recreation zones are also taken into account.

There are more cars on the roads and in a wider variety of models. The repair and maintenance service system operates on the tourist routes, just as it does on all the other motor highways of the country. The highways comply with the modern international specifications. They have reflector indicators and road signs, which can be clearly seen both in the daytime and at night. Ferro-concrete and metal guard posts and barriers, and inspection pits for cars are placed at the roadside at definite intervals. The roads also have overnight shelters for cars and parking zones at regular intervals, so that the drivers and passengers can take a rest there.

Well-appointed highways connect Moscow with Saint-Petersburg, the Northern Caucasus, Minsk, Suzdal, Pskov and other ancient Russian cities. From Moscow one can travel over good highways to Novorossiisk, Sochi, the foothills of Mt.Elbrus, and the Mineralniye Vody spa. Modern motorways make it easy for tourists to visit the sightseeing spots of the Northern Caucasus, the Crimea and other places.

It is difficult to enumerate all the new roads. New bus terminals are being built on the new highways.

At present the cities of the Russian Federation have a lot of bus routes.

The bus and taxi fleets were considerably expanded in the last few years.

Part 2

Motor Roads or highways represent the important means of transportation in our country. Road design in our country is regulated by State Plans. According to their technical characteristics roads can be classified as follows:

Primitive Roads. They are natural roads where no road construction work has been made. Such roads are only passable for a part of the year.

Seasonal Roads. They have a specially constructed carriageway, proper drainage being made. Seasonal roads are not passable in certain parts of the year.

Permanent Roads of Local Transport. They have specially constructed stable carriageways, proper drainage and road surfacing securing traffic all the year round.

Permanent Motor-Car Roads or Motor Highways. They have a specially constructed stable carriage way with a road surface of an improved type. They are constructed for high speed traffic.

The roads are constantly being improved so as to meet all the requirements of comfortable driving.

Exercises

I. Подберите соответствующие ответы к следующим вопросам по прочитанному тексту.

1. What operates on the tourist routes?
2. What is road design in our country regulated by?
3. What are the characteristic features of primitive roads?
4. For what purpose are roads constantly improved?
5. What roads have a specially constructed stable carriageway with a road surface of an improved type?
6. What are the properties of permanent roads of local transport?

a) The roads are constantly improved so as to meet all the requirements of comfortable driving.

b) Permanent motor-car roads or motor highway have a specially constructed stable carriageway with a road surface of an improved type.

c) The repair and maintenance service system operates on the tourist routes, the roads also have overnight shelters for cars and parking zones at regular intervals.

d) Primitive roads are natural where no road construction work is made.

e) Permanent roads of local transport have specially constructed stable carriageway, proper drainage and road surfacing securing traffic all the year around.

f) Road design in our country is regulated by State Plans.

II. Переведите следующие предложения, пользуясь табл. 2. Обратите внимание на структуру предложений.

Т а б л . 2

Thousands of kilometers of new highways	are		put	into service every year.
New bus terminals	are being		built	on the new highways.
The bus and taxi fleets	will be	considerably	expanded	in the next few years.
Road construction work	has not been		made	on primitive roads.
Road design in our country	is		regulated	by State Plans.
Seasonal roads	were		improved	in summer.

1. Ежегодно вводятся в действие тысячи километров шоссейных дорог.
2. Новые автобусные станции строятся на новых шоссейных дорогах в настоящее время.
3. В последующие несколько лет парки автобусов и такси будут значительно расширены.
4. На неулучшенных грунтовых дорогах не проведено (выполнено) никаких дорожно-строительных работ.
5. Дорожное проектирование в нашей стране регулируется государственными планами.
6. Сезонные дороги летом были улучшены.

III. Выберите правильный перевод предложения с неопределенно-личным местоимением ***one.***

From Moscow one can travel over good highways to Novorossiisk, Sochi, the foothills of Mt.Elbrus, and the Mineralniye Vody spa.

1. Из Москвы один может проехать по хорошим шоссейным дорогам в Новороссийск, Сочи, к подножию горы Эльбрус и на курорт Минеральные Воды.
2. Из Москвы вы можете проехать по хорошим шоссейным дорогам в Новороссийск, Сочи, к подножию горы Эльбрус и на курорт Минеральные Воды.
3. Из Москвы по хорошим шоссейным дорогам можно проехать в Новороссийск, Сочи, к подножию горы Эльбрус и на курорт Минеральные Воды

IV. Переведите следующее предложение на русский язык, обратив внимание на глагол-заменитель ***does****.*

The repair and maintenance service system operates on the tourist routes, just as it does on all the other motor highways of the country.

V. Определите, в каком предложении употреблен независимый причастный оборот.

1) Permanent roads of local transport have specially constructed stable carriageways and road surfacing securing traffic all the year round.

2) Seasonal roads have a specially constructed carriageway, proper drainage being made.

3) The roads are constantly being improved so as to meet all the requirements of comfortable driving.

VI. Выберите предложение, соответствующее действительности.

1.

a) Primitive roads have a specially constructed stable carriageway.

b) Primitive roads are natural roads where no road construction work has been made.

c) Primitive roads have a specially constructed carriageway.

2.

a) Seasonal roads are passable all the year round.

b) Seasonal roads are passable in all parts of the year.

c) Seasonal roads are not passable in certain parts of the year.

3.

a) Permanent roads of local transport have road surfacing securing traffic all the year round.

b) Permanent roads of local transport have road surfaces of an improved type.

c) Permanent roads of local transport have no surfaces.

VII. Подберите подходящее по смыслу сказуемое: ***take a rest; make it easy; take into account; put into service.***

1. Every year thousands of kilometers of new highways ………………..

2. Car tourists and the need to ensure ready approach to recreation zones …………………

3. The roads have overnight shelters for cars and parking zones at regular intervals, so that the drivers and passengers can ………………… there.

4. Modern motorways ……………. for tourists to visit the sightseeing spots of the Northern Caucasus, the Crimea and other places.

VIII. Переведите на английский язык.

1. В настоящее время дорожно-строительные работы ведутся по всей России.
2. Автострады удовлетворяют современным международным спецификациям.
3. На дорогах имеются отражательные приборы и дорожные указатели.
4. Отражательные приборы и дорожные указатели четко видно как в дневное время, так и ночью.
5. Через определенные промежутки на обочинах размещаются железобетонные и металлические предохранительные столбы и барьеры.
6. Прекрасные автострады соединяют Москву с Санкт-Петербургом, Северным Кавказом, Минском, Псковом и другими городами.
7. Трудно перечислить все новые дороги.
8. Постоянные дороги местного назначения имеют прочную проезжую часть, должный водоотвод и покрытие, обеспечивающее движение круглый год.
9. Автострады имеют прочную, специально сооружаемую проезжую часть и покрытие улучшенного типа.
10. Автострады сооружают для высокоскоростного движения.

TE X T 2

The Character of Roads

Answer the questions:

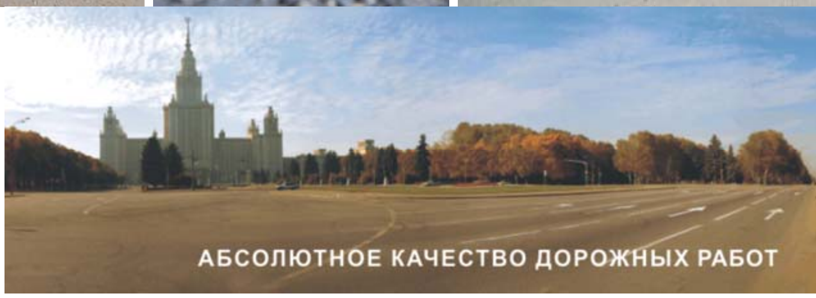
Part 1

1. What is the governing factor in the road design?
2. What does the traffic speed affect?
3. How many types of roads are there?

Part 2

1. What principles were set out to obtain an easy flow of alignment?
2. What is it necessary to remember?



Part 1

The traffic speed for which the road is intended is the governing factor in its design. It affects the width, surface and super-elevation; the degree of permissible curves and gradients which affect the relationship of road to landscape. The higher the speed for which the road is designed, the flatter the curves should be. There are three main types of roads, each having a different landscape character:

The slow traffic road, inflecting to the landscape and serving local needs.

The one-way motor road. It requires long-sight distances for safe stopping, but no additional lengths for overtaking.

The two-way fast traffic-road. It requires both long-sight distances and over-taking lengths.

The last is the most difficult to fit into the landscape, and potentially the most dangerous.

A two-way fast traffic-road is probably an anachronism. The slow traffic-road does not involve any radical departure from the old pattern of landscape, but the fast traffic-ways present a set of factors new to landscape design.

Part 2

The principles of easy and continuous flow and the correlation of vertical and horizontal curves are recognized as the good engineering practice. The following principles were set out to obtain an easy flow of alignment.

1. Any vertical curve, not on a straight section, should coincide in length with a horizontal curve.

2. A combination of straights with short curves should be avoided.

3. Curves in the same direction should not be connected by straights.

4. Super-elevation greater than one per cent over the general gradient will cause a visual kink.

5. Transition curves between a straight and a radius, should proceed from infinity to the radius.

It is necessary to remember the following:

1) A small, angular difference between two tangents may need a longer curve, for the sake of appearance, than is needed for design-speed.

2) There should be ample length of tangents between two curves in the opposite direction, and, except in the case of the flattest curves, spirals should be inserted between straights and radii.

Exercises

I. Подберите соответствующие ответы к следующим вопросам по прочитанному тексту.

1. What are the properties of the slow traffic road?
2. What road requires long-sight distances for safe stopping but no additional lengths for overtaking?
3. What road is the most difficult to fit into the landscape?
4. What combination of straights should be avoided?
5. Where spirals should be inserted?
6. What curves should not be connected by straights?

a) Spirals should be inserted between straights and radii.

b) A combination of straights with short curves should be avoided.

c) The one-way motor road requires long-sight distances for safe stopping but no additional lengths for overtaking.

d) Curves in the same direction should not be connected by straights.

e) The slow traffic road inflects to the landscape and serves the local need.

f) The two-way fast traffic road is the most difficult to fit into the landscape.

II. Основываясь на содержании текста, закончите предложения, используя предложенные варианты.

1. The traffic speed for which the road is intended affects…

   a) the width;
   b) surface;
   c) super-elevation;
   d) the degree of permissible curves and gradients.

2. The slow traffic road …

a) inflects to the landscape;

b) serves local needs.

c) is the most dangerous.

3. The two-way fast traffic road ...

a) requires over-taking lengths;

b) is the most difficult to fit into the landscape;

c) is the most dangerous.

III. Определите функции **-ing** *формы глаголов, переведите на русский язык.*

1. There are three main types of roads, each having a different landscape character.
2. The principles of easy and continuous flow and the correlation of vertical and horizontal curves are recognized as the good engineering practice.
3. One of the types of roads is the slow traffic road, inflecting to the landscape and serving local needs.
4. The one-way motor road does not require any additional lengths for overtaking.

IV. Определите функции инфинитива в следующих предложениях, переведите на русский язык.

1. The two-way fast traffic road is the most difficult to fit into the landscape.
2. It is necessary to remember the following.
3. The following principles were set out to obtain an easy flow of alignment.

V. Выберите предложения, которые соответствуют действительности.

A.

1) There should be no ample length of tangents between two curves in the opposite direction.

2) There should be ample length of tangents between two curves in the opposite direction.

3) There should be additional length of tangents between two curves in the opposite direction.

B.

1) A small, angular difference between two tangents may need a longer curve, for the sake of stopping.

2) A small, angular difference between two tangents may need a longer curve, for the sake of safety.

3) A small, angular difference between two tangents may need a longer curve, for the sake of appearance.

C.

1) Curves in the same direction should be connected by straights.

2) Curves in the same direction should not be connected by spirals.

3) Curves in the same direction should not be connected by straights.

D.

1) A combination of straights with short curves should be avoided.

2) A combination of straights with short curves should be preferred.

3) A combination of straights with long curves should be avoided.

E.

1) Any vertical curve on a straight section coincide in length with a horizontal curve.

2) Any vertical curve, not on a straight section, should coincide in length with a horizontal curve.

3) Any vertical curve, not on straight section, should differ in length with a horizontal curve.

VI. Переведите на английский язык.

1. Скорость движения, для которой дорога предназначена, является главным фактором при ее проектировании.

2. Скорость движения влияет на ширину дороги, покрытие, на подъем виража на закруглениях дороги, а также на степень допустимых кривых и уклонов.

3. Чем выше скорость, для которой проектируется дорога, тем ровнее должны быть кривые.

4. Каждая дорога имеет отличительный ландшафтный характер.

5. Существуют дороги для тихоходного транспорта, дороги, позволяющие движение в одном направлении, дороги для двустороннего движения.

6. Закругления, идущие в одном и том же направлении, не должны соединяться прямыми.

TEXT 3

Highway Network Fundamentals

Answer the questions.

1. What makes up traffic streams?

2. What is it necessary to take into account in planning an effective automobile highway network?

3. What is the framework of a highway network?

Roads which interconnect inhabited localities and industrial and agricultural centres constitute the basic highway network. Persons and goods requiring to be transported between specific origins and destinations, the amount of goods depending on the requirements of the national economy and established trade relations, make up traffic streams.

In planning an effective automobile highway network it is essential in the first instance, to take into account the main freight and passenger traffic streams in order to keep the costs down and to facilitate the delivery of goods. The framework of a highway network is a system of trunk roads designed for long-distance high-speed passenger and goods traffic, and connecting the main economic regions of the country with its basic economic centres.

When laying out a highway network it is essential to maintain administrative, cultural and economic communications between various parts of the country.

The location of a highway network is a fundamental element of road planning, and is determined by the distribution of the country's productive forces, the further development of which it must promote. However, the considerable amount of money already invested in road building compels the designer to make maximum use of the existing metalled roads. In all projects concerned with the development of highway networks, therefore, considerable attention must be given to the reconstruction of roads in order to render them suitable for modern high-speed motor traffic.

Exercises

I. Закончите предложения в соответствии с содержанием текста.

1. Roads which interconnect inhabited localities and industrial and agricultural centres constitute … .
2. When laying out a highway network it is essential to maintain … .
3. The considerable amount of money already invested in road building compels the designer to make maximum use of … .
4. Considerable attention must be given to the reconstruction of roads in order to render them suitable for … .

II. Составьте диалоги по следующим темам, используя активный словарь:

1) движение на дорогах;
2) классификация дорог по их техническим характеристикам;
3) туристические маршруты для автолюбителей.

III. Сделайте сообщения по следующим темам, используя материалы текстов и Интернет источников:

1) дорожные знаки и их значение;
2) новые автодороги России;
3) зарубежные автострады.

Unit 2. ROADS AND ROAD CONSTRUCTION

I. Изучите следующую лексику.

1) road – дорога
2) construction – сооружение
3) subsoil – грунт
4) life – жизнь, продолжительность служения
5) stability – прочность, устойчивость, стабильность
6) surfacing – устройство дорожного покрытия, отделка поверхности, покрытие
7) foundation – основание, фундамент
8) riding qualities – ездовые качества, эксплуатационные качества дороги
9) maintenance – уход, ремонт
10) smooth – гладкий
11) finishing – заключительный, отделочный
12) waviness – волнистость, ухабы
13) unevenness – неровность
14) surface – покрытие, дорожная одежда
15) to roll – укатывать катком
16) joint – стык
17) earth – земля
18) gravel – гравий
19) drainage – осушение
20) clay – глина
21) untreated – необработанный
22) aggregate – заполнитель, агрегат
23) broken stone – щебенка, битый камень
24) sand – песок
25) bituminous – битуминозный, пропитанный смолистыми веществами, битумный
26) silt – ил
27) traffic – движение
28) layer – слой
29) base – основание
30) moisture – влага, влажность
31) compaction – уплотнение
32) water-bound macadam surface – необработанное щебеночное покрытие
33) traffic-bound surface – уплотненное, укатанное движением покрытие
34) concrete – бетон
35) raft – плотообразный (стропило)

36) tough – вязкий, тягучий, прочный, плотный, жесткий
37) cast iron – чугун
38) wear – износ, изнашивать
39) to treat with – обрабатывать
40) strength – прочность, крепость
41) durability – долговечность, прочность
42) nonskidding – шероховатость
43) property – свойство
44) loam – жирная глина, суглинок
45) seams – швы

II. Подберите правильный перевод к английским терминам.

1) subsoil	a) покрытие
2) life	b) движение
3) riding qualities	c) продолжительность служения
4) surface	d) прочность, устойчивость
5) unevenness	e) стык
6) joint	f) основание
7) traffic	g) грунт
8) base	h) уплотнение
9) stability	i) неровность
10) compaction	j) эксплуатационные качества дороги

III. Подберите правильный перевод русским терминам.

1) необработанное щебеночное покрытие	a) traffic-bound road
2) пропитанный смолистыми веществами	b) cast iron
3) щебенка	c) clay
4) заполнитель	d) silt
5) чугун	e) water-bound macadam surface
6) ил	f) moisture
7) укатанное движением покрытие	g) layer
8) глина	h) broken stone
9) слой	i) aggregate
10) влага	j) bituminous

IV. Подберите правильное определение к английским терминам.

1) The road
2) Concrete roads
3) Unsurfaced roads
4) Roads with untreated surfaces

a) These are constructed of natural aggregates or broken stone without bituminous or other surfacing.

b) They are roads of natural earth with little or no improvement.

c) It includes the construction above the subsoil itself.

d) Such roads are often unpleasant for riding as a result of the joint difficulties.

V. Подберите правильный термин к английским определениям.

1. They are composed of broken stone and natural binder, such as cementitous stone, dust or screenings.
2. They are obtained by stabilizing such natural materials as sand-clay mixtures and gravels by controlling their gradation amount of blinder soil, moisture content and thoroughness of compaction.
3. They are used where strength durability, nonskidding properties and low maintenance charges can be offset against high initial cost.
4. They are usually employed to increase or to retain the stability.

a) Stabilised roads

b) Admixtures

c) Water-bound macadam surfaces

d) Cast iron pavings

VI. Переведите на русский язык следующие существительные с суффиксом ***-ness.***

1) wave – waviness
2) uneven – unevenness
3) effective – effectiveness
4) rough – roughness
5) cohesive – cohesiveness
6) thorough – thoroughness
7) light – lightness
8) soft – softness

VII. Переведите следующие антонимы.

1) even – uneven
2) pleasant – unpleasant
3) surfaced – unsurfaced
4) treated – untreated
5) usual – unusual

T E X T 1

Answer the questions:

Part 1

1. What does the road include?
2. Why are the riding qualities of road of great importance?
3. What is particularly liable to the waviness and unevenness?

Part 2

1. What are the characteristics of unsurfaced roads?

Part 3

1. What are untreated surfaces constructed of?
2. What do the sand-clay surfaces consist of?
3. Where are gravel surfaces commonly used?



Part 1

The road includes not only construction above the subsoil itself. Its life depends on the stability of the surfacing, the foundation and the subsoil.

Riding qualities of roads must be considered. This aspect of road construction and maintenance is of great importance and it is very largely by the degree in which a road affords smooth or comfortable riding.

Great care therefore should be exercised in the finishing stage of road construction to prevent waviness or uneveness of surface materials that are rolled being particularly liable to the former defect.

Part 2

Many miles of rural roads are unsurfaced roads. They are of natural earth with little or no improvement. These are maintained in usable condition by occasional dragging and by building up soft spots with earth or gravel. The condition of such roads depends on the nature of the soil and the effectiveness of drainage. The surface will be fairly stable only where the natural soil is gravelly or sand with some clay.

Part 3

Untreated surfaces are constructed of natural aggregates or broken stone without bituminous or other surfacing. The sand-clay surfaces consist of intimate mixture of sand and clay in about the proportions of 12 to 18 per cent clay, 5 to 15 per cent silt, and 65 to 80 per cent sand. If the natural topsoil occurs in about these proportions it can be used for the surface; or clay may be added to a sandy soil or sand to a clay soil. The sand and clay are mixed on the road bed by harrowing and blading, consolidated by traffic or preferably by rolling and shaped with blade graders to a crowned section. Gravel surfaces are commonly used for minor roads where natural gravel is plentiful. The gravel is spread on the subgrade, compacted by rolling or under traffic and bladed to a crowned surface. The gravel may be placed in one layer, but better results are obtained if pit-run gravel is used in the base course and a selected gravel for the surface. Sizes up to 5 in. may be used in the base. The top course should be screened gravel under 1¼ in, and containing 10 to 15 percent binding material, such as iron oxide, limestone dust, clay or loam.

Exercises

I. Подберите соответствующие ответы к следующим вопросам по прочитанному тексту.

1. What does the road life depend on?
2. What roads are usually unsurfaced roads?
3. What does the condition of unsurfaced road depend on?
4. What gravel is used in the base course?
5. What should the top course be?
6. How many applications of calcium chloride or light oil to the gravel road are required per season?

a) The top course should be screened gravel under 1¼ in., and containing 10 to 15 percent binding material, such as iron oxide, limestone dust, clay or loam.
b) The pit-run gravel is used in the base course.
c) The road life depends on the stability of the surfacing, the foundation and the subsoil.
d) The condition of unsurfaced roads depends on the nature of the soil and the effectiveness of the drainage.
e) Two or more applications of ½ lb. per square.

II. Переведите следующие предложения на русский язык, обращая внимание на модальные глаголы.

1. Riding qualities of roads must be considered.
2. Great care should be exercised in the finishing stage of road construction to prevent waviness or uneveness of surface materials.

3. If the natural topsoil occurs in the proper proportions it can be used for the surface.

4. Clay may be added to a sandy soil, or sand to a clay soil.

5. Sizes of gravel up to 3 inches may be used in the base of the road.

6. The top should be screened gravel.

III. Вставьте подходящие по смыслу слова: ***must be added; may be obtained; can be used.***

1) If a satisfactory binder is not present in the natural gravel, it … from another source.

2) This natural topsoil … for the surface because it consists of an intimate mixture of sand and clay in the proper proportions.

3) As the soil is sandy, clay ... .

IV. Переведите на английский язык.

1) Дорога должна быть гладкой и удобной для эксплуатации.

2) Если здесь много естественного гравия, то следует использовать гравийное покрытие для дороги.

3) Гравий можно засыпать в один слой.

4) Эта дорога может быть пригодна (использована) для эксплуатации весь год.


TEXT 2

Answer the questions:

1) How are stabilized roads and bases obtained?

2) For what purpose are admixtures usually employed?

3) What are traffic and water-bound macadam surfaces composed of?

4) What are the properties of concrete roads?

5) When is cast iron paving used?

Stabilized roads and bases are obtained by "stabilizing" such natural materials as sand-clay mixtures and gravels by controlling their gradation, amount of binder soil, moisture content, and thoroughness of compaction. Admixtures are usually employed to increase and to retain the stability obtained by the above controls. Natural gravels are often lacking or overabundant in certain sizes. The grading is corrected in the stabilizing process by combining materials from different sources and mixing them thoroughly on the roadbed by harrowing and blading, or in mechanical mixers which travel along the roadway. Grading limits for stabilized mixtures have been standardized. The liquid limit and the plasticity index are also a part of the specifications. The plasticity index is a measure of the cohesive qualities of the binder soil. In general, dense graded mixtures, such as sand-clay, require a higher plasticity index than the coarser mixtures. Likewise more cohesion is desirable in an untreated surface course than in a base course with a bituminous surface. The upper value of the liquid limit is that at which softening may occur. Common admixtures applied to stabilized surfaces are calcium chloride, asphaltic coils, tars, and Portland cement. The calcium chloride, being deliquescent, absorbs moisture from the air, thus keeping the soil moist and preserving the natural cohesion. Portland cement sets the mix in a weak concrete. Bituminous materials waterproof the mixtures and add cohesion. Calcium chloride may be applied to the surface or mixed with the aggregate; other products are thoroughly mixed into the road during construction.

Traffic and water-bound macadam surfaces are composed of broken stone and a natural binder, such as cementitious stone, dust or screenings. In the traffic-bound process, layers of broken stone I to 2 in. thick are impregnated with subgrade material or screenings as they are compacted under traffic. In the water-bound process, common in the preautomobile era, a slurry of stone screenings and water was pressed into a layer of broken stone under the action of the roller. Upon drying the slurry set up into a week mortar, binding the stones together. This type is unsuited to any appreciable motor traffic unless surface treated with bituminous materials.

Polyvinyl chloride clothing is used for protection from the elements and chemicals. The apparel is made with welded seams.

The provision of a concrete wearing surface is usually included as the final operation in the construction of a concrete raft forming the main structure of the road. Wearing courses are usually made 2 to 3 inches thick. Granite and similar aggregates are usually preferred for hard wear, and a maximum size of 3/4 inch is sometimes specified. Concrete wearing surfaces are often treated with silica soda. Concrete roads are often very unpleasant for riding as a result of joint difficulties.

Cast iron paving has definitely established a place for itself among road surfacing materials where strength, durability, nonskidding properties and low maintenance charges can be offset against high initial cost. Cast iron sections are usually bedded upon a film of specially prepared bituminous grout applied to the surface of a concrete foundation. The sections are fixed while the bitumen is still hot and the thin joints between sections are filled with the same grouting medium.

Exercises

I. Подберите ответы на следующие вопросы к прочитанному тексту.

1. How is the grading of natural gravel corrected?
2. What are the common admixtures applied to stabilized surfaces?
3. What are the properties of calcium chloride?
4. What are layers of broken stone, in the traffic-bound process, compacted under?
5. What are concrete surfaces often treated with?
6. What are cast iron sections usually bedded upon?

a) In the traffic-bound process.
b) Concrete wearing surfaces are often treated with silicate soda.
c) Common admixtures applied to stabilized surfaces are calcium chloride, asphaltic oils, tars and Portland cement.
d) Cast iron sections are usually bedded upon a film of specially prepared bituminous grout applied to the surfaces of a concrete foundation.
e) The grading is corrected in the stabilizing process by combining materials from different sources and mixing them thoroughly on the roadbed by harrowing and blading, or in mechanical mixers which travel along the roadway.
f) The calcium chloride is deliquescent. It absorbs moisture from the air, keeping the soil moist and preserving the natural cohesion.

II. Переведите предложения, пользуясь табл. 3.

Табл. 3

Admixtures	may be corrected	with silicate soda.
The grading	can be offset	to increase and to retain the stability of roads.
The strength, durability, nonskidding properties of the cast iron paving	may be treated	against high initial cost.
Concrete wearing surfaces	should be employed	in the stabilizing process by combining materials from different sources.

1. Примеси следует использовать для того, чтобы увеличить и сохранить прочность дорог.

2. Гранулометрический состав может быть исправлен в процессе укрепления путем смешивания материалов из различных источников.

3. Свойства прочности, долговечности, шероховатости чугунной мостовой могут возместить высокую первоначальную стоимость.

4. Бетонные несущие поверхности могут быть обработаны кремнекислым натрием.

III. Найдите причастия, определите форму и функцию причастий, переведите их на русский язык.

1. The calcium chloride, being deliquescent, absorbs moisture from the air, thus keeping the soil moist and preserving the natural cohesion.

2. The provision of a concrete wearing surface is usually included as the final operation in the construction of a concrete raft forming the main structure of the road.

3. Cast iron sections are usually bedded upon a film of specially prepared bituminous grout applied to the surface of a concrete foundation.

IV. Вставьте пропущенный предлог (***into; with; between; for; among; of***)*, переведите на русский язык.*

1. Grading limits … stabilized mixtures have been standardized.
2. The liquid limit and the plasticity index are a part … the specifications.
3. Asphaltic oils and tars are thoroughly mixed … the road during construction.
4. Calcium chloride may be mixed … aggregate.
5. Cast iron paving has definitely established a place for itself … road surfacing materials.
6. The cast iron sections are fixed while the bitumen is hot and the thin joints … sections are filled with the same grouting medium.

V. Подберите правильный по смыслу перевод для предложенных герундиальных форм.

1. Stabilized roads and bases are obtained **by stabilizing such natural materials** as sand-clay mixture and gravels.

a) с помощью укрепления таких естественных материалов,
b) укреплением таких естественных материалов,
c) путем укрепления таких естественных материалов.

2. **Upon drying** the mixture sets up into a weak mortar.

a) по мере высыхания,
b) когда высохнет,
c) при высыхании

3. Concrete roads are often very unpleasant **for riding** as a result of joint difficulties.

a) для эксплуатации,
b) для езды,
c) как покрытие для эксплуатации (для движения).

TEXT 3

I. Подберите заголовок к тексту.

a) Types of highways
b) New type of Dressing
c) Rubber highway

II. Задайте вопросы к тексту.

III. Перескажите текст на английском языке.

Old rubber goods mixed with asphalt have proved to be an excellent paving for highways. This became clear after an experiment carried out in Georgia. A section of a road, 25 km northwest of Tbilisi, was coated with the so-called rubber-asphalt-concrete. Five years of service have not changed its original condition.

The new dressing has found an extensive application in the country. This will help to lower the cost of road construction and make tyres last longer.

Exercises

I. Сделайте сообщения на английском языке по следующим темам, используя активный словарь:

1) типы дорожных покрытий;
2) свойства, которые должны иметь дороги;
3) строительные материалы, используемые для строительства дорог.

II.Составьте диалоги и обсудите следующие проблемы:

1) строительство дорог в России;
2) дорожные покрытия, необходимые для зимнего периода;
3) экономичность при строительстве дорог.

Unit 3. PAVEMENT

I. Изучите следующую лексику.

1) rigidity – жесткость, прочность, устойчивость
2) uniformity – однородность

3) resistance – сопротивление, устойчивость
resistance to wear – устойчивость к износу
4) wear – износ
5) roadbed – земляное полотно, естественное грунтовое основание
6) resist – сопротивляться, выдерживать
7) stress – напряжение, напряженность
8) multilayer – многослойный
9) magnitude – величина
10) abrasion – истирание, стирание
11) impact – толчок, удар, сотрясение, динамическое воздействие
12) expensive – дорогой
13) adhesion – сцепление
14) coat – слой покрытия, облицовка
15) sub-base – нижний слой покрытия
16) impervious – непроницаемый, водонепроницаемый
17) destroy – разрушаться
18) treatment – обработка
19) bearing – несущий
20) pl.matrix (matrice) – вяжущее
21) protect – защищать
22) loam – суглинок
23) accumulation – накопление
24) subgrade – основание дорожной одежды, грунтовое основание
25) loading – нагрузка
26) service quality – качество обслуживания
27) grade – сортировать
28) interstice – промежуток, пустота, щель
29) particle – частица
30) inherent – присущий, прирожденный
31) slab – балка
32) fluctuation – колебание
33) expansion – расширение
34) contract – сужаться
35) shrink – сокращаться, сжиматься, давать усадку (оседать)
36) bar – прут
37) dowel – штырь, стыковой стержень, костыль
38) chippings – осколки
39) wedging – заклинивание
40) contain – содержать
41) quantity – количество
42) fraction – частица, обломок
43) inferior – низший
44) strain – напряжение, усилие, деформация

II. Подберите правильный перевод английским терминам.

1) resistance to wear	a) нижний слой основания
2) rigidity	b) напряжение
3) roadbed	c) промежуток
4) stress	d) нагрузка
5) impervious	e) устойчивость к износу
6) sub-base	f) несущий
7) loading	j) вяжущее
8) bearing	k) жесткость
9) matrice	l) водонепроницаемый
10) interstice	m) естественное грунтовое основание

III. Подберите правильный перевод русским терминам.

1) сужаться 2) низший 3) стыковой стержень 4) давать усадку 5) балка 6) частица 7) прут 8) суглинок 9) осколки 10) расширение	a) slab b) expansion c) contact d) bar e) dowel f) chippings g) interior h) particle i) shrink j) loam

IV. Подберите правильное определение к английским терминам.

1. Surfacing	a) A strong bearing layer of strong material or stone with a binding matrix.
2. Pavement base	b) A layer of earth or stone materials, resistant to moisture, inserted.
3. Sub-base	c) Comprises the thoroughly compacted upper layers or the roadbed, upon which the layers of the pavement are laid.
4.Subgrade	d) The upper and the most rigid layer of the pavement.

V. Подберите правильный термин к английским определениям.

1. It is the cheapest form of road and the simplest from the construction point of view	a) Cement concrete surfacings
2. These surfacings are of high resistance to wear	b) Broken-stone surfacings
3. Surfaces made of individual natural or artificial stones placed close to each other	c) Surfacings of natural gravel
4. Such surfacings are made of uniform size chippings	d) Pavings

VI. Переведите на русский язык следующие существительные с суффиксом ***-er****.*

1) to lay – layer
2) to bind – binder
3) to roll – roller
4) to work – worker
5) to move – mover
6) to fill – filler

VII. Переведите на русский язык следующие прилагательные с суффиксом ***-y.***

1) silt – silty
2) loam – loamy
3) clay – clayey
4) sand – sandy
5) wind – windy

VIII. Найдите составные части следующих слов, переведите на русский язык.

1) semi-rigid
2) multilayer
3) renewed
4) subgrade
5) overlarge
6) intermediate

7) sub-base
8) granulometric
9) roadbed

TEXT 1

Answer the questions:

1. What is the carriageway of the road covered with?
2. How many layers does the pavement consist of?
3. What is surfacing?
4. What are the properties of surfacing?
5. What does surfacing usually comprise?
6. What is the pavement base?
7. What is the sub-base?
8. What is the sub-base made of?
9. What does the subgrade comprise?
10. In what conditions can the stability of road pavement be ensured?

The carriageway of the road is covered with a pavement which is a rigid or semi-rigid structure laid on the surface of the roadbed and resisting traffic stresses and climatic factors.

The stresses induced in the pavement by motor vehicle wheels become less with the depth. This enables the pavement to be designed in the form of a multilayer structure, employing materials whose strengths vary for each layer and are determined in accordance with the magnitude of the acting forces. The pavement consists of the following layers:

1. Surfacing is the upper and most rigid layer of the pavement. It is comparatively thin, but resists well the abrasion and the impacts caused by the wheels and also the effect of weather conditions. Usually, the surfacing is the most expensive part of the pavement and, therefore, is laid to the minimum admissible thickness. The surfacing provides the required service qualities (surface smoothness, high coefficient of adhesion). Surfacing usually comprises

two coats or courses – the base course, on which depend the basic qualities of the surfacing, and a wearing course, which is not regarded in calculations and which is periodically renewed as it wears out. When the surfacings are made of weak materials, which are subject to appreciable wear, a special wearing course made of strong stone material treated with organic binders is necessary, which may be periodically renewed in the course of road operation. If the surfacing is not sufficiently impervious to water and may be destroyed during freezing or drying out in hot arid weather conditions, it is covered with a thin protective or sealing coat by surface treatment with a binder and a filling of fine sand. Surface treatment is also used for increasing the roughness of polished surfacings.

2. Below the surfacing base coat is the pavement base, a strong bearing layer of stony material or stone with a binding matrix. This layer is designed to distribute the individual wheel-loads over the roadbed or sub-base. The pavement base is not subject to the direct action of automobile wheels. Therefore, materials of a lesser strength than those used for the surfacing or the wearing course can be employed in its construction. When the base is protected from the action of surface water – in the case of an impervious surfacing – it may become saturated by water drawn upwards from the roadbed during winter frost penetration. For this reason, in the northern regions materials used for base construction have to satisfy certain requirements concerning frost resistance.

3. The sub-base is a layer of earth or stone materials, resistant to moisture, inserted when necessary between the pavement base and the roadbed to reduce the required thickness of the pavement base. The sub-base is made of gravel, slag, soil treated with binding agents, sand, etc.

On sections where the roadbed comprises silty loamy and clayey soils, inside which winter moisture accumulation may occur, a sub-base of porous materials is introduced. This consists of a sand or gravel layer which drains away excess water from the upper layers of the roadbed, drains the pavement structure and increases the bearing strength of the roadbed. It is termed a drainage course.

If the roadbed is composed of stable, impervious sand, sandy loam or gravel soils, a sub-base is not necessary.

4. The subgrade comprises the thoroughly compacted upper layers of the roadbed, upon which are laid the layers of the pavement. The subgrade receives all the distributed pressure of traffic loads and, therefore, is a very important element of the pavement structure. The stability of road pavements can be ensured only on a heterogeneous, well compacted roadbed with adequate drainage. The increase of roadbed soil resistance to external loading, its drainage and the uniformity of water conditions are the best means for ensuring pavement stability and reducing its cost. No increase in the thickness of the pavement base can guarantee the strength of a pavement laid on a weak bed soil.

E x e r c i s e s

I. Подберите ответы на следующие вопросы к прочитанному тексту.

1. What is the pavement laid on?
2. What enables the pavement to be designed in the form of a multilayer structure?
3. What does the surfacing resist well?
4. For what purpose is the pavement base designed?
5. For what purpose is surface treatment used?
6. Why is the subgrade a very important element of the pavement structure?

a) This layer is designed to distribute the individual wheel-loads over the roadbed or sub-base.

b) The pavement is laid on the surface of the roadbed.

c) Surface treatment is used if the surfacing is not sufficiently impervious to water and may be destroyed during freezing or drying out and also for increasing the roughness of polished surfacings.

d) It resists well the abrasion and the impacts caused by the wheels and the effect of weather conditions.

e) The subgrade receives all the distributed pressure of traffic loads and therefore is a very important element of the pavement structure.

f) As the stresses induced in the pavement by motor vehicle wheels become less with the depth, this enables the pavement to be designed in the form of a multilayer structure.

II. Переведите предложения, определите, в котором из них имеется объектный инфинитивный оборот.

1. This enables the pavement to be designed in the form of a multilayer structure.
2. The pavement base is designed to distribute the individual wheel-loads over the roadbed or sub-base.
3. The sub-base is inserted between the pavement base and the roadbed to reduce the required thickness of the pavement base.

III. Укажите, в каких предложениях слова с суффиксом **-ing** *являются Participle 1, переведите предложения на русский язык.*

1. Surfacing is the most expensive part of the pavement.
2. A pavement is a rigid or semi-rigid structure laid on surface of the roadbed and resisting traffic stresses.
3. If the surfacing is not sufficiently impervious to water and may be destroyed during freezing or drying out, it is covered with a thin protective or sealing coat.

4. Surface treatment is used for increasing the roughness of polished surfacings.

5. The pavement base is a strong bearing layer of stony material or stone with binding matrix.

IV. Замените причастие прошедшего времени в функции определения целым придаточным определительным предложением.

О б р а з е ц : A pavement is a rigid or semi-rigid structure laid on the surface of the roadbed.

A pavement is a rigid or semi-rigid structure which is laid on the surface of the roadbed.

1. The stresses induced in the pavement by motor vehicle wheels become less with the depth.
2. Surfacing resists well the abrasion and the impacts caused by the wheels.
3. When the surfacings are made of weak materials a special wearing course made of strong stone material treated with organic binders is necessary.
4. The northern region materials used for base construction have to satisfy certain requirements concerning frost resistance.
5. No increase in the thickness of the pavement base can guarantee the strength of a pavement laid on a weak bed soil.

V. Дополните следующие предложения.

1. The pavement is designed in the form of a multilayer structure, employing materials whose … .
   a) strengths vary for each layer;
   b) strengths are determined in accordance with the magnitude of the acting forces.
2. Surfacing usually comprises a wearing course, which … .
   a) is not regarded in calculations;
   b) is periodically renewed as it wears out.
3. A sub-base of porous materials consists of a sand or gravel layer which … .
   a) drains away excess water from the upper layers of the roadbed;
   b) drains the pavement structure;
   c) increases the bearing strength of the roadbed.

V. Переведите предложения на английский язык.

1. Дорожная одежда – это жесткое или полужесткое сооружение, уложенное на поверхность земляного полотна.
2. Дорожная одежда – это сооружение, выдерживающее напряженности движения и (противостоящее) климатические(им) факторы(ам).

3. Дорожная одежда состоит из следующих слоев: покрытия, основания дорожной одежды, нижнего слоя покрытия, грунтового основания.

4. Покрытие – верхний и самый жесткий слой дорожной одежды.

5. Покрытие обычно включает два слоя покрытия.

6. Когда покрытия делаются из слабых материалов, необходим специальный слой износа из прочного камня, обработанного органическими вяжущими веществами.

7. Нижний слой покрытия делается из гравия, грунта, обработанного вяжущими веществами, шлака, песка и др.

8. Если грунтовое основание сооружается из прочных, водонепроницаемых материалов – песка, песчаного суглинка и гравийных грунтов, в нижнем слое покрытия нет необходимости.

T E X T 2

Main types of pavement

Answer the questions:

1. What must be the properties of road pavement?
2. What types can the surfacings be divided into?
3. What are the properties of cement concrete and asphalt surfacings?
4. What do cement concrete surfacings usually consist of?
5. What joints are there?
6. What are the properties of bituminous macadam-broken-stone and gravel surfacing treated with organic binders?
7. What are the properties of broken-stone surfacings?
8. What are the properties of surfacings of natural gravel?
9. What are the properties of paving?

The road pavement must be of an adequate rigidity, uniformity and resistance to wear. The pavement service qualities are determined mainly by the nature of the surfacings. The surfacings can be divided into the following basic structural types.

Cement concrete and asphalt surfacings. These surfacings are of high rigidity and of high resistance to loading.

The stone aggregate is thoroughly graded so that the interstices between large particles are filled with smaller chips, and the material as a whole has a minimum porosity. Cohesion is provided by the use of cement and organic binders.

In contrast to asphalt surfacing, cement concrete surfacing has a very considerable inherent strength and temperature stability. These surfacings usually consist of separate concrete slabs. The slabs are separated from each other by joints which are necessary to allow for changes in length owing to temperature fluctuations. There are expansion joints which contract when the slab length increases, and contraction joints which expand when the slab shrinks. Inserted into the joints are steel bars called dowels which transmit vertical loads from one slab to the other, and, to a lesser degree, flexible moments.

Bituminous macadam-broken-stone gravel surfacing treated with organic binders. This surfacing is highly resistant to the destructive action of traffic. Such pavement is impervious to water.

Broken-stone surfacings and bases made of uniform size chippings. The strength of broken-stone surfacings is provided by the wedging action which takes place during rolling. Broken-stone surfacings have a low resistance to wear under automobile traffic. Such pavements are used only when the traffic intensity is low.

Surfacings of natural gravel. The gravel road is the cheapest form of road and the simplest from the construction point of view. It has high strength and stability when it does not contain an overlarge quantity of fine fractions, which make the mixture plastic in wet conditions.

Pavings are surfaces and bases made of individual natural or artificial stones placed close to each other.

Earth road pavements stabilized with granulometric additions consist of local soils.

Natural earth roads actually have no pavement. The carriageway comprises the upper layers of the natural ground compacted by traffic. These roads can only serve for carrying traffic of low intensity in dry seasons of the year.

Depending on the riding quality road pavements are classified as high-quality, intermediate and inferior. When classifying road pavements the decisive factors are the permissible traffic speed and the rate of strain accumulation in them.

E x e r c i s e s

I. Подберите ответы на следующие вопросы к прочитанному тексту.

1. What are the pavement service qualities determined by?
2. How is the stone aggregate of cement concrete and asphalt surfacings graded?
3. Why are the slabs of cement concrete surfacings separated from each other by joints?
4. What are broken-stone surfacings and bases made of?
5. When are broken-stone surfacings used?
6. How are road pavements classified depending on the riding quality?

a) The slabs are separated from each other by joints to allow for changes in length owing to temperature fluctuations.

b) Such pavements are used only when the traffic intensity is low.

c) The stone aggregate is thoroughly graded, so that the interstices between large particles are filled with smaller chips.

d) Depending on the riding quality road pavements are classified as high-quality, intermediate and inferior.

e) Depending on the riding quality road pavements are classified as high-quality, intermediate and inferior.

f) Broken-stone surfacings and bases are made of uniform size chippings.

II. Закончите следующие предложения:

1. The stone aggregate is thoroughly graded, so that ...
   a) the interstices between large particles are filled with smaller chips;
   b) the material as a whole has a minimum porosity.
2. Cohesion is provided by ...
   a) the use of cement;
   b) the use of organic binders.
3. Bituminous macadam-broken stone surfacings treated with organic binders are ...
   a) highly resistant to the destructive action of traffic;
   b) impervious to water.
4. The gravel road is ...
   a) the cheapest form of road;
   b) the simplest form of road from the construction point of view.

III. Определите грамматическую форму слов с суффиксом ***-ing****, их функцию в предложении и переведите на русский язык.*

1. Natural earth roads can only serve for carrying traffic of low intensity in dry seasons of the year.
2. Depending on the riding quality road pavements are classified as high-quality, intermediate and inferior.
3. When classifying road pavements the decisive factors are the permissible traffic speed and the rate of strain accumulation in them.
4. Asphalt surfacings are of high rigidity and of high resistance to loading.

IV. Подберите по смыслу пропущенный союз или союзное слово: ***which; so that; when.***

1. The stone aggregate is thoroughly graded …. the interstices between the large particles are filled with smaller chips.
2. The contraction joints expand …. the slab shrinks.
3. The strength of broken-stone surfacings is provided by the wedding action …. takes place during rolling.

*V. Чтобы запомнить выражение «****owing to****», переведите следующие предложения по образцу:*

Образец*:* The slabs are separated from each other by joints which are necessary to allow for changes in length **owing to** temperature fluctuations.

Балки отделяются друг от друга пазами (швами), которые необходимы, если принять во внимание изменения в длине по причине температурных колебаний.

1. The expansion joints are used owing to the increase of the slab length.
2. Contraction joints expand owing to the shrinking of the slab.

VI. Подберите подходящий по смыслу предлог: ***in; for; of; from; into; with; by.***

1. Cement concrete surfacings are …. high rigidity.
2. Inserted …. the joints are steel bars called dowels.
3. Bituminous macadam-broken-stone surfacings are treated …. organic binders.
4. Bituminous macadam-broken stone surfacings are impervious …. water.
5. The carriageway of the natural earth roads comprises the upper layers of the natural gravel compacted …. traffic.
6. Natural earth roads can only serve …. carrying traffic of low intensity.
7. Dowels transmit vertical loads …. slab to the other.

T E X T 3

Choice of pavement type

1. Прочитайте текст.

2. Составьте план к тексту и выпишите ключевые слова и словосочетания.

3. Перескажите текст на английском языке.

Various types of road pavement construction may be used for the same traffic intensity. In the planning stage the choice should be made from several possible types and the most appropriate pavement should be selected. The traffic requirements, local natural conditions, availability of local building materials, and of the facilities offered for organizing construction work are of great importance.

When making the final choice of pavement construction from several possible types, preference should be given to the most economical.

The best type of pavement is the one which provides during the assumed repayment period the minimum cost per ton-kilometre.

The final choice of the type of pavement is made by comparing the periods necessary for repayment of the capital cost of construction with the economy in the relevant operation cost.

E x e r c i s e s

I. Составьте диалоги по следующим темам:

1) самые лучшие дороги;

2) достоинства и недостатки дорог с различными типами покрытий;

3) проблемы грунтовых дорог.

II. Сделайте сообщения на английском языке по следующей тематике:

1) применение цемента и битума для строительства дорог;

2) дорожные покрытия из щебня.

III. Подготовьте презентацию по теме «Строительство дорог в России и за рубежом», используя Интернет ресурсы.

Unit 4. ROAD, ROAD MATERIALS

I. Изучите следующую лексику.

1) slurry – шлам, жидкая глина, жидкий цемент

2) seal coat – защитный слой, покрывающий слой, слой износа (дорожной одежды)

3) quick-set – быстросхватывающийся, быстро оседающий
4) aggregate – заполнитель
5) contain – содержать
6) suspended – взвешенный
7) dissolve – растворяться
8) stable – прочный
9) coalesce – срастаться, соединяться
10) charge – заряд
11) lattice – решетка
12) attach – прикреплять, связывать
13) strength – прочность
14) cohesive – связанный
15) sustain – выдерживать
16) resistance – устойчивость, сопротивление
17) extent – длительность
18) adsorption – поглощение, поглотительная способность
19) cationic – положительно заряженный
20) anionic – отрицательно заряженный
21) exchange – обмен
22) solution – раствор
23) filler – заполнитель
24) fluid – жидкость, раствор; жидкий, текучий, гидравлический
25) pavement – мостовая
26) convert – превращать, обращать, преобразовывать
27) multivalent – многовалентный
28) droplet – капля
29) emulsion – эмульсия
30) segregation – расслоение, выделение
31) excess – избыток
32) delay – замедлять
33) ambient temperature – температура окружающей среды
34) hydrated – гашеная
35) lime – известь
36) tar – гудрон, смола, деготь
37) rock – естественный камень, скалистая порода
38) pebble – щебень
39) broken stone – битый камень, щебенка
40) dehydration – удаление воды, дегидрация

II. Подберите правильный перевод английским терминам.

1) slurry	а) положительно заряженный
2)seal coat	б) комнатная температура
3)cationic	в) расслоение, выделение
4)anionic	г) прочность, стабильность
5)adsorption	д) шлам, жидкая глина, жидкий цемент
6)segregation	е) устойчивость, сопротивление
7)stability	ж) раствор
8)solution	з) отрицательно заряженный
9)ambient	и) поглощение, поглотительная способность
10)resistance	к) защитный слой, покрывающий слой, слой износа

III. Подберите правильный перевод русским терминам.

1) решетка	a) aggregate
2) растворяться	b) dissolve
3) эмульсия	c) suspend
4) превращать	d) pebble
5) взвешенный	e) tar
6) заполнитель	f) lattice
7) быстросхватывающийся	g) convert
8) заполнитель	h) filler
9) гудрон	i) emulsion
10) щебень	j) quick-set

III. Подберите правильное определение к английским терминам.

1. Natural gravel	a) It is generally used in the form of crushed stone.
2. Rock	b) It is a mixture of complex organic compounds.
3. Asphalt	c) It is a product of the manufacture of coke from bituminous coal.
4. Tar	d) It is a mixture of sand and pebbles.

V. Подберите английский термин к данным определениям.

1. Small particles of asphalt suspended in water, in which emulsifier moleculars are partially dissolved.	a) Calcium chloride.
2. The lower the ambient temperature, the more mineral filler is needed to achieve quickset.	b) Asphaltic oils and Portland cement.
3. It is deliquescent.	c) Cationic quick-setting asphalt emulsion.
4. They are common admixtures to be applied to stabilized surfaces.	d) For the anionic quick-setting slurry mix.
5. The length of the time during which a mix remains fluid.	e) Mixing time.

VI. Переведите на русский язык следующие существительные с суффиксом ***-ty****.*

1) capable – capacity
2) stable – stability
3) flexible – flexibility
4) durable – durability
5) difficult – difficulty
6) proper – property
7) local – locality
8) continuous – continuity

VII. Переведите на русский язык следующие прилагательные с суффиксом ***-ic****.*

1) economy – economic
2) cation – cationic
3) anion – anionic
4) ion – ionic
5) asphalt – asphaltic
6) organ – organic

T E X T 1

Road materials

Answer the questions:

Part 1

1. What materials are used in construction of road surfaces?
2. What are common admixtures applied to stabilized surfaces?

Part 2

1. What emulsion has been announced, to meet quick-set needs in slurry seal work?
2. How may the cationic quick-setting asphalt emulsion be described?
3. What properties does a cationic quick-setting slurry emulsion have?

Part 1

The materials of which road surfaces are composed are the following: the natural gravel of the region.

Natural gravel is a mixture of sand and pebbles. Rock is of different kinds. Rock is generally used in the form of crushed stone.

Asphalt is a mixture of complex organic compounds.

Tar is a product of the manufacture of coke from bituminous coal.

Cement, sand, clay and other materials are used in construction of road surfaces. Common admixtures applied to stabilized surfaces are calcium chloride, asphaltic oils, tars and Portland cement.

The calcium chloride is deliquescent; it absorbs moisture from the air, thus keeping the soil moist and reserving the natural cohesion.

Part 2

Two new quick-set emulsions developed for slurry seal coats

Two new asphalt emulsions designed to meet quick-set needs in slurry seal work have been announced.

The objective of the new quick-set methods is to provide economic slurry seal coats that can be constructed rapidly to perform under a broad range of traffic and weather conditions.

Cationic Quick-set (QS-kh), one of the new emulsions, is available on a limited marketing basis in the East, Midwest and South, consistent with manufacturing and supply limitations, available only in the West at San Diego, California.

Anionic Quick-set (QS-h), the second new emulsion, is available generally in the West, consistent with the same limitations. Available in the East, Midwest and South on an experimental basis only.

How cationic QS-kh system works:

The cationic quick-setting asphalt emulsion (Bitumils QS-kh) is a unique mixing type emulsion. The cationic emulsifiers in QS-kh react chemically with the aggregate. An aggregate may be thought of as a surface containing many chemically reactive sites.

An emulsion may be described as small particles of asphalt suspended in water, in which emulsifier moleculars are partially dissolved. It is postulated that the reactive emulsifier heads protrude from the asphalt particle into the emulsions water phase. The proper amount of emulsifier in an emulsion imparts stability to it, but a lower emulsifier concentration will make the emulsion unstable, and the asphalt particles will coalesce. When an aggregate and a cationic emulsion are mixed together, a reaction occurs.

As the emulsifier reacts chemically with the aggregate, some of the electrical charges are neutralised. This lowers the stability of the emulsion. The asphalt particles then coalesce, forming lattices of asphalt attached to the aggregate. These lattices impart cohesive strength to the chemically broken slurry mix.

To develop full strength, however, the water of the slurry mix still must be removed. Beyond this initial chemical set, then, the rapid-setting system depends on dehydration for further cohesive strength development. Note the initial development of cohesive strength with the quick setting system.

Thus, a cationic quick-setting slurry seal emulsion has two unique properties which provide a basis for its characterisation.

First, it is capable of being mixed with an aggregate for a short time. After a few minutes the emulsion on the mix breaks by chemical action, and the mix begins to set. The length of time during which a mix remains fluid is referred to as «mixing time».

Secondly, a properly designed, rapid-setting system, in contrast to a SS-type slurry, quickly develops some cohesive strength – enough to sustain rolling traffic.

E x e r c i s e s

I. Подберите ответы на следующие вопросы к прочитанному тексту.

1. What is the objective of the new quick-set method?
2. What is the aggregate with which the cationic emulsifiers in the quick-setting emulsion react chemically?
3. Why must the amount of emulsifier in an emulsion be proper?
4. What occurs when an aggregate and a cationic emulsion are mixed?
5. Where can the cationic quick-set system be used?
6. What has very high exchange capacities?

a) When an aggregate and a cationic emulsion are mixed together, a reaction occurs.

b) Clay has very high exchange capacities.

c) The aggregate may be thought of as a surface containing many chemically reactive sites.

d) The cationic quick-set system can be used in critical areas, such as high bridges and high traffic areas where only limited barricade time can be tolerated.

e) The objective of the new quick-set method is to provide economic slurry seal coats that can be constructed rapidly to perform under a broad range of traffic and weather conditions.

f) The proper amount of emulsifier in an emulsion imparts stability in it, but a lower emulsifier concentration will make the emulsion unstable, and the asphalt particles will coalesce.

II. Определите функцию инфинитива, переведите предложения на русский язык.

1. Two new asphalt emulsions designed to meet quick-set needs in slurry seal, work have been announced.
2. The objective of the new quick-set methods is to provide economic slurry seal coats that can be constructed rapidly to perform under a broad range of traffic and weather conditions.
3. To develop full strength, the water of the slurry mix must be removed.
4. After a few minutes, the emulsion in the mix breaks by chemical action, and the mix begins to set.
5. A properly designed rapid-setting system quickly develops some cohesive strength – enough to sustain rolling traffic.
6. The more reactive the aggregate, the more emulsifier needed to obtain a specific mixing time.
7. It is necessary to add a specially formulated chemical solution capable of reacting with the aggregate.

III. Определите тип придаточного предложения, переведите на русский язык.

1. The objective of the new quick-set methods is to provide economic slurry seal coats that can be constructed rapidly.
2. An emulsion may be described as small particles of asphalt suspended in water, in which emulsifier moleculars are partially dissolved.
3. It is postulated that the reactive emulsifier heads protrude from the asphalt particle into the emulsion's water phase.
4. When an aggregate and a cationic emulsion are mixed together, a reaction occurs.
5. As the emulsifier reacts chemically with the aggregate, some of the electrical charges are neutralized.
6. Since a chemical reaction is involved, utilization of the cationic quick-set system is largely independent of weather.
7. Limestone has more exchange absorption sites than does silica.
8. If an aggregate contains clay, its total reactivity is greatly increased.

IV. Подберите правильный перевод к выделенным словам.

The cationic quick-setting slurry seal emulsion is **capable of being mixed** with an aggregate for a short time.

1) смешиваться;
2) обладать способностью смешиваться;
3) способна смешиваться.

V. Используя вышеперечисленные слова, восстановите предложения.

1) ***emulsion, chemically, emulsifier, cationic***

The -ic -ers in the quick-setting asphalt -sion react -ly with the aggregate.

2) ***particles, described, emulsion, suspended***.

An -sion may be -ed as small -s of asphalt -ed in water.

3*)* ***emulsifier, electrical, chemically, reacts, neutralized, charges***.

As the -er -s -ly with the aggregate, some of the -al -s are -ed.

VI. Выберите предложения, которые соответствуют действительности.

A.

1. Natural gravel is a mixture of clay and pebbles.
2. Natural gravel is a product of complex organic compounds.
3. Natural gravel is a mixture of sand and pebbles.
4. Natural gravel is a mixture of broken stone and lime.

B.
1. Asphalt is a product of the manufacture of coke from bituminous coal.
2. Asphalt is a mixture of complex organic compounds.
3. Asphalt is a mixture of sand and pebbles.
4. Asphalt is a mixture of complex inorganic compounds.
C.
1. Tar is an admixture.
2. Tar is deliquescent.
3. Tar is a product of the manufacture of asphaltic oils.
4. Tar is a product of the manufacture of coke from bituminous coal.

VII. Закончите предложения подходящими по смыслу словами.

1. The cationic emulsifiers in the quick-setting asphalt emulsion react chemically … .
2. An emulsion may be described … .
3. The asphalt particles coalesce, forming … .
4. A cationic quick-setting slurry seal emulsion is capable of being mixed … .
5. A properly designed, rapid-setting system develops some cohesive strength … .
6. The extent of chemical reaction between the aggregate and the emulsion is dependent … .

a) enough to sustain rolling traffic.
b) with an aggregate.
c) with the aggregate for a short time.
d) on both the generic nature of the aggregate and its fine content.
e) lattices of asphalt attached to the aggregate.
f) as small particles of asphalt suspended in water, in which emulsifier moleculars are partially dissolved.

T E X T 2

Anionic Quick-set Emulsion


Answer the questions:

1. What causes the slurry mix set quickly?
2. What changes the properties of the anionic quick-setting asphalt (emulsion) mix?
3. What do the ions react with?

How anionic QS-h system works:

In this way the Bitumuls QS-h-asphalt emulsion breaks by reaction with the mineral filler and the slurry quickly. When mixed with pre-wetted aggregate a stable mix is formed similar to the conventional slurry made with SS-Ch or SS-kh asphalt emulsion.

Controlled addition of Portland cement or hydrated lime in the machine mixer changes the properties of the anionic Bitumuls QS-h mix in minutes, the fluid slurry on the pavement converts to a water and traffic resistant seal.

The mechanism involved depends on the release of multivalent cations by the mineral filler. These ions react with the special emulsifiers in the asphalt emulsion. The electrical surface charge that kept the emulsified asphalt droplets separated is neutralized by this reaction, allowing the asphalt droplets attach to the aggregate to form a lattice of asphalt which gives cohesive strength to the slurry seal mix.

Beyond this initial chemical set, however, the quick-setting system with either QS-kh or QS-h emulsion depends on dehydration for further strength development.

General comments: All slurry seal mixes should be properly designed. This is particularly true of quick-setting slurry mixes. Pretesting of the job aggregate, mineral filler and asphalt emulsion in the laboratory is essential. The job variables cause little difficulty in the field if the mix is properly designed. Sufficient water is needed in the slurry to obtain the desired consistency – a creamy, homogeneous mixture which does not segregate on standing.

Minor variations in water from the mix design do not noticeably change the setting characteristics of the quick-set slurry.

Large differences in mix water however, do affect the slurry. Too little water will make the slurry too thick to handle, and it will set very fast. Too much water will cause segregation and should be avoided. Excess water also delays setting. The best quality quick-setting slurry is obtained by using as dry a mix as the machine will handle and apply.

Field experience shows that high ambient temperature presents no unusual problem in controlling the characteristics of the quick-setting slurry. In hot weather the mix will set up fast on the road because of accelerated chemical setting and rapid dehydration.

Correspondingly less mineral filler is needed for the anionic Qp-h slurry in hot weather than in cooler weather successful application of quick-set has been made at ambient temperatures up to 100°F.

Bitumals QS-kh is formulated to design slurry seals with quick-set characteristic at temperatures down to 50°F. For the anionic QS-h slurry mix, the lower the ambient temperature the more mineral filler is needed to achieve quickset, Portland cement, however, is not sufficiently active as a chemical set initiator at low temperatures. Hydrated lime is usually recommended for 60° and colder weather.

Exercises

I. Подберите ответы на следующие вопросы к прочитанному тексту.

1. Under what condition does the anionic quick-setting asphalt emulsion break?
2. When is a stable mix formed?
3. What changes the properties of the anionic quick-setting mix?
4. What does the fluid slurry on the pavement convert into?
5. What keeps the emulsified asphalt droplets separated?
6. What does the quick-setting system with both emulsions depend on?

a) Controlled addition of Portland cement or hydrated lime in the machine mixer changes the properties of the anionic quick-setting asphalt mix.

b) The quick-setting system with either QS-kh or QS-h emulsions depends on dehydration for further strength development.

c) The electrical surface charge keeps the emulsified asphalt droplets separated.

d) The anionic quick-setting asphalt emulsion breaks by reaction with the mineral filler and the slurry mix sets quickly.

e) The fluid slurry on the pavement converts to a water and traffic resistant seal.

f) When mixed with pre-wetted aggregate a stable mix is formed similar to the conventional slurry made with SS-Ch or SS-kh asphalt emulsion.

II. Подберите подходящий по смыслу предлог: ***on; by; with; to; in; for; of.***

1. When mixed … pre-wetted aggregate a stable mix is formed.
2. Controlled addition of Portland cement or hydrated lime … the machine mixer changes the properties of the anionic slurry mix.
3. The fluid slurry on the pavement converts … a water and traffic resistant seal.

4. The mechanism involved depends … the release of multivalent cations by the natural filler.

5. The electrical surface charge that kept the emulsified asphalt droplets separated is neutralized … the reaction of ions with the emulsifiers.

6. The asphalt droplets attach to the aggregate to form a lattice … asphalt.

7. The quick-setting system with either QS-kh or QS-h emulsion depends on dehydration … further strength development.

III. Переведите на английский язык.

1. Положительно заряженная быстросхватывающаяся эмульсия представляет собой мелкие частицы асфальта, взвешенные в воде, в которой частично растворены молекулы эмульгатора.
2. Заполнитель представляет собой покрытие, содержащее много химически способных к реакции частиц.
3. Когда эмульгатор вступает в химическую реакцию с заполнителем, некоторые из электрических зарядов нейтрализуются.
4. Катионная быстросхватывающаяся суспензиональная эмульсия способна смешиваться с заполнителем на короткое время.
5. В результате реакции с минеральным заполнителем анионная быстросхватывающая эмульсия разрушается, и смесь быстро схватывается.
6. Определенное добавление портланд цемента или гашеной извести в смеситель изменяет свойства анионной быстросхватывающей эмульсии.

TEXT 3

I. Подберите заголовок к тексту из предложенных ниже.

1. Seal Mixes.
2. Properties of Quick-Setting Emulsions.
3. Quick-set Emulsions for Slurry Seal Coats.

II. Составьте 6 вопросов к тексту и ответьте на них.

Cationic Quick-set system is largely independent of weather. Early rain resistance and capability to accept traffic are achieved. The workday can be extended. Instead of stopping operations in the early afternoon on days when dehydrating conditions are poor, a full workday can be utilized with traffic restored before darkness. This means that minimum barricade equipment and traffic control personnel are required.

In addition, the cationic quick-set system can be used in critical areas, such as bridges and high traffic areas, where only limited barricade time can be tolerated.

Cationic QS-kh is formulated to set rapidly with most commercially available aggregates. However, the extent of chemical reaction between the aggregate and the emulsion is dependent on both the generic nature of the aggregate and its fine content. The more reactive the aggregate, the more emulsifier needed to obtain a specific mixing time.

The amount of emulsifier needed is dependent on the cationic exchange adsorption capacity of the aggregate. Limestone type aggregates are generally more reactive than silica types; i.e. limestone has more exchange adsorption sites than does silica.

The number of reactive sites increases also as the aggregate fine content increases due to the additional surface area. Clays have very high exchange capacities. If an aggregate contains clay, then, its total reactivity is greatly increased.

It is obvious that no single set ionic asphalt emulsion can be formulated to react equally well with a broad range of aggregate types or even with one source since some variation will occur in commercially produced aggregates.

Therefore, it is necessary to add a specially formulated chemical solution capable of reacting with the aggregate. This solution is a mixing additive which will permit the slurry machine operator to control the mixing and setting rate of the slurry mix. Sufficient mixing additive is used to obtain adequate mixing time yet to achieve a rapid setting rate.

Exercises

I. Сделайте следующие сообщения на английском языке:

1. Специальные эмульсии для дорожных покрытий.
2. Природные материалы для дорожных покрытий.

II. Подготовьте презентацию по теме: «Дорожные покрытия и движение транспорта в различных погодных условиях». Используйте Интернет-ресурсы.

PART II.
CARS: HISTORY, TECHNICAL CHARACTERISTICS

Unit 1. ELECTRIC CARS

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Расскажите об электромобилях на русском языке, используя информацию текста.

Electric car

From Wikipedia, the free encyclopedia http://en.wikipedia.org/wiki/Electric Car

The REVAi/G-Wiz i electric car charging from an on-street station in London

An electric car is an automobile which is propelled by electric motor(s), using electrical energy stored in batteries or another energy storage device. Electric cars were popular in the late-19th century and early 20th century, until advances in internal combustion engine techology and mass production of cheaper gasoline vehicles led to a decline in the use of electric drive vehicle. The energy crises of the 1970s and 80s brought a short lived interest in electric cars, but in the mid 2000s took place a renewed interest in the production of electric cars due mainly to concerns about rapidly increasing oil prices and the need to curb greenhouse gas emissions. As of October 2011 series production models available in some countries include the Tesla Roadster, REVAi, Renault Fluence Z.E., Buddy, Mitsubishi i MiEV, Tazzari Zero, Nissan Leaf, Smart ED, Wheego Whip LiFe, Mia electric, and BYD e6. The Leaf and the i-MiEV, with worldwide cumulative sales of more than 16,000 units each, are the top selling highway-capable electric cars by October 2011.

Electric cars have several potential benefits as compared to conventional internal combustion automobiles that include a significant reduction of urban air pollution as they do not emit harmful tailpipe pollutants from the onboard source of power at the point of operation (zero tail pipe emissions); reduced greenhouse gas emissions from the onboard source of power depending on the fuel and technology used for electricity generation to charge the batteries; and less dependence on foreign oil, which for the United States, other developed and emerging countries is cause of concerns about their vulnerability to price shocks and supply disruption. Also for many developing countries, and particularly for the poorest in Africa, high oil prices have an adverse impact on their balance of payments, hindering their economic growth.

Despite their potential benefits, widespread adoption of electric cars faces several hurdles and limitations. As of 2011 electric cars are significantly more expensive than conventional internal combustion engine vehicles and hybrid electric vehicles due to the additional cost of their lithium-ion battery pack. However, battery prices are coming down with mass production and expected to drop further. Other factors discouraging the adoption of electric cars are the lack of public and private recharging infrastructure and the driver's fear of the batteries running out of energy before reaching their destination (range anxiety) due to the limited range of existing electric cars. Several governments have established policies and economic incentives to overcome existing barriers, to promote the sales of electric cars, and to fund further development of electric vehicles, more cost-effective battery technology and their components. The U.S. has pledged US$2.4 billion in federal grants for electric cars and batteries. China has announced it will provide US$15 billion to initiate an electric car industry within its borders. Several national and local governments have established tax credits, subsidies, and other incentives to reduce the net purchase price of electric cars and other plug-ins.

Etymology

Electric cars are a variety of electric vehicle (EV); the term «electric vehicle» refers to any vehicle that uses electric motors for propulsion, while «electric car» generally refers to road-going automobiles powered by electricity. While an electric car's power source is not explicitly an on-board battery, electric cars with motors powered by other energy sources are generally referred to by a different name: an electric car powered by sunlight is a solar car, and an electric car powered by a gasoline generator is a form of hybrid car. Thus, an electric car that derives its power from an on-board battery pack is a form of battery electric vehicle (BEV). Most often, the term "electric car" is used to refer to pure battery electric vehicles.

History

Electric cars enjoyed popularity between the mid-19th century and early 20th century, when electricity was among the preferred methods for automobile propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. Advances in internal combustion technology, especially the electric starter, soon rendered this advantage moot; the greater range of gasoline cars, quicker refueling times, and growing petroleum infrastructure, along with the mass production of gasoline vehicles by companies such as the Ford Motor Company, which reduced prices of gasoline cars to less than half that of equivalent electric cars, led to a decline in the use of electric propulsion, effectively removing it from important markets such as the United States by the 1930s. However, in recent years, increased concerns over the environmental impact of gasoline cars, higher gasoline prices, improvements in battery technology, and the prospect of peak oil, have brought about renewed interest in electric cars, which are perceived to be more environmentally friendly and cheaper to maintain and run, despite high initial costs. Electric cars currently enjoy relative popularity in countries around the world, though they were absent from the roads of the United States, after they briefly re-appeared in the late 90s.

German electric car, 1904, with the chauffeur on top

Detroit Electric car charging

1890s to 1900s: Early history

Before the pre-eminence of internal combustion engines, electric automobiles held many speed and distance records. Among the most notable of these records was the breaking of the 100 km/h (62 mph) speed barrier, by Camille Jenatzy on April 29, 1899 in his «rocket-shaped» vehicle Jamais Contente, which reached a top speed of 105.88 km/h (65.79 mph). Before the 1920s, electric automobiles were competing with petroleum-fueled cars for urban use of a quality service car.

Thomas Edison and an electric car in 1913 (courtesy of the National Museum of American History)

Tribelhorn 1908

Proposed as early as 1896 in order to overcome the lack of recharging infrastructure, an exchangeable battery service was first put into practice by Hartford Electric Light Company for electric trucks. The vehicle owner purchased the vehicle from General Electric Company (GVC) without a battery and the electricity was purchased from Hartford Electric through an exchangeable battery. The owner paid a variable per-mile charge and a monthly service fee to cover maintenance and storage of the truck. The service was provided between 1910 to 1924 and during that period covered more than 6 million miles. Beginning in 1917 a similar service was operated in Chicago for owners of Milburn Light Electric cars who also could buy the vehicle without the batteries.

In 1897, electric vehicles found their first commercial application in the U.S. as a fleet of electrical New York City taxis, built by the Electric Carriage and Wagon Company of Philadelphia. Electric cars were produced in the US by Anthony Electric, Baker, Columbia, Anderson, Edison, Fritchle, Studebaker, Riker, Milburn, and others during the early 20th century.

Despite their relatively slow speed, electric vehicles had a number of advantages over their early-1900s competitors. They did not have the vibration, smell, and noise associated with gasoline cars. They did not require gear changes, which for gasoline cars was the most difficult part of driving. Electric cars found popularity among well-heeled customers who used them as city cars, where their limited range was less of a disadvantage. The cars were also preferred because they did not require a manual effort to start, as did gasoline cars which featured a hand crank to start the engine. Electric cars were often marketed as suitable vehicles for women drivers due to this ease of operation.

In 1911, the New York Times stated that the electric car has long been recognized as «ideal» because it was cleaner, quieter and much more economical than gasoline-powered cars. Reporting this in 2010, the Washington Post commented that «the same unreliability of electric car batteries that flummoxed Thomas Edison persists today».

The Henney Kilowatt,
a 1961 production electric car based on the Renault Dauphine

1990s to present: Revival of mass interest

The energy crises of the 1970s and 80s brought about renewed interest in the perceived independence that electric cars had from the fluctuations of the hydrocarbon energy market. In the early 1990s, the California Air Resources Board (CARB), the government of California's began a push for more fuel-efficient, lower-emissions vehicles, with the ultimate goal being a move to zero-emissions vehicles such as electric vehicles. In response, automakers developed electric models, including the Chrysler TEVan, Ford Ranger EV pickup truck, GM EV1 and S10 EV pickup, Honda EV Plus hatchback, Nissan lithium-battery Altra EV miniwagon and Toyota RAV4 EV. These cars were eventually withdrawn from the U.S. market.

The global economic recession in the late 2000s led to increased calls for automakers to abandon fuel-inefficient SUVs, which were seen as a symbol of the excess that caused the recession, in favor of small cars, hybrid cars, and electric cars. California electric car maker Tesla Motors began development in 2004 on the Tesla Roadster, which was first delivered to customers in 2008. As of January 2011 Tesla had produced more than 1,500 Roadsters sold in at least 31 countries. The Mitsubishi i MiEV was launched for fleet customers in Japan in July 2009, and for individual customers in April 2010, followed by sales to the public in Hong Kong in May 2010, and Australia in July 2010 via leasing.

Retail customer deliveries of the Nissan Leaf in Japan and the United States began in December 2010, though initial availability is restricted to a few launch markets and in limited quantities. As of September 2011 other electric automobiles, city cars, and light trucks available in some markets included the REVAi, Buddy, Citroen C1 ev'ie, Transit Connect Electric, Mercedes-Benz Vito E-Cell, Smart ED, Wheego Whip LiFe, and several neighborhood electric vehicles.

First Nissan Leaf delivered in the U.S. on the road south of San Francisco

Comparison with internal combustion engine vehicles

An important goal for electric vehicles is overcoming the disparity between their costs of development, production, and operation, with respect to those of equivalent internal combustion engine vehicles (ICEVs).

Unit 2. GASOLINE AND ELECTRIC CARS

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Переведите письменно текст под заголовком «Price».
4. Обсудите на английском языке следующие проблемы: загрязнение воздуха, вопросы энергосбережения, безопасность движения автомобиля.

Price

Sales of the Mitsubishi i MiEV to the public began in Japan in April 2010, in Hong Kong in May 2010 and in Australia in July 2010.

Electric cars are generally more expensive than gasoline cars. The primary reason is the high cost of car batteries. US and British car buyers seem to be unwilling to pay more for an electric car. This prohibits the mass transition from gasoline cars to electric cars. A survey taken by Nielsen for the Financial Times has shown that 65 percent of Americans and 76 percent of Britons are not willing to pay more for an electric car above the price of a gasoline car. Also a report by J.D. Power and Associates claims that about 50 percent of U.S. car buyers are not even willing to spend more than US$5,000 on a green vehicle above the price of a petrol car despite their concern about the environment.

The Nissan LEAF is the most affordable five door family electric car in the U.S. at a price of US$32,780 going down to US$25,280 after federal tax rebate of US$7,500, going further down to US$20,280 after the US$5,000 tax rebate in California and similar incentives in other states.

The Renault Fluence Z.E. five door family saloon electric car will be priced at less than US$20,000 before any U.S. federal and state tax rebates are applied. It will be sold without the battery thus the significant price difference. The customer will buy the Renault Fluence Z.E. with a contract to lease the battery from the company Better Place.

The electric car company Tesla Motors is using laptop battery technology for the battery packs of their electric cars that are 3 to 4 times cheaper than dedicated electric car battery packs that other auto makers are using. While dedicated battery packs cost $700–$800 per kilowatt hour, battery packs using small laptop cells cost about $200. That could potentially drive down the cost of electric cars that are using Tesla's battery technology such as the Toyota RAV4 EV and the Smart ED as well as their own upcoming 2014 models such as the Model X.

A study published in 2011 by the Belfer Center, Harvard University, found that the gasoline costs savings of plug-in electric cars over the vehicles' lifetimes do not offset their higher purchase prices. This finding was estimated comparing their lifetime net present value at 2010 purchase and operating costs for the U.S. market, and assuming no government subsidies. According to the study estimates, a PHEV-40 is US$5,377 more expensive than a conventional internal combustion engine, while a battery electric vehicle is US$4,819 more expensive. The study also examined how this balance will change over the next 10 to 20 years, assuming that battery costs will decrease while gasoline prices increase. Under the future scenarios considered, the study found that BEVs will be significantly less expensive than conventional cars (US$1,155 to US$7,181 cheaper), while PHEVs, will be more expensive than BEVs in almost all comparison scenarios, and only less expensive than conventional cars in an scenario with very low battery costs and high gasoline prices. The reason for the different savings among plug-in cars is due to the fact that BEVs are simpler to build and do not use liquid fuel, while PHEVs have more complicated powertrains and still have gasoline-powered engines.

Running costs and maintenance

The Tesla Roadster is sold in the US and Europe and has a range of 245 miles per charge.

Most of the running cost of an electric vehicle can be attributed to the maintenance and replacement of the battery pack because an electric vehicle has only around 5 moving parts in its motor, compared to a gasoline car that has hundreds of parts in its internal combustion engine. Electric cars have expensive batteries that must be replaced but otherwise incur very low maintenance costs, particularly in the case of current Lithium based designs.

To calculate the cost per kilometer of an electric vehicle it is therefore necessary to assign a monetary value to the wear incurred on the battery. This can be difficult due to the fact that it will have a slightly lower capacity each time it is charged and is only considered to be at the end of its life when the owner decides its performance is no longer acceptable. Even then an 'end of life' battery is not completely worthless as it can be re-purposed, recycled or used as a spare.

Since a battery is made of many individual cells that do not necessarily wear evenly periodically replacing the worst of these can retain the vehicle's range.

The Tesla Roadster's very large battery pack is expected to last seven years with typical driving and costs US$12,000 when pre-purchased today. Driving 40 miles (64 km) per day for seven years or 102,200 miles (164,500 km) leads to a battery consumption cost of US$0.1174 per 1 mile (1.6 km) or US$4.70 per 40 miles (64 km). The company Better Place provides another cost comparison as they anticipate meeting contractual obligations to deliver batteries as well as clean electricity to recharge the batteries at a total cost of US$0.08 per 1 mile (1.6 km) in 2010, US$0.04 per mile by 2015 and US$0.02 per mile by 2020. 40 miles (64 km) of driving would initially cost US$3.20 and fall over time to US$0.80.

In 2010 the U.S. government estimated that a battery with a 100 miles (160 km) range would cost about US$33,000. Concerns remain about durability and longevity of the battery.

Nissan estimates that the Leaf's 5 year operating cost will be US$1,800 versus US$6,000 for a gasoline car. The documentary film Who Killed the Electric Car? shows a comparison between the parts that require replacement in a gasoline powered cars and EV1s, with the garages stating that they bring the electric cars in every 5,000 mi (8,000 km), rotate the tires, fill the windshield washer fluid and send them back out again.

Electricity vs. hydrocarbon fuel

«Fuel» cost comparison: the Tesla Roadster sport car's plug-to-wheel energy use is 280 W·h/mi. In Northern California, the local electric utility company PG&E says that «The E-9 rate is mandatory for those customers that are currently on a residential electric rate and who plan on refueling an EV on their premises». Combining these two facts implies that driving a Tesla Roadster 40 miles (64 km) a day would use 11.2 kW·h of electricity costing between US$0.56 and US$3.18 depending on the time of day chosen for recharging. For comparison, driving an internal combustion engine-powered car the same 40 miles (64 km), at a mileage of 25 miles per US gallon (9.4 L/100 km; 30 mpg_{-imp}), would use 1.6 US gallons (6.1 l; 1.3 imp gal) of fuel and, at a cost of US$4 per 1 US gallon (3.8 l; 0.83 imp gal), would cost US$6.40.

The Tesla Roadster uses about 17.4 kW·h/100 km (0.63 MJ/km; 0.280 kW·h/mi), the EV1 used about 11 kW·h/100 km (0.40 MJ/km; 0.18 kW·h/mi). Other electric vehicles such as the Nissan Leaf are quoted at 21.25 kW·h/100 km (0.765 MJ/km; 0.3420 kW·h/mi) by the US Environmental Protection Agency. These differences reflect the different design and utility targets for the vehicles, and the varying testing standards. The actual energy use is greatly dependent on the actual driving conditions and driving style.

Range and refuelling time

Cars with internal combustion engines can be considered to have indefinite range, as they can be refuelled very quickly almost anywhere. Electric cars often have less maximum range on one charge than cars powered by fossil fuels, and they can take considerable time to recharge. This is a reason that many automakers marketed EVs as «daily drivers» suitable for city trips and other short hauls. The average American drives less than 40 miles (64 km) per day; so the GM EV1 would have been adequate for the daily driving needs of about 90 % of U.S. consumers. Nevertheless, people can be concerned that they would run out of energy from their battery before reaching their destination, a worry known as range anxiety.

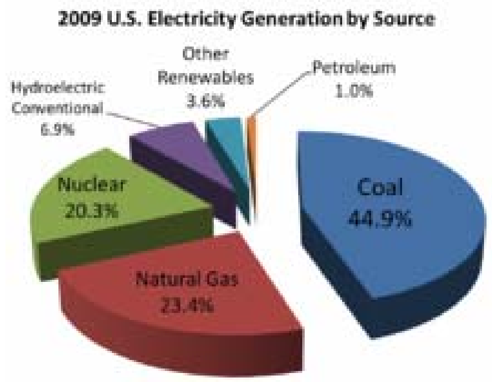
The Tesla Roadster can travel 245 miles (394 km) per charge; more than double that of prototypes and evaluation fleet cars currently on the roads. The Roadster can be fully recharged in about 3.5 hours from a 220-volt, 70-amp outlet which can be installed in a home.

One way automakers can extend the short range of electric vehicles by building them with battery switch technology. An EV with battery switch technology and a 100 miles (160 km) driving range will be able to go to a battery switch station and switch a depleted battery with a fully charged one in 59.1 seconds giving the EV an additional 100 miles (160 km) driving range. The process is cleaner and faster than filling a tank with gasoline and the driver remains in the car the entire time, but because of the high investment cost, its economics are unclear. As of late 2010 there are only 2 companies with plans to integrate battery switching technology to their electric vehicles: Better Place and Tesla Motors. Better Place operated a battery-switch station in Japan until November 2010 and announced a commitment to open four battery switch stations in California, USA.

Another way is the installation of DC Fast Charging stations with high-speed charging capability from three-phase industrial outlets so that consumers could recharge the 100 mile battery of their electric vehicle to 80 percent in about 30 minutes. A nationwide fast charging infrastructure is currently being deployed in the US that by 2013 will cover the entire nation. DC Fast Chargers are going to be installed at 45 BP and ARCO locations and will be made available to the public as early as March 2011. The EV Project will deploy charge infrastructure in 16 cities and major metropolitan areas in six states. Nissan has announced that 200 of its dealers in Japan will install fast chargers for the December 2010 launch of its Leaf EV, with the goal of having fast chargers everywhere in Japan within a 25 mile radius.

In July 2011, there are hints that Whole Foods, Walmart, etc. will be adding various charging stations.

Air pollution and carbon emissions



Sources of electricity in the U.S. in 2009

Electric cars contribute to cleaner air in cities because they produce no harmful pollution at the tailpipe from the onboard source of power, such as particulates (soot), volatile organic compounds, hydrocarbons, carbon monoxide, ozone, lead and various oxides of nitrogen. The clean air benefit is usually local because, depending on the source of the electricity used to recharge the batteries, air pollutant emissions are shifted to the location of the generation plants. The amount of carbon dioxide emitted depends on the emission intensity of the power source used to charge the vehicle, the efficiency of the said vehicle and the energy wasted in the charging process.

For mains electricity the emission intensity varies significantly per country and within a particular country it will vary depending on demand, the availability of renewable sources and the efficiency of the fossil fuel-based generation used at a given time. Charging a vehicle using off-grid renewable energy yields very low carbon intensity (only that to produce and install the off-grid generation system e.g. domestic wind turbine).

An EV recharged from the existing US grid electricity emits about 115 grams of CO_2 per kilometer driven (6.5 oz(CO_2)/mi), whereas a conventional US-market gasoline powered car emits 250 g(CO_2)/km (14 oz(CO_2)/mi) (most from its tailpipe, some from the production and distribution of gasoline). The savings are questionable relative to hybrid or diesel cars (according to official

British government testing, the most efficient European market cars are well below 115 grams of CO_2 per kilometer driven, although a study in Scotland gave 149.5gCO_2/km as the average for new cars in the UK), but would be more significant in countries with cleaner electric infrastructure. In a worst-case scenario where incremental electricity demand would be met exclusively with coal, a 2009 study conducted by the World Wide Fund for Nature and IZES found that a mid-size EV would emit roughly 200 g(CO_2)/km (11 oz(CO_2)/mi), compared with an average of 170 g(CO_2)/km (9.7 oz(CO_2)/mi) for a gasoline-powered compact car. This study concluded that introducing 1 million EV cars to Germany would, in the best-case scenario, only reduce CO_2 emissions by 0.1 %, if nothing is done to upgrade the electricity infrastructure or manage demand.

In France, which has a clean energy grid, CO_2 emissions from electric car use would be about 12g per kilometer.

A study made in the UK in 2008 concluded that electric vehicles had the potential to cut down carbon dioxide and greenhouse gas emissions by at least 40 %, even taking into account the emissions due to current electricity generation in the UK and emissions relating to the production and disposal of electric vehicles.

A 2011 report prepared by Ricardo found that hybrid electric vehicles, plug-in hybrids and all-electric cars generate more carbon emissions during their production than current conventional vehicles, but still have a lower overall carbon footprint over the full life cycle. The initial higher carbon footprint is due mainly to battery production. As an example, the study estimated that 43 percent of production emissions for a mid-size electric car are generated from the battery production.

Acceleration and drivetrain design

Electric motors can provide high power-to-weight ratios, and batteries can be designed to supply the large currents to support these motors.

Although some electric vehicles have very small motors, 15 kW (20 hp) or less and therefore have modest acceleration, many electric cars have large motors and brisk acceleration. In addition, the relatively constant torque of an electric motor, even at very low speeds tends to increase the acceleration performance of an electric vehicle relative to that of the same rated motor power internal combustion engine. Another early solution was American Motors' experimental Amitron piggyback system of batteries with one type designed for sustained speeds while a different set boosted acceleration when needed.

Electric vehicles can also use a direct motor-to-wheel configuration which increases the amount of available power. Having multiple motors connected directly to the wheels allows for each of the wheels to be used for both propulsion and as braking systems, thereby increasing traction. In some cases, the motor can be housed directly in the wheel, such as in the Whispering Wheel design, which lowers the vehicle's center of gravity and reduces the number of moving parts. When not fitted with an axle, differential, or transmission, electric vehicles have less drivetrain rotational inertia. However, housing the motor within the wheel can increase the unsprung weight of the wheel, which can have an adverse effect on the handling of the vehicle.

Transmission

A gearless or single gear design in some EVs eliminates the need for gear shifting, giving such vehicles both smoother acceleration and smoother braking. Because the torque of an electric motor is a function of current, not rotational speed, electric vehicles have a high torque over a larger range of speeds during acceleration, as compared to an internal combustion engine. As there is no delay in developing torque in an EV, EV drivers report generally high satisfaction with acceleration.

The disadvantage of providing high acceleration by high torque from the motor is lowered efficiency due to higher losses in the form of Joule heating in the motor windings caused by the high electric current. This energy loss increases fourfold as the input current is doubled, so the practical limit for sustained torque from an electric motor depends on how well it can be cooled during operation. There is always a compromise between torque and energy efficiency. This limits the top speed of electric vehicles operating on a single gear due to the need to limit the required torque and maintain efficiency at low vehicle speeds.

For example, the Venturi Fetish delivers supercar acceleration despite a relatively modest 220 kW (295 hp) and top speed of around 160 km/h (100 mph). The Tesla Roadster 2.5 Sport can accelerate from 0 to 60 mph (97 km/h) in 3.7 seconds with a motor rated at 215 kW (288 hp).

Also the Wrightspeed X1 prototype created by Wrightspeed Inc is the worlds fastest street legal electric car. With an acceleration of 0-60 mph in 2.9 seconds the X1 has bested some of the worlds fastest sports cars.

Energy efficiency

Internal combustion engines are relatively inefficient at converting on-board fuel energy to propulsion as most of the energy is wasted as heat. On the other hand, electric motors are more efficient in converting stored energy into driving a vehicle, and electric drive vehicles do not consume energy while at rest or coasting, and some of the energy lost when braking is captured and reused through regenerative braking, which captures as much as one fifth of the energy normally lost during braking. Typically, conventional gasoline engines effectively use only 15 % of the fuel energy content to move the vehicle or to power accessories, and diesel engines can reach on-board efficiencies of 20 %, while electric drive vehicles have on-board efficiency of around 80 %.

Production and conversion electric cars typically use 10 to 23 kW·h/100 km (0.17 to 0.37 kW·h/mi). Approximately 20 % of this power consumption is due to inefficiencies in charging the batteries. Tesla Motors indicates that the vehicle efficiency (including charging inefficiencies) of their lithium-ion battery powered vehicle is 12.7 kW·h/100 km (0.21 kW·h/mi) and the well-to-wheels efficiency (assuming the electricity is generated from natural gas) is 24.4 kW·h/100 km (0.39 kW·h/mi).

Safety

The safety issues of BEVs are largely dealt with by the international standard ISO 6469. This document is divided in three parts dealing with specific issues:

- On-board electrical energy storage, i.e. the battery
- Functional safety means and protection against failures
- Protection of persons against electrical hazards.

Firefighters and rescue personnel receive special training to deal with the higher voltages and chemicals encountered in electric and hybrid electric vehicle accidents. While BEV accidents may present unusual problems, such as fires and fumes resulting from rapid battery discharge, there is apparently no available information regarding whether they are inherently more or less dangerous than gasoline or diesel internal combustion vehicles which carry flammable fuels.

Vehicle safety

Great effort is taken to keep the mass of an electric vehicle as low as possible to improve its range and endurance. However, the weight and bulk of the batteries themselves usually makes an EV heavier than a comparable gasoline vehicle, reducing range and leading to longer braking distances; it also has less interior space. However, in a collision, the occupants of a heavy vehicle will, on average, suffer fewer and less serious injuries than the occupants of a lighter vehicle; therefore, the additional weight brings safety benefits despite having a negative

Frontal crash test of a Volvo C30 DRIVe Electric to assess the safety of the battery pack effect on the car's performance. An accident in a 2,000 lb (900 kg) vehicle will on average cause about 50 % more injuries to its occupants than a 3,000 lb (1,400 kg) vehicle. In a single car accident, and for the other car in a two car accident, the increased mass causes an increase in accelerations and hence an increase in the severity of the accident. Some electric cars use low rolling resistance tires, which typically offer less grip than normal tires. Many electric cars have a small, light and fragile body, though, and therefore offer inadequate safety protection. The Insurance Institute for Highway Safety in America had condemned the use of low speed vehicles and "mini trucks", referred to as neighborhood electric vehicles (NEVs) when powered by electric motors, on public roads.

Hazard to pedestrians

At low speeds, electric cars produced less roadway noise as compared to vehicles propelled by internal combustion engines. Blind people or the visually impaired consider the noise of combustion engines a helpful aid while crossing streets, hence electric cars and hybrids could pose an unexpected hazard. Tests have shown that this is a valid concern, as vehicles operating in electric mode can be particularly hard to hear below 20 mph (30 km/h) for all types of road users and not only the visually impaired. At higher speeds, the sound created by tire friction and the air displaced by the vehicle start to make sufficient audible noise.

The US Congress and the Government of Japan passed legislation to regulate the minimum level of sound for hybrids and plug-in electric vehicles when operating in electric mode, so that blind people and other pedestrians and cyclists can hear them coming and detect from which direction they are approaching. The Nissan Leaf is the first electric car to use Nissan's Vehicle Sound for Pedestrians system, which includes one sound for forward motion and another for reverse.

Differences in controls

Presently most EV manufacturers do their best to emulate the driving experience as closely as possible to that of a car with a conventional automatic transmission that motorists are familiar with. Most models therefore have a PRNDL selector traditionally found in cars with automatic transmission despite the underlaying mechanical differences. Push buttons are the easiest to implement as all modes are implemented through software on the vehicle's controller.

Even though the motor may be permanently connected to the wheels through a fixed-ratio gear and no parking pawl may be present the modes "P" and "N" will still be provided on the selector. In this case the motor is disabled in "N" and an electrically actuated handbrake provides the "P" mode.

In some cars the motor will spin slowly to provide a small amount of creep in "D", similar to a traditional automatic.

When the foot is lifted from the accelerator of an ICE, engine braking causes the car to slow. An EV would coast under these conditions, and applying mild regenerative braking instead provides a more familiar response. Selecting the L mode will increase this effect for sustained downhill driving, analogous to selecting a lower gear.

Cabin heating and cooling

Electric vehicles generate very little waste heat and resistance electric heat may have to be used to heat the interior of the vehicle if heat generated from battery charging/discharging can not be used to heat the interior.

While heating can be simply provided with an electric resistance heater, higher efficiency and integral cooling can be obtained with a reversible heat pump (this is currently implemented in the hybrid Toyota Prius). Positive Temperature Coefficient (PTC) junction cooling is also attractive for its simplicity – this kind of system is used for example in the Tesla Roadster.

Some electric cars, for example the Citroen Berlingo Electrique, use an auxiliary heating system (for example gasoline-fueled units manufactured by Webasto or Eberspacher) but sacrifice "green" and "Zero emissions" credentials. Cabin cooling can be augmented with solar power, most simply and effectively by inducting outside air to avoid extreme heat buildup when the vehicle is closed and parked in the sunlight (such cooling mechanisms are available as aftermarket kits for conventional vehicles). Two models of the 2010 Toyota Prius include this feature as an option.

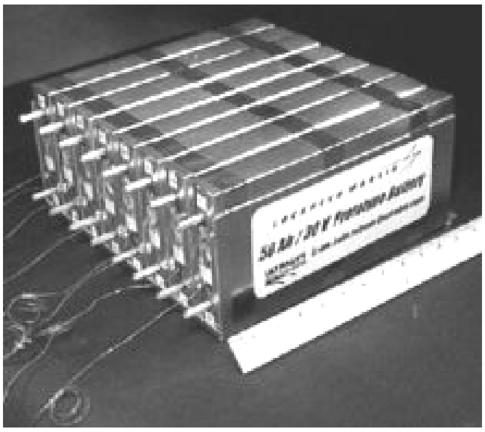
Unit 3. THE USE OF BATTERIES IN CARS

1. Прочитайте текст и ознакомьтесь с его общим содержанием.

2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.

3. Расскажите на русском языке об использовании аккумуляторных батарей в автомобилях, их замене и сроках службы.

Batteries



Prototypes of 75 watt-hour/kilogram lithium-ion polymer battery. Newer lithium-ion cells can provide up to 130 W·h/kg and last through thousands of charging cycles.

Finding the economic balance of range against performance, energy density and accumulator type versus cost challenges every EV manufacturer.

While most current highway-speed electric vehicle designs focus on lithium-ion and other lithium-based variants a variety of alternative batteries can also be used. Lithium based batteries are often chosen for their high power and energy density but have a limited shelf-life and cycle lifetime which can significantly increase the running costs of the vehicle. Variants such as

Lithium-iron phosphate and Lithium-titanate attempt to solve the durability issues with traditional lithium-ion batteries.

Other battery technologies include:

- Lead acid batteries are still the most used form of power for most of the electric vehicles used today. The initial construction costs are significantly lower than for other battery types, and while power output to weight is poorer than other designs, range and power can be easily added by increasing the number of batteries.
- NiCd – Largely superseded by NiMH
- Nickel metal hydride (NiMH)
- Nickel iron battery – Known for its comparatively long lifetime and low power density
- Several battery technologies are also in development such as:
- Zinc-air battery
- Molten salt battery
- Zinc-bromine flow batteries or Vanadium redox batteries can be refilled, instead of recharged, saving time. The depleted electrolyte can be recharged at the point of exchange, or taken away to a remote station.

Travel range before recharging

The range of an electric car depends on the number and type of batteries used. The weight and type of vehicle, and the performance demands of the driver, also have an impact just as they do on the range of traditional vehicles. The range of an electric vehicle conversion depends on the battery type:

Replacing

The Renault Fluence Z.E. will be the first electric car within the Better Place network, with sales scheduled to begin in Israel and Denmark by late 2011.

An alternative to quick recharging is to exchange the drained or nearly drained batteries (or battery range extender modules) with fully charged batteries, similar to how stagecoach horses were changed at coaching inns. Batteries could be leased or rented instead of bought, and then maintenance deferred to the leasing or rental company, and ensures availability.

Renault announced at the 2009 Frankfurt Motor Show that they have sponsored a network of charging stations and plug-in plug-out battery swap stations. Other vehicle manufacturers and companies are also investigating the possibility.

Replaceable batteries were used in the electric buses at the 2008 Summer Olympics.

Lifespan

Battery life should be considered when calculating the extended cost of ownership, as all batteries eventually wear out and must be replaced. The rate at which they expire depends on the type of battery technology and how they are used – many types of batteries are damaged by depleting them beyond a certain level. Lithium-ion batteries degrade faster when stored at higher temperatures.

Future

The future of battery electric vehicles depends primarily upon the cost and availability of batteries with high specific energy, power density and long life, as all other aspects such as motors, motor controllers and chargers are fairly mature and cost-competitive with internal combustion engine components. Diarmuid O'Connell, VP of Business Development at Tesla Motors, estimates that by the year 2020 30 % of the cars driving on the road will be battery electric or plug-in hybrid.

Nissan CEO Carlos Ghosn has predicted that one in 10 cars globally will run on battery power alone by 2020. Additionally a recent report claims that by 2020 electric cars and other green cars will take a third of the total of global car sales.

It is estimated that there are sufficient lithium reserves to power 4 billion electric cars.

Unit 4. METHODS OF ENERGY STORAGE

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Выполните реферативный перевод текстов.

Other methods of energy storage

Experimental supercapacitors and flywheel energy storage devices offer comparable storage capacity, faster charging and lower volatility. They have the potential to overtake batteries as the preferred rechargeable storage for EVs. The FIA included their use in its sporting regulations of energy systems for Formula One race vehicles in 2007 (for supercapacitors) and 2009 (for flywheel energy storage devices).

Solar cars

Solar cars are electric cars that derive most or all of their electricity from built in solar panels. After the 2005 World Solar Challenge established that solar race cars could exceed highway speeds, the specifications were changed to provide for vehicles that with little modification could be used for transportation.

Charging

Charging station at Rio de Janeiro, Brazil. This station is run by Petrobras and uses solar energy.

Unlike vehicles powered by fossil fuels, BEVs are most commonly and conveniently charged from the power grid overnight at home, without the inconvenience of having to go to a filling station. Charging can also be done using a street or shop charging station.

The electricity on the grid is in turn generated from a variety of sources; such as coal, hydroelectricity, nuclear and others. Power sources such as roof top photovoltaic solar cell panels, micro hydro or wind may also be used and are promoted because of concerns regarding global warming.

Level 1, 2 and 3 charging

Around 1998 the California Air Resources Board classified levels of charging power that have been codified in title 13 of the California Code of Regulations, the U.S. 1999 National Electrical Code section 625 and SAE International standards.

Level 1, 2, 3 charging

Level	Original definition	Coulomb Technologies definition	Connectors
Level 1	AC energy to the vehicle's on-board charger; from the most common U.S. grounded household receptacle, commonly referred to as a 120 volt outlet	120 V AC; 16 A (= 1.92 kW)	SAE J1772 (16.8 kW), ordinary household 120 volt outlet
Level 2	AC energy to the vehicle's on-board charger;208 – 240 volt, single phase. The maximum current specified is 32 amps (continuous) with a branch circuit breaker rated at 40 amps. Maximum continuous input power is specified as 7.68 kW (= 240V x 32A*)	208–240 V AC; 12 A…80 A (= 2.5… 19.2 kW)	SAE J1772 (16.8 kW), IEC 62196 (44 kW), Magne Charge (Obsolete), Avcon, IEC 60309 16 A (3.8 kW) IEC 62198-2 Type 2 same as VDE-AR-E 2623-2-2, also known as the Mennekes connector (43.5 kW) IEC 62198-2 Type 3 also known as Scame
Level 3	DC energy from an off-board charger; there is no minimum energy requirement but the maximum current specified is 400 amps and 240 kW continuous power supplied	very high voltages (300–600 V DC); very high currents (hundreds of Amperes)	Magne Charge (Obsolete) CHΛdeMO (62.5 kW)

Or potentially 208V x 37A, out of the strict specification but within circuit breaker and connector/cable power limits. Alternatively, this voltage would impose a lower power rating of 6.7 kW at 32A.

More recently the term «Level 3» has also been used by the SAE J1772 Standard Committee for a possible future higher-power AC fast charging standard. To distinguish from Level 3 DC fast charging, this would-be standard is written as «Level 3 AC». SAE has not yet approved standards for either AC or DC Level 3 charging.

For comparison in Europe the IEC 61851-1 charging modes are used to classify charging equipment. The provisions of IEC 62196 charging modes for conductive charging of electric vehicles include Mode 1 (max. 16A / max. 250V a.c. or 480V three-phase), Mode 2 (max. 32A / max. 250V a.c. or 480V three-phase), Mode 3 (max. 63A (70A U.S.) / max. 690V a.c. or three-phase) and Mode 4 (max. 400A / max. 600V d.c.).

Connectors

Most electric cars have used conductive coupling to supply electricity for recharging after the California Air Resources Board settled on the SAE J1772-2001 standard as the charging interface for electric vehicles in California in June 2001. In Europe the ACEA has decided to use the Type 2 connector from the range of IEC 62196 plug types for conductive charging of electric vehicles in the European Union as the Type 1 connector (SAE J1772-2009) does not provide for three-phase charging.

Another approach is inductive charging using a non-conducting "paddle" inserted into a slot in the car. Delco Electronics developed the Magne Charge inductive charging system around 1998 for the General Motors EV1 and it was also used for the Chevrolet S-10 EV and Toyota RAV4 EV vehicles.

Regenerative braking

Using regenerative braking, a feature which is present on many hybrid electric vehicles, approximately 20 % of the energy usually lost in the brakes is recovered to recharge the batteries.

Charging time

Smart ED charging from a Level 2 station

More electrical power to the car reduces charging time. Power is limited by the capacity of the grid connection and, for level 1 and 2 charging, by the power rating of the car's on-board charger. A normal household outlet is between 1.5 kW (in the US, Canada, Japan and other countries with 110 volt supply) to 3 kW (in countries with 230V supply). The main connection to a house may sustain 10, 15 or even 20 kW in addition to «normal» domestic loads – though it would be unwise to use all the apparent capability – and special wiring can be installed to use this. As examples of on-board chargers, the Nissan Leaf at launch has a 3.3 kW charger and the Tesla Roadster appears to accept 16.8 kW (240V at 70A) from the Tesla Home Connector. These power numbers are small compared to the effective power delivery rate of an average petrol pump, about 5,000 kW. Even if the electrical supply power can be increased, most batteries do not accept charge at greater than their charge rate ("1C"), because high charge rates have an adverse effect on the discharge capacities of batteries. Despite these power limitations, plugging in to even the least-powerful conventional home outlet provides more than 15 kilowatt-hours of energy overnight, sufficient to propel most electric cars more than 70 kilometres (43 mi).

Faster charging

Some types of batteries such as Lithium-titanate, LiFePO4 and even certain NiMH variants can be charged almost to their full capacity in 10–20 minutes. Fast charging requires very high currents often derived from a three-phase power supply. Careful charge management is required to prevent damage to the batteries through overcharging.

Most people do not usually require fast recharging because they have enough time, six to eight hours (depending on discharge level) during the work day or overnight at home to recharge. BEV drivers frequently prefer recharging at home, avoiding the inconvenience of visiting a public charging station.

Hobbyists, conversions and racing

Eliica prototype

The full electric Formula Student car of the Eindhoven University of Technology

Hobbyists often build their own EVs by converting existing production cars to run solely on electricity. There is a cottage industry supporting the conversion and construction of BEVs by hobbyists. Universities such as the University of California, Irvine even build their own custom electric or hybrid-electric cars from scratch.

Short-range battery electric vehicles can offer the hobbyist comfort, utility, and quickness, sacrificing only range. Short-range EVs may be built using high-performance lead–acid batteries, using about half the mass needed for a 100 to 130 km (60 to 80 mi) range. The result is a vehicle with about a 50 km (30 mi) range, which, when designed with appropriate weight distribution (40/60 front to rear), does not require power steering, offers exceptional acceleration in the lower end of its operating range, and is freeway capable and legal. But their EVs are expensive due to the higher cost for these higher-performance batteries. By including a manual transmission, short-range EVs can obtain both better performance and greater efficiency than the single-speed EVs developed by major manufacturers. Unlike the converted golf carts used for neighborhood electric vehicles, short-range EVs may be operated on typical suburban throughways (where 60–80 km/h / 35-50 mph speed limits are typical) and can keep up with traffic typical on such roads and the short "slow-lane" on-and-off segments of freeways common in suburban areas.

Faced with chronic fuel shortage on the Gaza Strip, Palestinian electrical engineer Waseem Othman al-Khozendar invented in 2008 a way to convert his car to run on 32 electric batteries. According to al-Khozendar, the batteries can be charged with US$2 worth of electricity to drive from 180 to 240 km (110 to 150 mi). After a 7-hour charge, the car should also be able to run up to a speed of 100 km/h (60 mph).

Japanese Professor Hiroshi Shimizu from Faculty of Environmental Information of the Keio University created an electric limousine: the Eliica

(Electric Lithium-Ion Car) has eight wheels with electric 55 kW hub motors (8WD) with an output of 470 kW and zero emissions, a top speed of 370 km/h (230 mph), and a maximum range of 320 km (200 mi) provided by lithium-ion batteries. However, current models cost approximately US$300,000, about one third of which is the cost of the batteries.

In 2008, several Chinese manufacturers began marketing lithium iron phosphate (LiFePO4) batteries directly to hobbyists and vehicle conversion shops. These batteries offered much better power-to-weight ratios allowing vehicle conversions to typically achieve 75 to 150 mi (120 to 240 km) per charge. Prices gradually declined to approximately US$350 per kW·h by mid 2009. As the $LiFePO_4$ cells feature life ratings of 3,000 cycles, compared to typical lead acid battery ratings of 300 cycles, the life expectancy of $LiFePO_4$ cells is around 10 years. This has led to a resurgence in the number of vehicles converted by individuals. $LiFePO_4$ cells do require more expensive battery management and charging systems than lead acid batteries.

Electric drag racing is a sport where electric vehicles start from standstill and attempt the highest possible speed over a short given distance. Organizations such as NEDRA keep track of records world wide using certified equipment.

Highway capable

As of late 2011 the number of mass production highway-capable models available in the market is limited. Most electric vehicles in the world roads are low-speed, low-range neighborhood electric vehicles, led by the Global Electric Motorcars (GEM) vehicles, which as of December 2010 had sold more than 45,000 units worldwide since 1998. The Nissan Leaf and the Mitsubishi i-MiEV, with worldwide cumulative sales of more than 16,000 units each, are the top selling highway-capable electric cars by October 2011. The i MiEV sales include units rebadged as Peugeot iOn and Citroen C-ZERO for sale in Europe.

The GEM neighborhood electric vehicle is the world's top selling electric vehicle, with 45,000 units sold through 2010

As of October 2011, Japan and the United States are the largest highway-capable electric car markets in the world, followed by several European countries. In Japan, more than 10,000 electric cars have been sold by July 2011, including more than 6,000 Nissan Leafs and more than 4,000 Mitsubishi i MiEVs. In the U.S. electric car sales are led by the Nissan Leaf with 8,066 units sold through October 2011. As of September 2011, Norway had almost 4,750 electric cars, the largest fleet of PEVs in Europe and the largest EV ownership per capita in the world. By mid 2011, the UK had a fleet of almost 2,500 electric cars, and Germany 2,307 units registered by January 1st, 2011.

In the original 15 member states of the European Union, 5,222 electric cars were sold during the first half of 2011. For year 2011 sales, the leading European countries are France and Norway, with 1,428 and 1,425 electric cars sold correspondingly through September, followed by Germany with 1,020 units sold through June, the UK with 812 units until August, and Austria with 347, Denmark with 283, and the Netherlands with 269 electric cars sold through June 2011.

There are also several pre-production models and plug-in conversions of existing internal combustion engine models undergoing field trials or are part of demonstration programs, such as the Mini E, Volvo C30 DRIVe Electric, Ford Focus Electric, and the RAV4 EV second generation.

Government subsidy

Several countries have established grants and tax credits for the purchase of new electric cars depending on battery size. The U.S. offers a federal income tax credit up to US$7,500, and several states have additional incentives. The U.K. offers a Plug-in Car Grant up to a maximum of GBJ5,000 (US$7,600) beginning in January 2011. As of April 2010, 15 European Union member states provide tax incentives for electrically chargeable vehicles, which consist of tax reductions and exemptions, as well as of bonus payments for buyers of plug-ins and hybrid vehicles.

Unit 5. HYBRID VEHICLES

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Расскажите об автомобилях-гибридах на английском языке.

Plug-in hybrid

From Wikipedia, the free encyclopedia http://en.wikipedia.org/wiki/Plug-in_hybrid

The Chevrolet Volt is the first mass production plug-in hybrid available in the United States

A plug-in hybrid electric vehicle (PHEV), plug-in hybrid vehicle (PHV), or plug-in hybrid is a hybrid vehicle which utilizes rechargeable batteries, or another energy storage device, that can be restored to full charge by connecting a plug to an external electric power source (usually a normal electric wall socket). A PHEV shares the characteristics of both a conventional hybrid electric vehicle, having an electric motor and an internal combustion engine (ICE); and of an all-electric vehicle, having a plug to connect to the electrical grid. Most PHEVs on the road today are passenger cars, but there are also PHEV versions of commercial vehicles and vans, utility trucks, buses, trains, motorcycles, scooters, and military vehicles.

The cost for electricity to power plug-in hybrids for all-electric operation has been estimated at less than one quarter of the cost of gasoline in California. Compared to conventional vehicles, PHEVs reduce air pollution locally and dependence on petroleum. PHEVs may reduce greenhouse gas emissions that contribute to global warming, compared with conventional vehicles. PHEVs also eliminate the problem of range anxiety associated to all-electric vehicles, because the combustion engine works as a backup when the batteries are depleted, giving PHEVs driving range comparable to other vehicles with gasoline tanks. Plug-in hybrids use no fossil fuel during their all-electric range and produce lower greenhouse gas emissions if their batteries are charged from renewable electricity. Other benefits include improved national energy security, fewer fill-ups at the filling station, the convenience of home recharging, opportunities to provide emergency backup power in the home, and vehicle-to-grid (V2G) applications.

Chinese battery manufacturer and automaker BYD Auto released the F3DM PHEV-62 (PHEV-100 km) to the Chinese fleet market in December 2008 and began sales to the general public in Shenzhen in March 2010. General Motors began deliveries of the Chevrolet Volt PHEV-35 (PHEV-56 km) in the

U.S. in December 2010. Deliveries of the Fisker Karma PHEV-50 (PHEV-80 km) began in the U.S. in July 2011. Other plug-in vehicles ongoing demonstration trials or slated to the market for 2011 and 2012 are the Toyota Prius Plug-in Hybrid, Ford C-Max Plug-in Hybrid, Volvo V70 Plug-in Hybrid, Suzuki Swift Plug-in, and Audi A1 e-tron.

Until 2010 most PHEVs on the road in the US are conversions of conventional hybrid electric vehicles, and the most prominent PHEVs are conversions of 2004 or later Toyota Prius, which have had plug-in charging and more batteries added and their electric-only range extended. Several countries, including the United States and several European countries, have enacted laws to facilitate the introduction of PHEVs through grants and tax credits, emissions mandates, and by financing research and development of advanced batteries and other related technologies.

Terminology

Hybrids Plus plug-in hybrid Toyota Prius conversion
with PHEV-30 (30 mile or 48 km all-electric range) battery packs

A plug-in hybrid's all-electric range is designated by PHEV-[miles] or PHEV[kilometers]km in which the number represents the distance the vehicle can travel on battery power alone. For example, a PHEV-20 can travel twenty miles (32 km) without using its combustion engine, so it may also be designated as a PHEV32km.

The Energy Independence and Security Act of 2007 defines a plug-in electric drive vehicle as a vehicle that:

- draws motive power from a battery with a capacity of at least 4 kilowatt hours;
- can be recharged from an external source of electricity for motive power; and
- is a light-, medium-, or heavy-duty motor vehicle or nonroad vehicle.

This distinguishes PHEVs from regular hybrid cars mass marketed today, which do not use any electricity from the grid.

The Institute of Electrical and Electronics Engineers (IEEE) defines PHEVs similarly, but also requires that the hybrid electric vehicle can drive at least ten miles (16 km) in all-electric mode (PHEV-10; PHEV16km), while consuming no gasoline or diesel fuel.

The California Air Resources Board uses the term "off-vehicle charge capable" (OVCC) to mean having the capability to charge a battery from an off-vehicle electric energy source that cannot be connected or coupled to the vehicle in any manner while the vehicle is being driven.

Other popular terms sometimes used for plug-in hybrids are "grid-connected hybrids", "Gas-Optional Hybrid Electric Vehicle" (GO-HEV) or simply "gas-optional hybrids". General Motors is calling its Chevrolet Volt series plug-in hybrid an "Extended-Range Electric Vehicle".

History

Lithium-ion battery pack, with cover removed, in a CalCars "PRIUS+" plug-in hybrid converted Toyota Prius converted by EnergyCS

Several plug-in hybrid converted Toyota Prius at Professorville, Palo Alto. The right side car is a Prius + converted by CalCars with a fuel economy of over 100 miles per gallon

The Lohner-Porsche Mixte Hybrid, produced as early as 1899, was the first hybrid electric car. Early hybrids could be charged from an external source before operation. However, the term "plug-in hybrid" has come to mean a hybrid vehicle that can be charged from a standard electrical wall socket. The term itself was coined by UC Davis Professor Andrew Frank, who has been called the "father of the plug-in hybrid." The July 1969 issue of Popular Science featured an article on the General Motors XP-883 plug-in hybrid. The concept commuter vehicle housed six 12-volt lead-acid batteries in the trunk area and a transverse-mounted DC electric motor turning a front-wheel drive. The car could be plugged into a standard North American 120 volt AC outlet for recharging.

In 2003, Renault began selling the Elect'road, a plug-in series hybrid version of their popular Kangoo, in Europe. It was sold alongside Renault's "Electri'city" electric-drive Kangoo battery electric van. The Elect'road had a 150 km (93 mi) range using a nickel-cadmium battery pack and a 500 cc (31 cu in), 16 kilowatt liquid-cooled gasoline "range-extender" engine. It powered two high voltage/high output/low volume alternators, each of which supplied up to 5.5 kW at 132 volts at 5000 rpm. The operating speed of the internal combustion engine—and therefore the output delivered by the generators—varied according to demand. The fuel tank had a capacity of 10 liters (2.6 U.S. gal; 2.2 imp gal) and was housed within the right rear wheel arch. The range extender function was activated by a switch on the dashboard. The on-board 3.5 kilowatt charger could charge a depleted battery pack to 95 % charge in about four hours from a 240 volts supply. Passenger compartment heating was powered by the battery pack as well as an auxiliary coolant circuit that was supplied by the range extender engine. After selling about 500 vehicles, primarily in France, Norway and the UK, at a price of about €25,000, the Elect'road was redesigned in 2007.

In September 2004, CalCars converted a 2004 Toyota Prius into a prototype of what it called the PRIUS+. With the addition of 130 kg (300 lb) of lead-acid batteries, the PRIUS+ achieved roughly double the fuel economy of a standard Prius and could make trips of up to 15 km (9 mi) using only electric power. The vehicle, which is owned by CalCars technical lead Ron Gremban, is used in daily driving, as well as a test bed for various improvements to the system.

On July 18, 2006, Toyota announced that it "plans to develop a hybrid vehicle that will run locally on batteries charged by a household electrical outlet before switching over to a gasoline engine for longer hauls." In April 2007 Toyota said it planned to migrate to lithium-ion batteries in future hybrid models, but not in the 2009 model year Prius. Lithium-ion batteries are expected to significantly improve fuel economy, and have a higher energy-to-weight ratio, but cost more to produce, and raise safety concerns due to high operating temperatures.

On November 29, 2006, GM announced plans to introduce a production plug-in hybrid version of Saturn's Greenline Vue SUV with an all-electric range of 10 mi (16 km). The model's sale is anticipated by third quarter 2009, and GM announced in January 2007 that contracts had been awarded to two companies to design and test lithium-ion batteries for the vehicle. GM has said that they plan on introducing plug-in and other hybrids "for the next several years".

In January 2007, GM unveiled the prototype of the Chevrolet Volt, which was expected to feature a plug-in capable, battery-dominant series hybrid architecture called E-Flex. Future E-Flex plug-in hybrid vehicles may use gasoline, diesel, or hydrogen fuel cell power to supplement the vehicle's battery. General Motors envisions an eventual progression of E-Flex vehicles from plug-in hybrids to pure electric vehicles, as battery technology improves.

On July 25, Japan's Ministry of Land, Infrastructure and Transport certified Toyota's plug-in hybrid for use on public roads, making it the first automobile to attain such approval. Toyota plans to conduct road tests to verify its all-electric range. The plug-in Prius was said to have an all-electric range of 13 km (8 mi). But later prototypes shown at the 2008 Paris Auto Show had an electric-only range of "just a little over six miles".

President Bush with A123Systems CEO on the White House South Lawn examining a Toyota Prius converted to plug-in hybrid with Hymotion technology

President Barack Obama behind the wheel of a Chevy Volt plug-in during his tour of the General Motors Auto Plant in Hamtramck, Michigan

Demonstration Ford Escape plug-in hybrid in New York City

On August 9, 2007, General Motors vice-president Robert Lutz announced that GM is on track for Chevrolet Volt road testing in 2008 and production to begin by 2010. Announcing an agreement with A123Systems, Lutz said GM would like to have their planned Saturn Vue plug-in on the roads by 2009. The Volt was designed with all-electric range of 40 mi (64 km). On September 5, Quantum Technologies and Fisker Coachbuild, LLC announced the launch of a joint venture in Fisker Automotive. Fisker intended to build a US$80,000 luxury PHEV-50, the Fisker Karma, initially scheduled for late 2009. In September, Aptera Motors announced their Typ-1 two-seater. They plan to produce both an electric 2e and a plug-in series hybrid 2h with a common three-wheeled, composite body design. As of 2009, over two thousand hybrid pre-orders have been accepted, and production of the hybrid configuration is expected to begin in 2010.

On October 9, 2007, Chinese manufacturer BYD Automobile Company (which is owned by China's largest mobile phone battery maker) announced that it would be introducing a production PHEV-60 sedan in China in the second half of 2008. BYD exhibited it January 2008 at the North American International Auto Show in Detroit. Based on BYD's midsize F6 sedan, it uses lithium iron phosphate ($LiFeP0_4$)-based batteries instead of lithium-ion, and can be recharged to 70 % of capacity in just 10 minutes.

On December 2007 Ford delivered the first Ford Escape Plug-in Hybrid of a fleet of 20 demonstration PHEVs to Southern California Edison. As part of this demonstration program Ford also developed the first ever flexible-fuel plug-in hybrid SUV, which was delivered in June 2008. This demonstration fleet of plug-ins has been in field testing with utility company fleets in the U.S. and Canada, and during the first two years since the program began, the fleet has logged more than 75,000 miles. On August 2009 Ford delivered the first Escape Plug-in equipped with intelligent vehicle-to-grid (V2G) communications and control system technology, and Ford plans to equip all 21 plug-in hybrid Escapes with the vehicle-to-grid communications technology. Sales of the Escape PHEV are scheduled for 2012.

In January 2008, a privately run waiting list to purchase the Chevy Volt reached 10,000 members. The list, administered by Lyle Dennis, was started one year prior. Dr. Yi Cui and colleagues at Stanford University's Department of Materials Science and Engineering have discovered that silicon nanowires give rechargeable lithium ion batteries 10 times more charge. On January 7, Bob Lutz, the Vice Chairman of General Motors said, "The electrification of the automobile is inevitable". On January 14, Toyota announced they would start sales of lithium-ion battery PHEVs by 2010, but later in the year Toyota indicated they would be offered to commercial fleets in 2009.

On March 27, the California Air Resources Board modified their regulations, requiring automobile manufacturers to produce 58,000 plug-in hybrids during 2012 through 2014. This requirement is an asked-for alternative to an earlier mandate to produce 25,000 pure zero-emissions vehicles, reducing that requirement to 5,000. On June 26, Volkswagen announced that they would be introducing production plug-ins based on the Golf compact. Volkswagen uses the term 'TwinDrive' to denote a PHEV. In September, Mazda was reported to be planning PHEVs. On September 23, Chrysler announced that they had prototyped a plug-in Jeep Wrangler and a Chrysler Town and Country mini-van, both PHEV-40s with series powertrains, and an all-electric Dodge sports car, and said that one of the three vehicles would go into production.

The Chevrolet Volt concept car
at North American International Auto Show 2007

On October 3, the U.S. enacted the Energy Improvement and Extension Act of 2008. The legislation provided tax credits for the purchase of plug-in electric vehicles of battery capacity over 4 kilowatt-hours. The federal tax credits were extended and modified by the American Clean Energy and Security Act of 2009, but now the battery capacity must be over 5 Kwh and the credit phases out after the automaker has sold at least 200,000 vehicles in the U.S.

On December 15, 2008 BYD Auto began selling its F3DM PHEV-60 in China, becoming the first production plug-in hybrid sold in the world, though initially was available only for corporate and government customers. Sales to the general public began in Shenzhen in March 2010, but because the F3DM nearly doubles the price of cars that run on conventional fuel, BYD expects subsidies from the local government to make the plug-in affordable to personal buyers.

A global demonstration program involving 600 Toyota Prius Plug-in pre-production test cars began in late 2009 in Japan and by mid 2010 field testing had began in France, Germany, the United Kingdom, Canada, and the United States.

Volvo Cars, in a joint venture with Vattenfall, a Swedish energy company, began a demonstration project with two Volvo V70 Plug-in Hybrids in Geteborg, Sweden since December 2009. As reported by the test drivers, the V70 Plug-in Hybrid demonstrators have an all-electric range between 20 kilometres (12 mi) to 30 kilometres (19 mi). The test plug-in hybrids were built with a button to allow test drivers to manually choose between electricity or diesel engine power at any time. Volvo announced series production of plug-in diesel-electric hybrids as early as 2012. Volvo claimed that its plug-in hybrid could achieve 125 miles per US gallon (1.88 L/100 km; 150 $mpg_{\text{-imp}}$), based on the European test cycle.

On October 2010 Lotus Engineering unveiled the Lotus CityCar at the 2010 Paris Motor Show, a plug-in series hybrid concept car designed for flex-fuel operation on ethanol, or methanol as well as regular gasoline. The lithium battery pack provides an all-electric range of 60 kilometres (37 mi), and the 1.2-liter flex-fuel engine kicks in to allow to extend the range to more than 500 kilometres (310 mi). GM officially launched the Chevrolet Volt PHEV-35 (PHEV-100 km) in the U.S. on November 30, 2010, and deliveries began in December 2010. Deliveries of the Fisker Karma PHEV-50 (PHEV-80 km) began in the U.S. in July 2011. Other plug-in vehicles ongoing demonstration trials or slated to the market for 2011 and 2012 are the Toyota Prius Plug-in Hybrid and Ford C-Max Plug-in Hybrid.

Unit 6. PROBLEMS OF TECHNOLOGY

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Расскажите об автомобилях различных зарубежных фирм на русском языке.

Technology

Powertrains

Toyota Prius plug-in hybrid demonstration program vehicle at the 2010 Washington Auto Show

The Toyota Prius converted plug-in hybrid is a series-parallel hybrid

PHEVs are based on the same three basic powertrain architectures as conventional electric hybrids:

Series hybrids use an internal combustion engine (ICE) to turn a generator, which in turn supplies current to an electric motor, which then rotates the vehicle’s drive wheels. A battery or supercapacitor pack, or a combination of the two, can be used to store excess charge. Examples of series hybrids include the Renault Kangoo Elect'Road, Toyota's Japan-only Coaster light-duty passenger bus, Daimler AG's hybrid Orion bus, Chevrolet Volt, Fisker Karma, Opel

Flextreme concept car, Swissauto REX VW Polo prototype and many diesel-electric locomotives. With an appropriate balance of components this type can operate over a substantial distance with its full range of power without engaging the ICE. As is the case for other architectures, series hybrids can operate without recharging as long as there is liquid fuel in the tank.

Parallel hybrids, such as Honda's Insight, Civic, and Accord hybrids, can simultaneously transmit power to their drive wheels from two distinct sources-for example, an internal combustion engine and a battery-powered electric drive. Although most parallel hybrids incorporate an electric motor between the vehicle's engine and transmission, a parallel hybrid can also use its engine to drive one of the vehicle's axles, while its electric motor drives the other axle and/or a generator used for recharging the batteries. (This type is called a road-coupled hybrid). The Audi Duo plug-in hybrid concept car is an example of this type of parallel hybrid architecture. Parallel hybrids can be programmed to use the electric motor to substitute for the ICE at lower power demands as well as to substantially increase the power available to a smaller ICE, both of which substantially increase fuel economy compared to a simple ICE vehicle.

Series-parallel hybrids have the flexibility to operate in either series or parallel mode. Hybrid powertrains currently used by Ford, Lexus, Nissan, and Toyota, which some refer to as “series-parallel with power-split,” can operate in both series and parallel mode at the same time. As of 2007, most plug-in hybrid conversions of conventional hybrids utilize this architecture.

Charging systems

Batteries are DC devices while grid power is AC. In order to charge the batteries, a DC charger must be utilized. The charger can be located in several locations:

On-board chargers are mounted inside the vehicle. Since the charger takes up space and adds weight, its power capacity is generally limited by practical considerations, avoiding carrying a more powerful charger that can only be fully utilized at certain locations. However, carrying the charger along with the vehicle ensures that power will be available anywhere a power connection can be found.

Off-board chargers can be as large as needed and mounted at fixed locations, like the garage or dedicated charging stations. Built with dedicated wiring, these charger can handle much more power and charge the batteries more quickly. However, as the output of these chargers is DC, each battery system requires the output to be changed for that car. Modern charging stations have a system for identifying the voltage of the battery pack and adjusting accordingly.

Using electric motor's inverter allows the motor windings to act as the transformer coils, and the existing high-power inverter as the AC-to-DC charger.

As these components are already required on the car, and are designed to handle any practical power capability, they can be used to form a very powerful form of on-board charger with zero additional weight or size. AC Propulsion uses this charging method, which they refer to as "reductive charging".

Modes of operation

Regardless of its architecture, a plug-in hybrid may be capable of charge-depleting and charge-sustaining modes. Combinations of these two modes are termed blended mode or mixed-mode. These vehicles can be designed to drive for an extended range in all-electric mode, either at low speeds only or at all speeds. These modes manage the vehicle's battery discharge strategy, and their use has a direct effect on the size and type of battery required:

Charge-depleting mode allows a fully charged PHEV to operate exclusively (or depending on the vehicle, almost exclusively, except during hard acceleration) on electric power until its battery state of charge is depleted to a predetermined level, at which time the vehicle's internal combustion engine or fuel cell will be engaged. This period is the vehicle's all-electric range. This is the only mode that a battery electric vehicle can operate in, hence their limited range.

The redesigned Renault Kangoo Elect'road operates in blended mode, using engine and battery power simultaneously.

Blended mode is a kind of charge-depleting mode. It is normally employed by vehicles which do not have enough electric power to sustain high speeds without the help of the internal combustion portion of the powertrain. A blended control strategy typically increases the distance from stored grid electricity compared to a charge-depleting strategy. The Renault Kangoo and some Toyota Prius conversions are examples of vehicles that use this mode of operation. The Electri'city and Elect'road versions of the Kangoo were charge-depleting battery electric vehicles: the Elect'road had a modest internal combustion engine which extended its range somewhat. Conversions of 2004 and later model Toyota Prius can only run without using the ICE at speeds of less than about 42 mph (68 km/h) due to the limits dictated by the vehicle's powertrain control software. However, at faster speeds electric power can still be used to displace gasoline, thus improving the fuel economy in blended mode and generally doubling the fuel efficiency.

Charge-sustaining mode is used by production hybrid vehicles (HEVs) today, and combines the operation of the vehicle's two power sources in such a manner that the vehicle is operating as efficiently as possible without allowing the battery state of charge to move outside a predetermined narrow band. Over the course of a trip in a HEV the state of charge may fluctuate but will have no net change. The battery in a HEV can thus be thought of as an energy accumulator rather than a fuel storage device. Once a plug-in hybrid has exhausted its all-electric range in charge-depleting mode, it can switch into charge-sustaining mode automatically.

Mixed mode describes a trip in which a combination of the above modes are utilized. For example, a PHEV-20 Prius conversion may begin a trip with 5 miles (8 km) of low speed charge-depleting, then get onto a freeway and operate in blended mode for 20 miles (32 km), using 10 miles (16 km) worth of all-electric range at twice the fuel economy. Finally the driver might exit the freeway and drive for another 5 miles (8 km) without the internal combustion engine until the full 20 miles (32 km) of all-electric range are exhausted. At this point the vehicle can revert back to a charge sustaining-mode for another 10 miles (16 km) until the final destination is reached. Such a trip would be considered a mixed mode, as multiple modes are employed in one trip. This contrasts with a charge-depleting trip which would be driven within the limits of a PHEV's all-electric range. Conversely, the portion of a trip which extends beyond the all-electric range of a PHEV would be driven primarily in charge-sustaining mode, as used by a conventional hybrid.

Electric power storage

PHEVs typically require deeper battery charging and discharging cycles than conventional hybrids. Because the number of full cycles influences battery life, this may be less than in traditional HEVs which do not deplete their batteries as fully. However, some authors argue that PHEVs will soon become standard in the automobile industry. Design issues and trade-offs against battery life, capacity, heat dissipation, weight, costs, and safety need to be solved. Advanced battery technology is under development, promising greater energy densities by both mass and volume, and battery life expectancy is expected to increase.

The cathodes of some early 2007 lithium-ion batteries are made from lithium-cobalt metal oxide. This material is expensive, and cells made with it can release oxygen if overcharged. If the cobalt is replaced with iron phosphates, the cells will not burn or release oxygen under any charge. The price premium for early 2007 conventional hybrids is about US$5000, some US$3000 of which is for their NiMH battery packs. At early 2007 gasoline and electricity prices, that would mean a break-even point after six to ten years of operation. The conventional hybrid premium could fall to US$2000 in five years, with US$1200 or more of that being cost of lithium-ion batteries, providing for a three-year payback. The payback period may be longer for plug-in hybrids, because of their larger, more expensive batteries.

Nickel-metal hydride and lithium-ion batteries can be recycled; Toyota, for example, has a recycling program in place under which dealers are paid a US$200 credit for each battery returned. However, plug-in hybrids typically use larger battery packs than comparable conventional hybrids, and thus require more resources. Pacific Gas and Electric Company (PG&E) has suggested that utilities could purchase used batteries for backup and load leveling purposes. They state that while these used batteries may be no longer usable in vehicles, their residual capacity still has significant value. More recently, General Motors (GM) has said it has been "approached by utilities interested in using recycled Volt batteries as a power storage system, a secondary market that could bring down the cost of the Volt and other plug-in vehicles for consumers."

Lithium iron phosphate ($LiMPO_4$) is a class of cathode materials used in lithium iron phosphate batteries that is getting attention from the auto industry. Valence Technologies produce a lithium iron manganese phosphate ($LiFeMgPO_4$) battery with LG Chem selling lithium iron phospate ($LiFePO_4$) batteries for the Chevy Volt and A123 produces a lithium nano-phosphate battery. The most important merit of this battery type is safety and high-power. Lithium iron phosphate batteries are one of three major types in LFP family, the other two being nano-phosphate and nano-cocrystalline-olivine.

In France, Electricity de France (EDF) and Toyota are installing charging stations for PHEVs on roads, streets and parking lots. EDF is also partnering with Elektromotive, Ltd. to install 250 new charging points over six months from October 2007 in London and elsewhere in the UK. Recharging points also can be installed for specific uses, as in taxicab stands. Project Better Place began in October 2007 and is working with Renault on development of exchangeable batteries (battery swapping).

Ultracapacitors (or "supercapacitors") are used in some plug-in hybrids, such as AFS Trinity's concept prototype, to store rapidly available energy with their high power density, in order to keep batteries within safe resistive heating limits and extend battery life. The CSIRO's UltraBattery combines a super-capacitor and a lead acid battery in a single unit, creating a hybrid car battery that lasts longer, costs less and is more powerful than current technologies used in plug-in hybrid electric vehicles (PHEVs).

The optimum battery size varies depending on whether the aim is to reduce oil consumption, running costs, or emissions, but a recent study concluded that "The best choice of PHEV battery capacity depends critically on the distance that the vehicle will be driven between charges. Our results suggest that for urban driving conditions and frequent charges every 10 miles or less, a low-capacity PHEV sized with an AER (all electric range) of about 7 miles would be a robust choice for minimizing gasoline consumption, cost, and greenhouse gas emissions. For less frequent charging, every 20–100 miles, PHEVs release fewer GHGs, but HEVs are more cost effective".

Unit 7. CONVERSIONS OF PRODUCTION VEHICLES

1. Прочитайте текст и ознакомьтесь с его общим содержанием.

2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.

3. Сделайте сообщение на английском языке об экономии топлива и безопасности движения автомобилей, используя информацию текста.

Conversion of fossil-fuel vehicles

Retrofit electrification requires only one-fifth the energy required to build a new vehicle. This is called ACEV-to-PHEV conversion. There are several companies that are converting fossil fuel non-hybrid vehicles (also called all-combustion engine vehicles) to plug-in hybrids:

Colorado is going to offer $6,000 credit for PHEV conversions (in addition to a federal 10 % credit up to $4,000 for qualifying vehicles).

Conversions of production hybrids

15 lead-acid batteries, PFC charger, and regulators installed into WhiteBird, a PHEV-10 conversion of a Toyota Prius

Aftermarket conversion of an existing production hybrid (a charge-maintaining hybrid) to a plug-in hybrid (called CHEV-to-PHEV conversion) typically involves increasing the capacity of the vehicle's battery pack and adding an on-board AC-to-DC charger. Ideally, the vehicle's powertrain software would be reprogrammed to make full use of the battery pack's additional energy storage capacity and power output.

Many early plug-in hybrid electric vehicle conversions have been based on the 2004 or later model Toyota Prius. Some of the systems have involved replacement of the vehicle's original NiMH battery pack and its electronic control unit. Others, such as A123 Hymotion, the CalCars Prius+, and the PiPrius, piggyback an additional battery back onto the original battery pack, this is also referred to as Battery Range Extender Modules (BREMs). Within the electric vehicle conversion community this has been referred to as a "hybrid battery pack configuration". Early lead-acid battery conversions by CalCars demonstrated 10 miles (15 km) of EV-only and 20 miles (30 km) of double mileage blended mode range.

EDrive Systems use Valence Technology Li-ion batteries and have a claimed 40 to 50 miles (64 to 80 km) of electric range. Other companies offering plug-in conversions or kits for the Toyota Prius (some of them also for Ford Escape Hybrid) include Hymotion, Hybrids Plus Manzanita Micro and OEMtek BREEZ (PHEV-30). AFS Trinity's XH-150 claims that it has created a functioning plug-in hybrid with a 40 miles (64 km) all-electric range and that it has solved the overheating problem that rapid acceleration can cause in PHEVs and extend battery life.

The EAA-PHEV project was conceived by CalCars and the Electric Auto Association in October 2005 to accelerate efforts to document existing HEVs and their potential for conversion into PHEVs. It includes a "conversion interest" page. The Electric Auto Association-PHEV "Do-It-Yourself" Open Source community's primary focus is to provide conversion instructions to help guide experienced converters through the process, and to provide a common design that could demonstrate multiple battery technologies. Many members of organizations such as CalCars and the EAA as well as companies like Hybrids Plus, Hybrid Interfaces of Canada, and Manzanita Micro participate in the development of the project.

Plug-In Supply, Inc. of Petaluma, California offers components and assemblies to build the Prius+, the plug-in conversion invented by CalCars. Their lead-acid battery box assembly forms a complete install package, providing access to the spare tire and containing twenty 12 volt lead-acid batteries and all high voltage components and control electronics. The "PbA Battery Box Assembly" is also available without batteries. It provides about 10 miles (16 km) of EV mode range. Conversion time was reduced by plug-in supply to one day.

Oemtek offers a Valence powered lithium iron phosphate conversion that should provide 50 miles (80 km) of all-electric range. The Motor Industry Research Association has announced a retrofit hybrid conversion kit that provides removable battery packs that plug into a wall outlet for charging.

Poulsen Hybrid is developing a conversion kit that will add through-the-road plug-in hybrid capability to conventional vehicles by externally mounting electric motors onto two of the wheels.

Enginer Inc. of Troy, Michigan offers universal plug-in conversion kits with components and assemblies to build two stage hybrid battery system. Their lithium-ion battery box assembly forms a complete install package, providing access to the spare tire and containing 16/32 lithium phosphate battery cells, a DC/DC converter, a BMS and a charger. It provides about 10 miles (16 km) of EV mode range for under $2000 (2 kW·h model). Longer range 4 kW·h model is also available for $1000 more. Conversion time was reduced to two/three hours.

Advantages

Energy resilience and petroleum displacement

Each kilowatt hour of battery capacity in use will displace up to 50 U.S. gallons (190 l; 42 imp gal) of petroleum fuels per year (gasoline or diesel fuels). Also, electricity is multi-sourced and, as a result, it gives the greatest degree of energy resilience.

Fuel efficiency

Typical fuel economy label
for series plug-in hybrid
or extended range electric vehicle

Typical fuel economy label
for blended or series-parallel plug-in
hybrid

The actual fuel economy for PHEVs depends on their powertrain operating modes, their all-electric range, and the amount of driving between charges. If no gasoline is used the miles per gallon gasoline equivalent (MPG-e) depends only on the efficiency of the electric system. The only mass production PHEV available in the market, the Chevrolet Volt, with an EPA rated all-electric range of 35 miles (56 km), and an additional gasoline-only extended range of 344 miles (554 km) has an EPA combined city/highway fuel economy of 93 MPG-e in all-electric mode, and 37 mpg_{-US} (6.4 L/100 km; 44 mpg_{-imp}) in gasoline-only mode, for an overall combined gas-electric fuel economy rating of 60 mpg_{-US} (3.9 L/100 km; 72 mpg_{-imp}) equivalent (MPG-e). The EPA also included in the Volt's fuel economy label a table showing fuel economy and electricity consumed for five different scenarios: 30, 45, 60 and 75 miles (121 km) driven between a full charge, and a never charge scenario. According to this table the fuel economy goes up to 168 mpg_{-US} (1.40 L/100 km; 202 mpg_{-imp}) equivalent (MPG-e) with 45 miles (72 km) driven between full charges.

For the more comprehensive fuel economy and environment label that will be mandatory in the U.S. beginning in model year 2013, the National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) issued two separate fuel economy labels for plug-in hybrids because of their design complexity, as PHEVS can operate in two or three operating modes: all-electric, blended, and gasoline-only. One label is for series hybrid or extended range electric vehicle (like the Chevy Volt), with all-electric and gasoline-only modes; and a second label for blended mode or series-parallel hybrid, that includes a combination of both gasoline and plug-in electric operation; and gasoline only, like a conventional hybrid vehicle.

A further advantage of PHEVs is that they have potential to be even more efficient than conventional hybrids because a more limited use of the PHEV's internal combustion engine may allow the engine to be used at closer to its maximum efficiency. While a Prius is likely to convert fuel to motive energy on average at about 30 % efficiency (well below the engine's 38 % peak efficiency) the engine of a PHEV-70 would be likely to operate far more often near its peak efficiency because the batteries can serve the modest power needs at times when the combustion engine would be forced to run well below its peak efficiency. The actual efficiency achieved depends on losses from electricity generation, inversion, battery charging/discharging, the motor controller and motor itself, the way a vehicle is used (its duty cycle), and the opportunities to recharge by connecting to the electrical grid.

The Society of Automotive Engineers (SAE) developed their recommended practice in 1999 for testing and reporting the fuel economy of hybrid vehicles and included language to address PHEVs. An SAE committee is currently working to review procedures for testing and reporting the fuel economy of PHEVs. The Toronto Atmospheric Fund tested ten retrofitted plug-in hybrid vehicles that achieved an average of 5.8 litres per 100 kilometre or 40.6 miles per gallon over six months in 2008, which was considered below the technology's potential.

In "real world" testing using normal drivers, some Prius PHEV conversions may not achieve much better fuel economy than HEVs. For example, a plug-in Prius fleet, each with a 30 miles (48 km) all-electric range, averaged only 51 mpg_{-US} (4.6 L/100 km; 61 mpg_{-imp}) in a 17,000-mile (27,000 km) test in

Seattle, and similar results with the same kind of conversion battery models at Google.org. Moreover, the additional battery pack costs $10,000–11,000.

Operating costs

A 2006 research estimate in California found that the operating costs of plug-ins charged at night was equivalent to 75ў US per US gallon of gasoline. The cost of electricity for a Prius PHEV is about US$0.03 per mile (US$0.019/km), based on 0.26 kilowatt-hours per mile (0.16 kW·h/km; 0.58 MJ/km) and a cost of electricity of US$0.10 per kilowatt hour. During 2008, government and industry researchers tried to determine the optimum all-electric range.

Former President George W. Bush is shown the PHEV Mercedes-Benz Sprinter van in the US Postal Service

Range anxiety elimination

One of the main barriers for the general adoption of all-electric cars is the range anxiety factor, the driver's fear of being stranded by a depleted battery before reaching the final destination. Plug-in hybrids, as opposed to pure plug-ins, eliminate the range anxiety concerns because the gasoline engine serves as a back-up to recharge the battery, to provide electric power to the electric motor, or to provide propulsion directly. In the case of the Volt, access to a regular fuel station guarantees similar driving ranges as conventional gasoline-powered automobile.

One of the advantages of the PEV design is that the generator can be completely decoupled from the traction. Unlike a conventional engine, which operates over a wide variety of power settings and operational conditions, the range extender can be operated under optimum conditions at all times. High-efficiency power sources that are not suitable for normal automotive use may be perfectly suitable for PEV use. These include advanced close-cycle steam engines, stirling engines, Wankel engines, and microturbines due primarily to their light weight and small size.

Smog

The Ontario Medical Association announced that smog is responsible for an estimated 9,500 premature deaths in its province every year. Plug-in hybrids in emission-free electric mode may contribute to the reduction of smog.

Vehicle-to-grid electricity

PHEVs and fully electric cars may allow for more efficient use of existing electric production capacity, much of which sits idle as operating reserve most of the time. This assumes that vehicles are charged primarily during off peak periods (i.e., at night), or equipped with technology to shut off charging during periods of peak demand. Another advantage of a plug-in vehicle is their potential ability to load balance or help the grid during peak loads. This is accomplished with vehicle-to-grid technology. By using excess battery capacity to send power back into the grid and then recharge during off peak times using cheaper power, such vehicles are actually advantageous to utilities as well as their owners. Even if such vehicles just led to an increase in the use of night time electricity they would even out electricity demand which is typically higher in the day time, and provide a greater return on capital for electricity infrastructure.

In the UK, VTG would need to comply with generation connection standard "G59/2", which means that it would need an earth rod at the premises, and would be unable to export more than 17 kW without the network firm's permission (which feeding onto one phase, i.e. for a normal house, would not be given – to maintain a balance of load across the three phases).

In October 2005, five Toyota engineers and one Asian AW engineer published an IEEE technical paper detailing a Toyota-approved project to add vehicle-to-grid capability to a Toyota Prius. Although the technical paper described "a method for generating voltage between respective lines of neutral points in the generator and motor of the THS-II (Toyota Hybrid System) to add a function for generating electricity", it did not state whether or not the experimental vehicle could be charged through the circuit, as well. However, the vehicle was featured in a Toyota Dream House, and a brochure for the exhibit stated that "the house can supply electricity to the battery packs of the vehicles via the stand in the middle of the garage", indicating that the vehicle may have been a plug-in hybrid.

U.S. President Barack Obama examines hybrid vehicles
in the Edison Electric Vehicle Technical Center in Pomona, California

In November 2005, more than 50 leaders from public power utility companies across the United States met at the Los Angeles Department of Water and Power headquarters to discuss plug-in hybrid and vehicle-to-grid technology. The event, which was sponsored by the American Public Power Association, also provided an opportunity for association members to plan strategies that public power utility companies could use to promote plug-in hybrid technology. Greg Hanssen and Peter Nortman of EnergyCS and EDrive attended the two-day session, and during a break in the proceedings, made an impromptu display in the LADWP parking lot of their converted Prius plug-in hybrid.

In September 2006, the California Air Resources Board held a Zero Emission Vehicle symposium that included several presentations on V2G technology. In April 2007, Pacific Gas and Electric Company showcased a PHEV at the Silicon Valley Leadership Alternative Energy Solutions Summit with vehicle-to-grid capability, and demonstrated that it could be used as a source of emergency home power in the event of an electrical power failure. Regulations intended to protect electricians against power other than from grid sources would need to be changed, or regulations requiring consumers to disconnect from the grid when connected to non-grid sources will be required before such backup power solutions would be feasible.

Federal Energy Regulatory Commissioner Jon Wellinghoff coined the term "Cash-Back Hybrids" to describe payments to car owners for putting their batteries on the power grid. Batteries could also be offered in low-cost leasing or renting or by donation (including maintenance) to the car owners by the public utilities, in a vehicle-to-grid agreement.

Unit 8. ADVANTAGES AND DISADVANTAGES OF BATTERIES

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Расскажите о преимуществах и недостатках использования батарей в автомобилях на английском языке.

Disadvantages

Cost of batteries

Disadvantages of plug-in hybrids include the additional cost, weight, and size of a larger battery pack. According to a 2010 study by the National

Research Council, the cost of a lithium-ion battery pack is about USD 1,700/kW·h of usable energy, and considering that a PHEV-10 requires about 2.0 kW·h and a PHEV-40 about 8 kW·h, the manufacturer cost of the battery pack for a PHEV-10 is around USD 3,000 and it goes up to USD 14,000 for a PHEV-40. According to the same study, even though costs are expected to decline by 35 % by 2020, market penetration is expected to be slow and therefore PHEVs are not expected to significantly impact oil consumption or carbon emissions before 2030, unless a fundamental breakthrough in battery technologies occur.

Т а б л . 4

Cost comparison between a PHEV-10 and a PHEV-40 (prices for 2010)

Plug-in type by EV range	Similar production model	Type of drivetrain	Manufacturer additional costcompared to conven-tional non-hybrid mid-size	Cost of battery pack	Cost of electric system upgrade at home	Expected gasoline savings compared to a HEV	Annual gasoline savings compared to a HEV(2)
PHEV-10	Prius Plug-in	Parallel	USD 6,300	USD 3,300	More than USD 1,000	20 %	70 gallons
PHEV-40	Chevy Volt	Series	USD 18,100	USD 14,000	More than USD 1,000	55 %	200 gallons

N o t e s : (1) Considers the HEV technology used in the Toyota Prius with a larger battery pack. The Prius Plug-in estimated all-electric range is 14.5 mi (23 km)
(2) Assuming 15,000 miles per year.

According to the 2010 NCR study, despite the fact that a mile driven on electricity is cheaper than one driven on gasoline, lifetime fuel savings are not enough to offset plug-ins high upfront costs, and it will take decades before the break even point is achieved. Furthermore, hundreds of billions of dollars in government subsidies and incentives are likely to be required to achieve a rapid plug-in market penetration in the U.S.

A study published in 2011 by the Belfer Center, Harvard University, found that the gasoline costs savings of plug-in electric cars over the vehicles' lifetimes do not offset their higher purchase prices. This finding was estimated comparing their lifetime net present value at 2010 purchase and operating costs for the U.S. market, and assuming no government subsidies. According to the study estimates, a PHEV-40 is US$5,377 more expensive than a conventional internal combustion engine, while a battery electric vehicle (BEV) is US$4,819 more expensive. The study also examined how this balance will change over the next 10 to 20 years, assuming that battery costs will decrease while gasoline prices increase. Under the future scenarios considered, the study found that BEVs will be significantly less expensive than conventional cars (US$1,155 to US$7,181 cheaper), while PHEVs, will be more expensive than BEVs in almost all comparison scenarios, and only less expensive than conventional cars in an scenario with very low battery costs and high gasoline prices. The reason for the different savings among PEVs is due to the fact that BEVs are simpler to build and do not use liquid fuel, while PHEVs have more complicated powertrains and still have gasoline-powered engines.

Lithium iron phosphate batteries from Valence Technologies were used in the first plug-in hybrids from CalCars are providing a conversion for the Toyota Prius priced at $12,000. Hymotion also offers a conversion for $10,000 US but their conversion is only 5 kW where Oemtek's is 9 kW.

Recharging outside home garages

RechargeIT converted plug-in hybrids at Google's Mountain View campus. The garage has recharging facilities powered by solar panels

On-street electric charging unit located at the Hillsboro Civic Center in Hillsboro, Oregon

Three plug-in converted Toyota Prius recharging at San Francisco City Hall public charging station

Many authors have assumed that plug-in recharging will take place overnight at home. However, residents of cities, apartments, dormitories, and townhouses do not have garages or driveways with available power outlets, and they might be less likely to buy plug-ins unless recharging infrastructure is developed. Electrical outlets or charging stations near their places of residence, or in commercial or public parking lots or streets or workplaces are required for these potential users to gain the full advantage of PHEVs. Even house dwellers might need to charge at the office or to take advantage of opportunity charging at shopping centers. However, this infrastructure is not in place today and it will require investments by both the private and public sectors.

Several cities in California and Oregon, and particularly San Francisco and other cities in the San Francisco Bay Area and Silicon Valley, as well as some local private firms such as Google and Adobe Systems, already have deployed charging stations and have expansion plans to attend both plug-ins and all-electric cars. In Google's case, its Mountain View campus has 100 available charging stations for its share-use fleet of converted plug-ins available to its employees. Solar panels are used to generate the electricity, and this pilot program is being monitored on a daily basis and performance results are published in RechargeIT website.

Emissions shifted to electric plants in some countries

Increased pollution is expected to occur in some areas with the adoption of PHEVs, but most areas will experience a decrease. A study by the ACEEE predicts that widespread PHEV use in heavily coal-dependent areas would result in an increase in local net sulfur dioxide and mercury emissions, given emissions levels from most coal plants currently supplying power to the grid. Although clean coal technologies could create power plants which supply grid power from coal without emitting significant amounts of such pollutants, the higher cost of the application of these technologies may increase the price of coal-generated electricity. The net effect on pollution is dependent on the fuel source of the electrical grid (fossil or renewable, for example) and the pollution profile of the power plants themselves. Identifying, regulating and upgrading single point pollution source such as a power plant—or replacing a plant altogether—may also be more practical. From a human health perspective, shifting pollution away from large urban areas may be considered a significant advantage.

According to a 2009 study by The National Academy of Science, "Electric vehicles and grid-dependent (plug-in) hybrid vehicles showed somewhat higher nonclimate damages than many other technologies." Efficiency of plug-in hybrids is also impacted by the overall efficiency of electric power transmission. Transmission and distribution losses in the USA were estimated at 7.2 % in

1995 and 6.5 % in 2007. By life cycle analysis of air pollution emissions, natural gas vehicles are currently the lowest emitter.

Tiered rate structure for electric bills

Electric utility companies generally do not utilize flat rate pricing. For example, Pacific Gas and Electric (PG&E) normally charges $0.10 per kilowatt hour (kW·h) for the base tier, but additional tiers are priced as high as $0.30 per kW·h to customers without electric vehicles. Some utilities offer electric vehicle users a rate tariff that provides discounts for off-peak usage, such as overnight recharging. PG&E offers a special, discounted rate for plug-in and other electric vehicle customers, the "Experimental Time-of-Use Low Emission Vehicle rate." That tariff gives people much cheaper rates if they charge at night, especially during the summer months.

The additional electrical utilization required to recharge the plug-in vehicles could push many households in areas that do not have off-peak tariffs into the higher priced tier and negate financial benefits. Without an off-peak charging tariff, one study of a certain PHEV-20 model having an all-electric range of 20 miles, gasoline-fueled efficiency of 52.7 mi/gal U.S., and all-electric efficiency of 4 mi/kW·h, found that household electricity customers who consumed 131 %–200 % of baseline electricity at $0.220/(kW·h) would see benefits if gasoline was priced above US$2.89/US gal; those that consumed 201 %–300 % of baseline electricity at $0.303/(kW·h) would only see benefits if gas was priced above $3.98; and households consuming over 300 % of baseline electricity at $0.346/(kW·h) would only see benefits if gasoline was priced above $4.55 (USD/gal). Off-peak tariff rates can lower the break-even point. The PG&E tariff would change those break-even gasoline prices to USD $1.96, $3.17 and $3.80 per gallon, respectively, for the given PHEV and usage pattern in question.

Customers under such tariffs could see significant savings by being careful about when the vehicle was charged, for example, by using a timer to restrict charging to off-peak hours. Thus, an accurate comparison of the benefit requires each household to evaluate its current electrical usage tier and tariffs weighed against the cost of gasoline and the actual observed operational cost of electric mode vehicle operation.

The Salar de Uyuni in Bolivia is one of the largest known lithium reserves in the world

Unit 9. ELECTRIC POWER CARS

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Побеседуйте в форме диалога о производственных и коммерческих проблемах использования современных автомобилей на английском языке.

Lithium availability and supply security

Current technology for plug-ins is based on the lithium-ion battery and an electric motor, and the demand for lithium, heavy metals and other rare elements (such as neodymium, boron and cobalt) required for the batteries and powertrain is expected to grow significantly due to the incoming market entrance of plug-ins and electric vehicles in the mid and long term. Some of the largest world reserves of lithium and other rare metals are located in countries with strong resource nationalism, unstable governments or hostile to U.S. interests, raising concerns about the risk of replacing dependence on foreign oil with a new dependence on hostile countries to supply strategic materials.

Currently, the main deposits of lithium are found in China and South America throughout the Andes mountain chain. In 2008 Chile was the leading lithium metal producer, followed by Australia, China, and Argentina. In the United States lithium is recovered from brine pools in Nevada. Nearly half the world's known reserves are located in Bolivia, and according to the US Geological Survey, Bolivia's Salar de Uyuni desert has 5.4 million tons of lithium, which can be used to make lithium batteries for hybrid and electric vehicles. Other important reserves are located in Chile, China, and Brazil. Regarding rare earth elements, most reserves are located in China, which controls the world market for these elements.

Greenhouse gas emissions

The effect of PHEVs on greenhouse emissions is complex. Plug-in hybrid vehicles operating on all-electric mode do not emit harmful tailpipe pollutants from the onboard source of power. The clean air benefit is usually local because depending on the source of the electricity used to recharge the batteries, air pollutant emissions are shifted to the location of the generation plants. In the same way, PHEVs do not emit greenhouse gases from the onboard source of power, but from the point of view of a well-to-wheel assessment, the extent of the benefit also depends on the fuel and technology used for electricity generation. From the perspective of a full life cycle analysis, the electricity used to recharge the batteries must be generated from renewable or clean sources such as wind, solar, hydroelectric, or nuclear power for PEVs to have almost none or zero well-to-wheel emissions. On the other hand, when PEVs are recharged from coal-fired plants, they usually produce slightly more greenhouse gas emissions than internal combustion engine vehicles. In the case of plug-in hybrid electric vehicle when operating in hybrid mode with assistance of the internal combustion engine, tailpipe and greenhouse emissions are lower in comparison to conventional cars because of their higher fuel economy.

There has been much debate over the potential GHG emissions reductions that can be achieved with PHEV. A study by the Electric Power Research Institute reports that a 338 TW·h or 5.8 % increase in power generation needed as a result of PHEV. In the same report the EPRI also states that CO_2 emissions could increase by 430 million metric tons. The article concludes:

"In summary, the addition of PHEVs as a significant transportation option adds approximately 6 % to the total national electricity demand in 2030 compared to the base case with no PHEVs. Due to the charging profile that results in most of this additional demand occurring during off-peak hours (late night/early morning) there is an increase in the need for baseload generation. The addition of coal-fired generation to meet this need for more baseload generation does not result in any significant differences in annual emissions of SO_2, NO_x and Hg because of the caps on those pollutants. Therefore, any reductions in emissions of SO_2, NO_x or Hg from non-electric generating sources would result in a net national decline in these emissions. However, it does result in an appreciable increase in CO_2 and PM emissions as this analysis has not assumed any limits on CO_2 or PM emissions."

A study by the American Council for an Energy Efficient Economy (ACEEE) predicts that, on average, a typical American driver is expected to achieve about a 15 % reduction in net CO_2 emissions compared to the driver of a regular hybrid, based on the 2005 distribution of power sources feeding the US electrical grid. The ACEEE study also predicts that in areas where more than 80 % of grid-power comes from coal-burning power plants, local net CO_2 emissions will increase, while for PHEVs recharged in areas where the grid is fed by power sources with lower CO_2 emissions than the current average, net CO_2 emissions associated with PHEVs will decrease correspondingly.

A 2007 joint study by the Electric Power Research Institute (EPRI) and the Natural Resources Defense Council (NRDC) similarly found that the introduction of PHEVs into America’s consumer vehicle fleet could achieve significant greenhouse gas emission reductions. The EPRI-NRDC report estimates that, between 2010 and 2050, a shift toward PHEV use could reduce GHG emissions by 3.4 to 10.4 billion metric tons. The magnitude of these reductions would ultimately depend on the level of PHEV market penetration and the carbon intensity of the US electricity sector. In general, PHEVs can be viewed as an element in the "Pacala and Socolow wedges" approach which shows a way to stabilize CO_2 emissions using a portfolio of existing techniques, including efficient vehicles. A 2008 study at Duke University suggests that for PHEV's to reduce greenhouse gas emissions more than hybrids a carbon pricing signal that encourages the development of low carbon power is needed. RAND also in 2008 studied the questions of a carbon tax, carbon cap and trade systems, increasing gasoline tax, and providing renewable energy subsidies under various economic conditions and vehicle type availabilities. RAND found that subsidies were able to provide a smoother transition to new energy sources, especially in the face of energy source price volatility, because subsidies can be structured according to relative costs between renewables and fossil fuel, while taxes and carbon trading schemes alone do not take relative prices of energy into account. The Minnesota Pollution Control Agency found that if Minnesota's fleet of vehicles making lengthy trips were replaced by plug-in hybrids, CO_2 emissions per vehicle would likely decrease. However, unless more than 40 % of the electricity used to charge the vehicles were to come from non-polluting sources, replacing the vehicles with non plug-in hybrids would engender a larger decrease in CO_2 emissions. Plug-in hybrids use less fuel in all cases, and produce much less carbon dioxide in short commuter trips, which is how most vehicles are used. The difference is such that overall carbon emissions would decrease if all internal combustion vehicles were converted to plug-ins.

In 2009 researchers at Argonne National Laboratory adapted their GREET model to conduct a full well-to-wheels (WTW) analysis of energy use and greenhouse gas (GHG) emissions of plug-in hybrid electric vehicles for several scenarios, considering different on-board fuels and different sources of electricity generation for recharging the vehicle batteries. Three US regions were selected for the analysis, California, New York, and Illinois, as these regions include major metropolitan areas with significant variations in their energy generation mixes. The full cycle analysis results were also reported for the US generation mix and renewable electricity to examine cases of average and clean mixes, respectively. This 2009 study showed a wide spread of petroleum use and GHG emissions among the different fuel production technologies and grid generation mixes. The following table summarizes the main results:

Табл. 5

PHEV well-to-wheels Petroleum energy use and greenhouse gas emissions for an all-electric range between 10 and 40 miles (16 and 64 km) with different on-board fuels. (as a % relative to an internal combustion engine vehicle that uses fossil fuel gasoline)

Analysis	Reformulated gasoline and Ultra-low sulfur diesel	E85 fuel from corn and switchgrass	Fuel cell hydrogen
Petroleum energy use reduction	40–60 %	70–90 %	more than 90 %
GHG emissions reduction	30–60 %	40–80 %	10–100 %

Source: Center for Transportation Research, Argonne National Laboratory (2009). See Table 1. Notes: (1) Simulations for year 2020 with PHEV model year 2015. (2) No direct or indirect land use changes included in the WTW analysis for bio-mass fuel feedstocks.

The Argonne study found that PHEVs offered reductions in petroleum energy use as compared with regular hybrid electric vehicles. More petroleum energy savings and also more GHG emissions reductions were realized as the all-electric range increased, except when electricity used to recharged was dominated by coal or oil-fired power generation. As expected, electricity from renewable sources realized the largest reductions in petroleum energy use and GHG emissions for all PHEVs as the all-electric range increased. The study also concluded that plug-in vehicles that employ biomass-based fuels (biomass-E85 and -hydrogen) may not realize GHG emissions benefits over regular hybrids if power generation is dominated by fossil sources.

A 2008 study by researchers at Oak Ridge National Laboratory analyzed oil use and greenhouse gas (GHG) emissions of plug-in hybrids relative to hybrid electric vehicles under several scenarios for years 2020 and 2030. Each type of vehicle was assumed to run 20 miles (32 km) per day and the HEV was assumed to have a fuel economy of 40 miles per US gallon (5.9 L/100 km; 48 $mpg_{\text{-imp}}$). The study considered the mix of power sources for 13 U.S. regions, generally a combination of coal, natural gas and nuclear energy, and to a lesser extend renewable energy. A 2010 study conducted at Argonne National Laboratory reached similar findings, concluding that PHEVs will reduce oil consumption but could produce very different greenhouse gas emissions for each region depending on the energy mix used to generate the electricity to recharge the plug-in hybrids. The following table summarizes the main results of the Oak Ridge National Laboratory study for the 2020 scenario:

Т а б л . 6

Comparison of carbon emissions and oil consumption by plug-in hybrids relative to hybrid electric vehicles (HEVs) by U.S. regional power generation sources on 2020

Region	Main electricity sources	Share total generation 2020	Carbon emissions relative to HEVs		Oil consumption relative to HEVs		States included in the region[2]
			Plug-in hybrid	All-electric mode	Plug-in hybrid	All-electric mode	
1	2	3	4	5	6	7	8
Northwest	Natural gasNuclear	84.3 % 15.7 %	–20.0 %	–37.2 %	–47.0 %	–99.6 %	Includes ID, MT, NV, OR, UT, SD, WA and WY.
California	Natural gas Renewable	99.0 % 1.0 %	–15.3 %	–26.5 %	–47.0 %	–99.6 %	
Texas	Natural gas	100 %	–15.0 %	–25.7 %	–47.0 %	–99.6 %	
Florida	Natural gas Oil	96.1 % 2.4 %	–14.8 %	–25.3 %	–45.6 %	–96.4 %	

Окончание табл. 6

1	2	3	4	5	6	7	8
New England	Natural gas Coal	70.3 % 15.5 %	–11.4 %	–17.4 %	–44.3 %	–93.5 %	Includes CT, MA, ME, NH, RI and VT.
Lower Midwest	Natural gas Coal	88.6 % 11.4 %	–11.0 %	–16.4 %	–46.9 %	–99.4 %	Includes AR, KS, LA, NM, OK and TX.
Southwest	Natural gas Coal	83.6 % 16.1 %	–9.40 %	–12.8 %	–46.9 %	–99.4 %	Includes AZ, CO, NM, NV and TX.
Mid–Atlantic	Natural gas Coal	60.6 % 37.0 %	–1.2 %	+6.1	–45.4 %	–95.9 %	Includes DC, DE, MD, ME, NJ and PA.
Upper Midwest	Natural gas Coal	47.6 % 46.0 %	–0.8 %	+7.2 %	–46.7 %	–99.0 %	Includes IA, MN, MT, ND, NE, SD and WI.
Southeast	Coal Natural gas	51.9 % 44.9 %	+2.4 %	+14.4 %	–46.7 %	–98.9 %	Includes AL, GA, LA, MS, NC, SC and TN.
New York	Oil Natural gas	67.2 % 29.4 %	+4.3 %	+19.0 %	–8.6 %	–10.9 %	
Greater Ohio	Coal Natural gas	65.7 % 32.8 %	+7.8 %	+27.0 %	–46.6 %	–98.7 %	Includes IN, KY, MI, OH, VA and WV.
Greater Illinois	Coal Natural gas	75.4 % 24.6 %	+11.7 %	+36.0 %	–46.5 %	–98.6 %	Includes IA, IL, MI, MO and WI.
Notes: Regions as defined by the North American Electric Reliability Corporation. Some states appear in more than one region because parts of them belong to different regions.							

Production and commercialization

Launched in December 2008, the BYD F3DM became the world's first mass produced plug-in hybrid automobile

Deliveries of the Chevrolet Volt began in the U.S. in December 2010

The Bright IDEA plug-in hybrid delivery truck is available for fleet customers in the U.S.

A survey from Pike Research shows 22 % of 1,041 consumers extremely and 26 % very interested in buying a PHEV-40-(like the Volt), with 17 % willing to pay 20–50 % more than a standard vehicle and half willing to pay 5-10 % more. Another 34 % have some interest for a total of 82 %. Pike projects 1.7 million PHEVs on the world's roads by 2015 and half a million annual sales.

Unit 10. NEW PRODUCTION CAR MODELS

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3.Расскажите о современном производстве автомобилей в США и Китае на английском языке.

Current production models

The BYD F3DM became the world's first mass produced plug-in hybrid compact sedan as it went on sale in China to government agencies and corporations on December 15, 2008. Sales to the general public began in Shenzhen in March 2010 but because the F3DM nearly doubles the price of cars that run on conventional fuel, BYD Auto is counting on subsidies from the local government to make the plug-in attractive to personal buyers. The F3DM is sold for 149,800 yuan (about USD 21,900) and during its first year in the market the F3DM only sold 48 vehicles. The F3DM has an all-electric range of 100 kilometers (60 mi) and is slated to go on sale in Europe and the U.S. in 2011.

General Motors introduced the first Chevrolet Volt off the assembly line on November 30, 2010. Sales and deliveries began in December 2010. The Volt will be sold initially only in California, Washington Metropolitan Area, Michigan, Texas, New York, New Jersey and Connecticut. The first cars will be available in Washington D.C., the New York City metropolitan region, California and Austin, Texas. During the first quarter of 2011 the market will expand to Michigan, the rest of Texas and to all of New York, New Jersey and Connecticut. The restricted roll-out is due to limited production, as GM planned production for 2011 is only 10,000 units. Nationwide availability in the U.S. and Canada is scheduled to begin in late 2011 until mid 2012.

In the United States, the Toyota Prius can now be commercially converted (using aftermarket kits and tax incentives) to a plug-in hybrid by CalCars and a number of third-party companies. On a smaller scale, PHEVs have been sold as commercial passenger vans, utility trucks, general and school buses, motorcycles, scooters and military vehicles. Hybrid Electric Vehicle Technologies, Inc converts diesel buses to plug-in hybrids under contract for the Chicago Transit Authority. Fisher Coachworks is developing a plug-in hybrid, the Fisher GTB-40, which is expected to get about twice the mileage of a regular hybrid electric bus.

Future production

At least fourteen car companies of all sizes are exploring or planning to offer a plug-in, including a modular kit car model (XR-3 Hybrid). Conversion kits and services are available to convert production model hybrid vehicles to plug-ins. Other plug-in vehicles ongoing demonstration trials or slated to the market for 2011 and 2012 are the Fisker Karma, Toyota Prius Plug-in Hybrid, Ford Escape Plug-in Hybrid, Volvo V70 Plug-in Hybrid, Suzuki Swift Plug-in and the Ford C-Max Energi. A startup in California named Aptera Motors is creating a series drivetrain PHEV version of its concept electric car, the Aptera 2h.

Unit 11. GOVERNMENT SUPPORT AND PUBLIC DEPLOYMENT

1. Прочитайте текст и ознакомьтесь с его общим содержанием.
2. Составьте список из ключевых слов и словосочетаний. Выберите из этого списка названия фирм и представьте их по-русски. Переведите английские слова и словосочетания на русский язык по словарю и с учетом контекста.
3. Расскажите о правительственной поддержке при использовании электромобилей в разных странах на английском и русском языках.

Subsidies and economic incentives

Several countries have established grants and tax credits for the purchase of new plug-in electric vehicles (PEVs) including plug-in hybrid electric vehicles, and usually the economic incentive depends on battery size. The U.S. offers a federal income tax credit up to US$7,500 and several states have additional incentives. The U.K. offers a Plug-in Car Grant up to a maximum of GBJ5,000 (US$7,600). As of April 2011, 15 of the 27 European Union member states provide tax incentives for electrically chargeable vehicles, which include all Western European countries plus the Czech Republic and Romania. Also 17 countries levy carbon dioxide related taxes on passenger cars as a disincentive. The incentives consist of tax reductions and exemptions, as well as of bonus payments for buyers of all-electric and plug-in hybrid vehicles, hybrid vehicles, and some alternative fuel vehicles.

Other government support

United States

Incentives for the development of PHEVs are included in the Energy Independence and Security Act of 2007. The Energy Improvement and Extension Act of 2008, signed into law on October 3, 2008, grants a tax credit for the purchase of PHEVs. President Barack Obama's New Energy for America calls for deployment of 1 million plug-in hybrid vehicles by 2015, and on March 19, 2009 he announced programs directing $2.4 billion to electric vehicle development.

The American Recovery and Reinvestment Act of 2009 modifies the tax credits, including a new one for plug-in electric drive conversion kits and for 2 or 3 wheel vehicles. The ultimate total included in the Act that is going to PHEVs is over $6 billion.

In March 2009, as part of the American Recovery and Reinvestment Act, the US Department of Energy announced the release of two competitive solicitations for up to $2 billion in federal funding for competitively awarded cost-shared agreements for manufacturing of advanced batteries and related drive components as well as up to $400 million for transportation electrification demonstration and deployment projects. This announcement will also help to meet the President Barack Obama's goal of putting one million plug-in hybrid vehicles on the road by 2015.

Public deployments also include:

- USDOE's Freedom CAR. US Department of Energy announced it would dole out $30 million in funding to three companies over three years to further development of plug-in hybrids.
- USDOE announced the selection of Navistar Corporation for a cost-shared award of up to $10 million to develop, test and deploy plug-in hybrid electric (PHEV) school buses.
- DOE and Sweden have a MOU to advance market integration of plug-in hybrid vehicles.
- PHEV Research Center.
- San Francisco Mayor Gavin Newsom, San Jose Mayor Chuck Reed and Oakland, California Mayor Ron Dellums announced a nine-step policy plan for transforming the Bay Area into the "Electric Vehicle (EV) Capital of the U.S." and of the world. There are partnerships with Coulomb, Better Place and others are also advancing. The first charging stations went up in San Jose.
- Washington State PHEV Pilot Project.
- Texas Governor Rick Perry's proposal for a state $5,000 tax credit for PHEVs in "non-attainment" communities.
- Seattle, that includes City's public fleet converted vehicles, the Port of Seattle, King County and the Puget Sound Clean Air Agency.

GM's roadmap for plug-in ready communities includes: consumer incentives to make this early technology more affordable; public and workplace charging infrastructure; consumer-friendly electricity rates and renewable electricity options; government and corporate vehicle purchases; supportive permitting and codes for vehicle charging and other incentives such as high-occupancy-vehicle (HOV) lanes access

European Union

Electrification of transport (electromobility) is a priority in the European Union Research Programme. It also figures prominently in the European Economic Recovery Plan presented in November 2008, in the frame of the Green Car Initiative. DG TREN will support a large European "electromobility" project on electric vehicles and related infrastructure with a total budget of around € 50 million as part of the Green Car Initiative.

Supportive organizations

Organizations that support plug-in hybrids include the World Wide Fund for Nature, its International Director General James Leape remarked, "the cars of the future ... should, increasingly, be powered by electricity".

Also National Wildlife Federation has done a strong endorsement of PHEVs.

CalCars (with their PHEV news service and "What car makers are saying about PHEVs") is dedicated only to the PHEV and has proposed a Prepayment Plan, where buyers would pay $1,000 to reserve a plug-in car and the federal government would match each payment with $9,000, all of which would go to carmakers. CalCars is also promoting public funds for conversion of internal combustion engines to plug-in vehicles.

Other supportive organizations are Plug In America, the Alliance for Climate Protection, Friends of the Earth, the Rainforest Action Network, Rocky Mountain Institute (Project Get Ready), the San Francisco Bay Area Council, the Apollo Alliance, the Set America Free Coalition, the Silicon Valley Leadership Group, and the Plug-in Hybrid Electric School Bus Project, FPL and Duke Energy has said that by 2020 all new purchases of fleet vehicles will be plug-in hybrid or all-electric.

NiMH battery patent encumbrance

Some battery formats and chemistries (nickel-metal hydride batteries) suitable for use in PHEVs are tightly patented and have not been licensed for use by PHEV manufacturers, thereby slowing the development of electric cars and PHEVs, particularly before the 2008 Oil Crisis.

An Italian Carabinieri GEM e2, called the Ovetti (egg), used for patrolling urban areas

GEM e2 NEV used by the Tourist Police in Playa del Carmen, Mexico, being recharged

Australia and New Zealand

In 2008 Australia started producing its first commercial all-electric vehicle. Originally called the Blade Runner, its name was changed to Electron, and is already being exported to New Zealand with one purchased by the Environment Minister Dr. Nick Smith. The Electron is based on the Hyundai Getz chassis and has proven popular with government car pools.

Canada

British Columbia is the only place where it is legal to drive a LSV electric car on public roads, although it also requires low speed warning marking and flashing lights. Quebec is allowing LSVs in a three year pilot project. These cars will not be allowed on the highway, but will be allowed on city streets.

China

The Chinese government adopted a plan with the goal of turning the country into one of the leaders of all-electric and hybrid vehicles by 2012. The government's intention is to create a world-leading industry that will produce jobs and exports, and to reduce urban pollution and its oil dependence. However, a study found that even though local air pollution would be reduced by replacing a gasoline car with a similar-size electric car, it would reduce greenhouse gas emissions by only 19 %, as China uses coal for 75 % of its electricity production. A 19 % reduction is, however, a substantial reduction and all cars being electric would be a larger incentive not only for more investment in renewable electricity generation, but also make a home solar system more economical.

The government is providing subsidies for electric car research and also subsidies of up to $8,800 US for each hybrid or all-electric vehicle purchased by taxi fleets and local government agencies in 13 Chinese cities. Electricity utilities have been ordered to set up electric car charging stations in Beijing, Shanghai and Tianjin. China wants to raise its annual production capacity to 500,000 hybrid or all-electric cars and buses by the end of 2011, from 2,100 in 2008.

As intercity driving is rare in China, electric cars provide several practical advantages because commutes are fairly short and at low speeds due to traffic congestion. These particular local conditions make the range limitation of all-electric cars less of a problem, especially as the latest Chinese models have a top speed of 100 km/h (60 mph) and a range of 200 km (120 mi) between charges.

As of May 2010, Chinese automakers have developed at least 10 models of high-speed, all-electric cars with plans for volume production.

Croatia

A small city car called XD assembled by Croatian company DOK-ING. The name XD comes from oddly shaped rear lights ("X" shaped) and "D" beginning letter of the company's name. The XD can travel over 250 km on a single charge with Lithium-ion batteries. Car's base-cost will be only 10.000€. Serial production is predicted to start mid-2012.

Finland

There is a lot of knowledge about electric cars in Finland, with companies such as Valmet Automotive (Fisker Karma and Garia A/S electric golf cart production) and also agreement of Think City (car production), Fortum (concept cars and infrastructure), Kabus (hybrid buses; part of Koiviston Auto Oy), BRP Finland (part of Bombardier Recreational Products), Lynx (snowmobile), Patria (military vehicles), European Batteries (Li-ion battery plant in Varkaus), Finnish Electric Vehicles (battery control systems), ABB, Efore, Vacon (electric motor technology production), Ensto (production of charging units), Elcat (electric vehicle production since the 1980s), production of electric car accessories, Suomen Sahksauto Oy (produces small electric cars), Oy AMC Motors Ltd. (produces and designs small electric cars), Raceabout (specialist electric sport car with very few sales), Gemoto scooters from Cabotec, Resonate's Gemini and Janus Scooters, Moto Bella Oy, Axcomotors, Randax, Visedo.

Research related to electric cars is in progress at the VTT Technical Research Centre of Finland.

Electric Motor Show

Sharing knowledge is also in progress: in Helsinki the Electric Motor Show will be held from 10 to 12 September 2010. The show will feature only cars, motorcycles, scooters, mopeds and microcars and components for them. Year 2010 is second year for Helsinki Electric motor show. The plan is to hold the show annually.

Infrastructure

Basic charging infrastructure is already available all over Finland, used for engine pre-warming in the cold winters. Because of its climate – cold winters and warm summers – Finland is considered a convenient "test laboratory" for electric cars and many companies have made field tests in Finland. It has been said in Autobild 08/09 magazine that Fortum is developing the high-speed charging system. With a new kind of three-phase charging method electric cars can be charged in four minutes. A commercial product should be ready by 2011.

There are also mines and metal refineries for lithium alloy in Finland. At the moment there are several mining projects under way such as the Keliber project.

Support organizations

There are several electric car organisations in Finland, such as the Electric Vehicle Association of Finland and Electric Vehicles of Finland.

Electric Cars – Now!

There is also a non-commercial electric car conversion organisation called Electric Cars – Now! that converts standard Toyota Corollas into Li-ion battery-powered electric cars. As of August 2009, more than 1,700 pre-orders for conversion Toyotas have been placed. The speciality in the Electric Cars – Now! project is that it is an open source project: anyone can start similar production anywhere they want, the benefits for the customer being open-source spare part coding and so on. The ideas and design are freely available from the Electric Cars – Now! organisation.

France

France's largest energy provider, EDF is currently working with Toyota to develop charging stations throughout France. Toyota is also leasing a fleet of 100 plug-in hybrid vehicles through selected partners in France.

Iceland

2012 – New beginning; A group in Iceland is planning to convert all vehicles in the country to electric by 2012, the first to do so.

Israel

Shai Agassi, CEO of Better Place, has reached agreements with Renault-Nissan and the government to begin the first phases of the company's efforts to make Israel the world's first integrated electric car network. Better Place will start importing and distributing Renault's first passenger electric vehicle – the Fluence ZE, five-seat sedan – to Israel in the first half of 2011. The battery for the Fluence ZE can be re-charged by means of a standard charge in four to eight hours or switched for a charged battery in under five minutes.

Better Place, whose aim is to reduce global dependency on oil by creating an infrastructure to support the implementation of a worldwide network of electric vehicles, was started in 2007 with the encouragement of President Shimon Peres. Israel is considered a viable site for this ground breaking endeavour due to the country's relatively small size and the fact that approximately 90 % of the nation's car owners drive less than 40 mi (60 km) a day.

Israel has enacted policies that create a tax differential between zero-emission vehicles and traditional cars, to accelerate the transition to electric cars.

Agassi has designed an infrastructure consisting of 500,000 charging stations and almost 200 battery-exchange stations. In December 2008, Better Place revealed its first plug-in parking lot in Tel Aviv. Additionally, in May 2009, the company unveiled its patented battery swap system, which is designed for drivers taking longer road trips who lack the time needed to recharge their own battery.

Better Place has currently opened 17 of the 150,000 charging stations planned for Israel by 2011.

Ireland

In November 2008, the Department of Transport announced the Electric Transport Plan which calls for 10 % of all vehicles to be electric by 2020. Government officials reached agreements with French car maker Renault and its Japanese partner Nissan to boost the use of electric cars. Eamon Ryan Ireland's Minister for Communications, Energy and Natural Resources has repeatedly emphasised the importance of the electric car within the Irish context. The Electricity Supply Board has actively supported this call and sees electric vehicles as a key part of its strategy with regard to wind power in the Republic of Ireland. Sustainable Energy Ireland (SEI) is currently looking at a number of pilot projects. More information on incentives is expected to come to light in the 2010 Irish Budget.

Japan

In mid 2009, Mitsubishi and Subaru respectively released electric cars for corporate lease in Japanese market, for price range of approximately US$32,000-34,000 (government tax relief and subsidy inclusive). Mitsubishi plans to extend it for consumer use in 2010. Nissan also announced its plan for the electric car "Leaf" in 2010.

Poland

Poland is developing charging station infrastructure in Gdańsk, Katowice, Krakyw, Mielec and Warsaw. Funds for the project come from the European Union. The biggest organization in Poland in the area of electric vehicles is Klaster Green Stream. The Polish company 3xE – samochody elektryczne (3xE – electric cars) offer electric vehicle conversions of small city cars such as the Smart ForTwo, Citroen C1, Fiat Panda, Peugeot 107, Audi A2. The converted cars have a range of about 100 km (60 mi), using lithium iron phosphate (LiFePO4) batteries and brushless DC electric motors and the conversion can cost less than €12,000.

Philippines

The first electric car in the country was launched at Silliman University by Insular Technologies in August 2007. In some major urban cities in the Philippines like Makati, E-Jeepneys or Electric Jeepneys are used as well as Electrical Tricycles (Rickshaws). Eagle G-Car a Philippine all-electric car was made available for purchase in the Philippines as low as $33,000-$66,000), the car is made out of fiber glass. While E-Jeepneys are expected to be available in many other cities in the Philippines and hope to be revolutionize and made into an icon of the Philippines, it is a venture of Renewable Independent Power Producer Inc., which sprang from Greenpeace and other groups, and Solarco, which in turn is a part of GRIPP.

Portugal

Portugal has also reached agreements with French car maker Renault and its Japanese partner Nissan to boost the use of electric cars by creating a national recharging network. The aim is to make Portugal one of the first countries to offer drivers nationwide charging stations.

Spain

On 8 September 2009 the Spanish Industry Minister Miguel Sebastian Gascyn announced that in late 2010 electric cars will be relisted in Spain, Madrid, Barcelona and Seville and will provide charging points.

Unit 12. AUTOMOBILE AND ITS HISTORY

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Составьте реферат текста на русском языке.

Automobile

Automobile is a wheeled motor vehicle used for transporting passengers, which also carries its own engine or motor. Most definitions of the term specify that automobiles are designed to run primarily on roads, to have seating for one to eight people, to have typically four wheels and to be constructed principally for the transport of people rather than goods.

The term motorcar has also been used in the context of electrified rail systems to denote a car which functions as a small locomotive but also provides space for passengers and baggage. These locomotive cars were often used on suburban routes by both interurban and intercity railroad systems.

There are approximately 600 million passenger cars worldwide (roughly one car per eleven people). Around the world, there were about 806 million cars and light trucks on the road in 2007; the engines of these burn over a billion cubic meters (260 billion US gallons) of petrol/gasoline and diesel fuel yearly. The numbers are increasing rapidly, especially in China and India.

History

The first working steam-powered vehicle was likely to have been designed by Ferdinand Verbiest, a Flemish member of a Jesuit mission in China around 1672. It was a 65 cm-long scale-model toy for the Chinese Emperor, that was unable to carry a driver or a passenger. It is not known if Verbiest's model was ever built.

Nicolas-Joseph Cugnot is widely credited with building the first self-propelled mechanical vehicle or automobile in about 1769; he created a steam-powered tricycle. He also constructed two steam tractors for the French Army, one of which is preserved in the French National Conservatory of Arts and Crafts. His inventions were however handicapped by problems with water supply and maintaining steam pressure. In 1801, Richard Trevithick built and demonstrated his Puffing Devil road locomotive, believed by many to be the first demonstration of a steam-powered road vehicle. It was unable to maintain sufficient steam pressure for long periods and was of little practical use.

In 1807 Nicéphore Niépce and his brother Claude probably created the world's first internal combustion engine which they called a Pyréolophore, but they chose to install it in a boat on the river Saone in France. Coincidentally, in 1807 the Swiss inventor François Isaac de Rivaz designed his own 'de Rivaz internal combustion engine' and used it to develop the world's first vehicle, to be powered by such an engine. The Niépces' Pyréolophore was fuelled by a mixture of Lycopodium powder (dried Lycopodium moss), finely crushed coal dust and resin that were mixed with oil, whereas de Rivaz used a mixture of hydrogen and oxygen. Neither design was very successful, as was the case with others, such as Samuel Brown, Samuel Morey, and Etienne Lenoir with his hippomobile, who each produced vehicles (usually adapted carriages or carts) powered by clumsy internal combustion engines.

In November 1881, French inventor Gustave Trouvé demonstrated a working three-wheeled automobile powered by electricity at the International Exposition of Electricity, Paris.

Although several other German engineers (including Gottlieb Daimler, Wilhelm Maybach and Siegfried Marcus) were working on the problem at about the same time, Karl Benz generally is acknowledged as the inventor of the modern automobile.

An automobile powered by his own four-stroke cycle gasoline engine was built in Mannheim, Germany by Karl Benz in 1885 and granted a patent in January of the following year under the auspices of his major company, Benz & Cie., which was founded in 1883. It was an integral design, without the adaptation of other existing components, and included several new technological elements to create a new concept. He began to sell his production vehicles in 1888. In 1879, Benz was granted a patent for his first engine, which had been designed in 1878. Many of his other inventions made the use of the internal combustion engine feasible for powering a vehicle.

His first Motorwagen was built in 1885, and he was awarded the patent for its invention as of his application on January 29, 1886. Benz began promotion of the vehicle on July 3, 1886, and about 25 Benz vehicles were sold between 1888 and 1893, when his first four-wheeler was introduced along with a model intended for affordability. They also were powered with four-stroke engines of his own design. Emile Roger of France, already producing Benz engines under license, now added the Benz automobile to his line of products. Because France was more open to the early automobiles, initially more were built and sold in France through Roger than Benz sold in Germany.

In August 1888 Bertha Benz, the wife of Karl Benz, undertook the first road trip by car, to prove the road-worthiness of her husband's invention.

In 1896, Benz designed and patented the first internal-combustion flat engine, called boxermotor. During the last years of the nineteenth century, Benz was the largest automobile company in the world with 572 units produced in 1899 and, because of its size, Benz & Cie., became a joint-stock company.

Daimler and Maybach founded Daimler Motoren Gesellschaft (DMG) in Cannstatt in 1890, and sold their first automobile in 1892 under the brand name, Daimler. It was a horse-drawn stagecoach built by another manufacturer, that they retrofitted with an engine of their design. By 1895 about 30 vehicles had been built by Daimler and Maybach, either at the Daimler works or in the Hotel Hermann, where they set up shop after disputes with their backers. Benz, Maybach and the Daimler team seem to have been unaware of each others' early work. They never worked together; by the time of the merger of the two companies, Daimler and Maybach were no longer part of DMG.

Daimler died in 1900 and later that year, Maybach designed an engine named Daimler-Mercedes, that was placed in a specially ordered model built to specifications set by Emil Jellinek. This was a production of a small number of vehicles for Jellinek to race and market in his country. Two years later, in 1902, a new model DMG automobile was produced and the model was named Mercedes after the Maybach engine which generated 35 hp. Maybach quit DMG shortly thereafter and opened a business of his own. Rights to the Daimler brand name were sold to other manufacturers.

Karl Benz proposed co-operation between DMG and Benz & Cie. when economic conditions began to deteriorate in Germany following the First World War, but the directors of DMG refused to consider it initially. Negotiations between the two companies resumed several years later when these conditions worsened and, in 1924 they signed an Agreement of Mutual Interest, valid until the year 2000. Both enterprises standardized design, production, purchasing, and sales and they advertised or marketed their automobile models jointly, although keeping their respective brands. On June 28, 1926, Benz & Cie. and DMG finally merged as the Daimler-Benz company, baptizing all of its automobiles Mercedes Benz, as a brand honoring the most important model of the DMG automobiles, the Maybach design later referred to as the 1902 Mercedes-35 hp, along with the Benz name. Karl Benz remained a member of the board of directors of Daimler-Benz until his death in 1929, and at times, his two sons participated in the management of the company as well.

In 1890, Émile Levassor and Armand Peugeot of France began producing vehicles with Daimler engines, and so laid the foundation of the automobile industry in France.

The first design for an American automobile with a gasoline internal combustion engine was made in 1877 by George Selden of Rochester, New York. Selden applied for a patent for an automobile in 1879, but the patent application expired because the vehicle was never built. After a delay of sixteen years and a series of attachments to his application, on November 5, 1895, Selden was granted a United States patent (U.S. Patent 549,160) for a two-stroke automobile engine, which hindered, more than encouraged, development of automobiles in the United States. His patent was challenged by Henry Ford and others and overturned in 1911.

In 1893, the first running, gasoline-powered American car was built and road-tested by the Duryea brothers of Springfield, Massachusetts. The first public run of the Duryea Motor Wagon took place on September 21, 1893, on Taylor Street in Metro Center, Springfield. To construct the Duryea Motor Wagon, the brothers had purchased a used horse-drawn buggy for $70 and then installed a 4 HP, single cylinder gasoline engine. The car had a friction transmission, spray carburetor, and low tension ignition. It was road-tested again on November 10, when the The Springfield Republican newspaper made the announcement. This particular car was put into storage in 1894 and stayed there until 1920 when it was rescued by Inglis M. Uppercu and presented to the United States National Museum.

In Britain, there had been several attempts to build steam cars with varying degrees of success, with Thomas Rickett even attempting a production run in 1860. Santler from Malvern is recognized by the Veteran Car Club of Great Britain as having made the first petrol-powered car in the country in 1894 followed by Frederick William Lanchester in 1895, but these were both one-offs. The first production vehicles in Great Britain came from the Daimler Motor Company, a company founded by Harry J. Lawson in 1896, after purchasing the right to use the name of the engines. Lawson's company made its first automobiles in 1897, and they bore the name Daimler.

In 1892, German engineer Rudolf Diesel was granted a patent for a "New Rational Combustion Engine". In 1897, he built the first Diesel Engine. Steam-, electric-, and gasoline-powered vehicles competed for decades, with gasoline internal combustion engines achieving dominance in the 1910s.

Although various pistonless rotary engine designs have attempted to compete with the conventional piston and crankshaft design, only Mazda's version of the Wankel engine has had more than very limited success.

Unit 13. MASS PRODUCTION OF AUTOMOBILES

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Расскажите на английском языке о массовом производстве автомобилей, видах топлива и системе безопасности движения.

Mass production

The large-scale, production-line manufacturing of affordable automobiles was debuted by Ransom Olds at his Oldsmobile factory in 1902 based on the assembly line techniques pioneered by Marc Isambard Brunel at the Portsmouth Block Mills, England in 1802. The assembly line style of mass production and interchangeable parts had been pioneered in the U.S. by Thomas Blanchard in 1821, at the Springfield Armory in Springfield, Massachusetts. This concept was greatly expanded by Henry Ford, beginning in 1914.

As a result, Ford's cars came off the line in fifteen minute intervals, much faster than previous methods, increasing productivity eightfold (requiring 12.5 man-hours before, 1 hour 33 minutes after), while using less manpower. It was so successful, paint became a bottleneck. Only Japan black would dry fast enough, forcing the company to drop the variety of colors available before 1914, until fast-drying Duco lacquer was developed in 1926. This is the source of Ford's apocryphal remark, "any color as long as it's black". In 1914, an assembly line worker could buy a Model T with four months' pay.

Ford's complex safety procedures – especially assigning each worker to a specific location instead of allowing them to roam about – dramatically reduced the rate of injury. The combination of high wages and high efficiency is called "Fordism," and was copied by most major industries. The efficiency gains from the assembly line also coincided with the economic rise of the United States. The assembly line forced workers to work at a certain pace with very repetitive motions which led to more output per worker while other countries were using less productive methods.

In the automotive industry, its success was dominating and quickly spread worldwide seeing the founding of Ford France and Ford Britain in 1911, Ford Denmark 1923, Ford Germany 1925; in 1921, Citroen was the first native European manufacturer to adopt the production method. Soon, companies had to have assembly lines, or risk going broke; by 1930, 250 companies which did not, had disappeared.

Development of automotive technology was rapid, due in part to the hundreds of small manufacturers competing to gain the world's attention. Key developments included electric ignition and the electric self-starter (both by Charles Kettering, for the Cadillac Motor Company in 1910-1911), independent suspension and four-wheel brakes.

Since the 1920s, nearly all cars have been mass-produced to meet market needs, so marketing plans often have heavily influenced automobile design. It was Alfred P. Sloan who established the idea of different makes of cars produced by one company, so buyers could "move up" as their fortunes improved.

Reflecting the rapid pace of change, makes shared parts with one another so larger production volume resulted in lower costs for each price range. For example, in the 1930s, LaSalles, sold by Cadillac, used cheaper mechanical parts made by Oldsmobile; in the 1950s, Chevrolet shared hood, doors, roof and windows with Pontiac; by the 1990s, corporate powertrains and shared platforms (with interchangeable brakes, suspension and other parts) were common. Even so, only major makers could afford high costs, and even companies with decades of production, such as Apperson, Cole, Dorris, Haynes, or Premier, could not manage: of some two hundred American car makers in existence in 1920, only 43 survived in 1930, and with the Great Depression, by 1940, only 17 of those were left.

In Europe much the same would happen. Morris set up its production line at Cowley in 1924, and soon outsold Ford, while beginning in 1923 to follow Ford's practice of vertical integration, buying Hotchkiss (engines), Wrigley (gearboxes), and Osberton (radiators), for instance, as well as competitors, such as Wolseley: in 1925, Morris had 41 % of total British car production. Most British small-car assemblers, from Abbey to Xtra had gone under. Citroen did the same in France, coming to cars in 1919; between them and other cheap cars in reply such as Renault's 10CV and Peugeot's 5CV, they produced 550,000 cars in 1925, and Mors, Hurtu and others could not compete. Germany's first mass-manufactured car, the Opel 4PS Laubfrosch (Tree Frog), came off the line at Russelsheim in 1924, soon making Opel the top car builder in Germany, with 37.5 % of the market.

Weight

The weight of a car influences fuel consumption and performance, with more weight resulting in increased fuel consumption and decreased performance. According to a research conducted by Julian Allwood of the University of Cambridge, global energy use could be heavily reduced by using lighter cars, and an average weight of 500 kg has been said to be well achievable.

In some competitions such as the Shell Eco Marathon, average car weights of 45 kg have also been achieved. These cars are only single-seaters (still falling within the definition of a car, although 4-seater cars are more common), but it nevertheless demonstrates the huge degree in which car weights can still be reduced, and the forthfluing lower fuel use (i.e. up to a fuel use of 2560 km/l).

Seating

Most cars are 4-seaters built using a 2 by 2 arrangement, also known as "mainstream". Other setups 2-seaters built using a 1 by 1 arrangement and single-seater cars. In the beginning, 4-seaters have been the most popular type of car, mostly due to the fact that the setup was similar to that of carriages. They have remained the most popular setup for cars upto today.

Fuel and propulsion technologies

Most automobiles in use today are propelled by an internal combustion engine, fueled by deflagration of gasoline (also known as petrol) or diesel. Both fuels are known to cause air pollution and are also blamed for contributing to climate change and global warming. Rapidly increasing oil prices, concerns about oil dependence, tightening environmental laws and restrictions on greenhouse gas emissions are propelling work on alternative power systems for automobiles. Efforts to improve or replace existing technologies include the development of hybrid vehicles, plug-in electric vehicles and hydrogen vehicles. Vehicles using alternative fuels such as ethanol flexible-fuel vehicles and natural gas vehicles are also gaining popularity in some countries.

Safety

Result of a serious automobile accident

While road traffic injuries represent the leading cause in worldwide injury-related deaths, their popularity undermines this statistics.

Mary Ward became one of the first documented automobile fatalities in 1869 in Parsonstown, Ireland and Henry Bliss one of the United States' first pedestrian automobile casualties in 1899 in New York. There are now standard tests for safety in new automobiles, like the EuroNCAP and the US NCAP tests, and insurance industry-backed tests by the Insurance Institute for Highway Safety (IIHS).

Unit 14. COSTS AND BENEFITS OF AUTOMOBILE USAGE

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Переведите письменно со словарем отрывок «Driverless cars».
4. Напишите перевод-аннотацию всего текста.

Costs and benefits

The costs of automobile usage, which may include the cost of: acquiring the vehicle, repairs, maintenance, fuel, depreciation, injury, driving time, parking fees, tire replacement, taxes, and insurance, are weighed against the cost of the alternatives, and the value of the benefits – perceived and real – of vehicle usage. The benefits may include on-demand transportation, mobility, independence and convenience.

Similarly the costs to society of encompassing automobile use, which may include those of: maintaining roads, land use, pollution, public health, health care and of disposing of the vehicle at the end of its life can be balanced against the value of the benefits to society that automobile use generates. The societal benefits may include: economy benefits, such as job and wealth creation, of automobile production and maintenance, transportation provision, society wellbeing derived from leisure and travel opportunities and revenue generation from the tax opportunities. The ability for humans to move flexibly from place to place has far reaching implications for the nature of societies.

Criticism

Transportation is a major contributor to air pollution in most industrialised nations. According to the American Surface Transportation Policy Project nearly half of all Americans are breathing unhealthy air. Their study showed air quality in dozens of metropolitan areas has worsened over the last decade. In the United States the average passenger car emits 11,450 pounds (5,190 kg) of the greenhouse gas, carbon dioxide annually, along with smaller amounts of carbon monoxide, hydrocarbons and nitrogen.

Animals and plants are often negatively impacted by automobiles via habitat destruction and pollution. Over the lifetime of the average automobile the "loss of habitat potential" may be over 50,000 square meters (540,000 sq ft) based on primary production correlations.

Fuel taxes may act as an incentive for the production of more efficient, hence less polluting, car designs (e.g. hybrid vehicles) and the development of alternative fuels. High fuel taxes may provide a strong incentive for consumers to purchase lighter, smaller, more fuel-efficient cars, or to not drive. On average, today's automobiles are about 75 percent recyclable, and using recycled steel helps reduce energy use and pollution. In the United States Congress, federally mandated fuel efficiency standards have been debated regularly, passenger car standards have not risen above the 27.5 miles per US gallon (8.55 L/100 km; 33.0 mpg-imp) standard set in 1985. Light truck standards have changed more frequently, and were set at 22.2 miles per US gallon (10.6 L/100 km; 26.7 mpg-imp) in 2007. Alternative fuel vehicles are another option that is less polluting than conventional petroleum powered vehicles.

Oil consumption in the twentieth and twenty-first centuries has been abundantly pushed by automobile growth; the 1985-2003 oil glut even fuelled the sales of low economy vehicles in OECD countries. The BRIC countries might also kick in, as China briefly was the first automobile market in December 2009.

Residents of low-density, residential-only sprawling communities are also more likely to die in car collisions which kill 1.2 million people worldwide each year, and injure about forty times this number. Sprawl is more broadly a factor in inactivity and obesity, which in turn can lead to increased risk of a variety of diseases. Millions of animals are also killed every year on roads by automobiles so-called Roadkill.

Driverless cars

A robotic Volkswagen Passat shown at Stanford University is a driverless car. Fully autonomous vehicles, also known as robotic cars, or driverless cars, already exist in prototype, and are expected to be commercially available around 2020. According to urban designer and futurist Michael E. Arth, driverless electric vehicles in conjunction with the increased use of virtual reality for work, travel, and pleasure could reduce the world's 800 million vehicles to a fraction of that number within a few decades. This would be possible if almost all private cars requiring drivers, which are not in use and parked 90 % of the time, would be traded for public self-driving taxis that would be in near constant use. This would also allow for getting the appropriate vehicle for the particular need: a bus could come for a group of people, a limousine could come for a special night out, and a Segway could come for a short trip down the street for one person. Children could be chauffeured in supervised safety, DUIs would no longer exist, and 41,000 lives could be saved each year in the US alone.

Future car technologies

Automobile propulsion technology under development include gasoline/ electric and plug-in hybrids, battery electric vehicles, hydrogen cars, biofuels, and various alternative fuels.

Research into future alternative forms of power include the development of fuel cells, Homogeneous Charge Compression Ignition (HCCI), stirling engines, and even using the stored energy of compressed air or liquid nitrogen.

New materials which may replace steel car bodies include duraluminum, fiberglass, carbon fiber, and carbon nanotubes.

Telematics technology is allowing more and more people to share cars, on a pay-as-you-go basis, through such schemes as City Car Club in the UK, Mobility in mainland Europe, and Zipcar in the US.

Communication is also evolving due to connected car systems.

Open source development

There have been several projects aiming to develop a car on the principles of open design. The projects include OScar, Riversimple (through 40fires.org) and c,mm,n. None of the projects have reached significant success in terms of developing a car as a whole both from hardware and software perspective and no mass production ready open-source based design have been introduced as of late 2009. Some car hacking through on-board diagnostics (OBD) has been done so far.

Alternatives to the automobile

Established alternatives for some aspects of automobile use include public transit such as buses, trolleybuses, trains, subways, tramways light rail, cycling and walking. Car-share arrangements and carpooling are also increasingly popular, the US market leader in car-sharing has experienced double-digit growth in revenue and membership growth between 2006 and 2007, offering a service that enables urban residents to "share" a vehicle rather than own a car in already congested neighborhoods. Bike-share systems have been tried in some European cities, including Copenhagen and Amsterdam. Similar programs have been experimented with in a number of US cities. Additional individual modes of transport, such as personal rapid transit could serve as an alternative to automobiles if they prove to be socially accepted.

Industry

The automotive industry designs, develops, manufactures, markets and sells the world's motor vehicles. In 2008, more than 70 million motor vehicles, including cars and commercial vehicles were produced worldwide.

In 2007, a total of 71.9 million new automobiles were sold worldwide: 22.9 million in Europe, 21.4 million in Asia-Pacific, 19.4 million in USA and Canada, 4.4 million in Latin America, 2.4 million in the Middle East and 1.4 million in Africa. The markets in North America and Japan were stagnant, while those in South America and other parts of Asia grew strongly. Of the major markets, China, Russia, Brazil and India saw the most rapid growth.

About 250 million vehicles are in use in the United States. Around the world, there were about 806 million cars and light trucks on the road in 2007; they burn over 260 billion US gallons (980,000,000 m3) of gasoline and diesel fuel yearly. The numbers are increasing rapidly, especially in China and India. In the opinion of some, urban transport systems based around the car have proved unsustainable, consuming excessive energy, affecting the health of populations and delivering a declining level of service despite increasing investments. Many of these negative impacts fall disproportionately on those social groups who are also least likely to own and drive cars. The sustainable transport movement focuses on solutions to these problems.

In 2008, with rapidly rising oil prices, industries such as the automotive industry, are experiencing a combination of pricing pressures from raw material costs and changes in consumer buying habits. The industry is also facing increasing external competition from the public transport sector, as consumers re-evaluate their private vehicle usage. Roughly half of the US's fifty-one light vehicle plants are projected to permanently close in the coming years, with the loss of another 200,000 jobs in the sector, on top of the 560,000 jobs lost this decade. Combined with robust growth in China, in 2009, this resulted in China becoming the largest automobile producer and market in the world. China 2009 sales had increased to 13.6 million, a significant increase from one million of domestic car sales in 2000.

Unit 15. THE AUTOMOTIVE MARKET

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Побеседуйте о проблемах, представленных в текстах, в форме диалога на английском языке.
4. Расскажите на русском языке о рынке автомобилей.

Market

The automotive market is formed by the demand and the industry. This article is about the general, major trends in the automotive market, mainly from the demand side.

The European automotive market has always boasted a higher number of smaller cars than the United States. With the high fuel prices and the world petroleum crisis, the United States may see its automotive market become more like the European market with fewer large vehicles on the road and more small cars.

For luxurious cars, with the current volatility in oil prices, going for smaller cars is not only smart, but also trendy. And because fashion is of high importance with the upper classes, the little green cars with luxury trimmings become quite plausible.

Automotive design

Automotive design is the profession involved in the development of the appearance, and to some extent the ergonomics, of motor vehicles or more specifically road vehicles. This most commonly refers to automobiles but also refers to motorcycles, trucks, buses, coaches, and vans. The functional design and development of a modern motor vehicle is typically done by a large team from many different disciplines included in automotive engineers. Automotive design in this context is primarily concerned with developing the visual appearance or aesthetics of the vehicle, though it is also involved in the creation of the product concept. Automotive design is practiced by designers who usually have an art background and a degree in industrial design or transportation design.

Design elements

The task of the design team is usually split into three main aspects: exterior design, interior design, and color and trim design. Graphic design is also an aspect of automotive design; this is generally shared amongst the design team as the lead designer sees fit. Design focuses not only on the isolated outer shape of automobile parts, but concentrates on the combination of form and function, starting from the vehicle package.

The aesthetic value will need to correspond to ergonomic functionality and utility features as well. In particular, vehicular electronic components and parts will give more challenges to automotive designers who are required to update on the latest information and knowledge associated with emerging vehicular gadgetry, particularly dashtop mobile devices, like GPS navigation, satellite radio, HD radio, mobile TV, MP3 players, video playback and smartphone interfaces. Though not all the new vehicular gadgets are to be designated as factory standard items, some of them may be integral to determining the future course of any specific vehicular models.

Exterior design

The stylist responsible for the design of the exterior of the vehicle develops the proportions, shape, and surfaces of the vehicle. Exterior design is first done by a series of digital or manual drawings. Progressively more detailed drawings are executed and approved. Clay (industrial plasticine) and/or digital models are developed from, and along with the drawings. The data from these models are then used to create a full sized mock-up of the final design (body in white). With 3 and 5 axis CNC Milling Machines, the clay model is first designed in a computer program and then "carved" using the machine and large amounts of clay. Even in times of high-class 3d software and virtual models on power walls the clay model is still the most important tool to evaluate the design of a car and therefore used throughout the industry.

Interior design

The stylist responsible for the design of the vehicle interior develops the proportions, shape, placement, and surfaces for the instrument panel, seats, door trim panels, headliner, pillar trims, etc. Here the emphasis is on ergonomics and the comfort of the passengers. The procedure here is the same as with exterior design (sketch, digital model and clay model).

Color and trim design

The color and trim (or color and materials) designer is responsible for the research, design, and development of all interior and exterior colors and materials used on a vehicle. These include paints, plastics, fabric designs, leather, grains, carpet, headliner, wood trim, and so on. Color, contrast, texture and pattern must be carefully combined to give the vehicle a unique interior environment experience. Designers work closely with the exterior and interior designers.

Designers draw inspiration from other design disciplines such as: industrial design, fashion, home furnishing, architecture and sometimes Product Design . Specific research is done into global trends to design for projects two to three model years in the future. Trend boards are created from this research in order to keep track of design influences as they relate to the automotive industry. The designer then uses this information to develop themes and concepts which are then further refined and tested on the vehicle models.

Graphic design

The design team also develop graphics for items such as: badges, decals, dials, switches, kick or tread strips, liveries.

Development process

Includes the following steps:
Concept sketching
Clay modeling
Class A surfaces
Scale model creation
Prototype development
Computer-aided design
Computer modeling
Powertrain engineering
Manufacturing process design

Automobile design

Integration of an automobile involves fitting together separate parts to form components or units and mounting these onto a frame forming the chassis.

An automobile chassis basically comprises the following:

1. The body shell which forms the skeleton of the vehicle.
2. The motor is the power unit of the vehicle, which in the past has been in large part, the internal combustion engine.
3. Transmission system which aides in transferring the drive from the engine to the wheels. Its main components are the clutch, gearbox, final drive and differential.
4. Suspension system which is used to connect the wheels to the body or chassis frame.
5. Steering
6. Brakes
7. Electrical equipment

The chassis is complete in itself as a road vehicle. It can drive and control itself just as in case of a complete car and therefore, in many motor works, the chassis is usually tested on the road before the complete body of the vehicle is attached as the chassis alone can behave as the propulsion means.

Unit 16. HISTORY OF AUTOMOBILE DESIGN

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Расскажите об истории автомобильного дизайна разных стран на английском и русском языках.

History of automobile design in the U.S.

In the United States, automotive design reached a turning point in 1924 when the American national automobile market began reaching saturation. To maintain unit sales, General Motors head Alfred P. Sloan Jr. suggested annual model-year design changes to convince car owners that they needed to buy a new replacement each year, an idea borrowed from the bicycle industry (though Sloan usually gets the credit, or blame). Critics called his strategy planned obsolescence. Sloan preferred the term "dynamic obsolescence". This strategy had far-reaching effects on the auto business, the field of product design, and eventually the American economy. The smaller players could not maintain the pace and expense of yearly re-styling. Henry Ford did not like the model-year change because he clung to an engineer's notions of simplicity, economics of scale, and design integrity. GM surpassed Ford's sales in 1931 and became the dominant company in the industry thereafter. The frequent design changes also made it necessary to use a body-on-frame rather than the lighter, but less flexible,[clarification needed] monocoque design used by most European automakers.

An early example of Forward look design 1956 Plymouth Fury

In the 1930s Chrysler's innovation with aerodynamics made them launch Chrysler Airflow in 1934, which was quite revolutionary and radical. But lower acceptance of the car forced Chrysler to re-design its later models of 'Airflow' made the industry take note of risks involved in taking major design advancements in short cycles.

One very well known American auto stylist is Harley Earl, who brought the tailfin and other aeronautical design references to auto design in the 1950s. He is joined among legendary designers by Gordon Buehrig, responsible for the Auburn 851 and iconic Cord 810 and 812 (hence also the Hupmobile Skylark and the Graham Hollywood). Another notable designer who had a markedly different style was Chrysler group's designer Virgil Exner, an early pioneer of cab forward (a.k.a.Forward look) design in mid-1950s later adapted by rest of the industry. He is also credited with introducing the pointed tail fins in the 1956 Plymouth Belvedere later adapted by all other Detroit studios. Personal injury litigation had a dramatic effect on the design and appearance of the car in the 20th century. Raymond Loewy was responsible for a number of Studebaker vehicles, including the Starlight (including the iconic bulletnose). Richard A. Teague, who spent most of his career with the American Motor Company, originated the concept of using interchangeable body panels so as to create a wide array of different vehicles using the same stampings starting with the AMC Cavalier. He was responsible for such unique automotive designs as the Pacer, Gremlin, Matador coupe, Jeep Cherokee, and the complete interior of the Eagle Premier.

In the 1960s Ford's first generation Ford Mustang and Thunderbird marked another era leading into new market segments from Detroit. The Ford Mustang achieved record sales in its first year of production and established the pony car segment.

History of automobile design in Europe

An early radical French Voisin C27

Europe is the continent where the first Automobile was invented, eventually replacing the Horse Drawn Coaches. Till World War I most of the manufacturers were concerned with mechanical reliability rather than its external appearance. Later, luxury and aesthetics became a demand and also an effective marketing tool. Designs from each nation with its own strong cultural identity, reflected in their exterior and interior designs. World War II slowed the progress, but after early-1950s, Italian designers set the trend and remained the driving force until the early part of the 1980s.

France

Citroën DS

In France notable designs came from Bugatti and Avions Voisin. Of the mass selling cars Citroën, launched their vehicles with innovative designs and engineering and mostly aided by the Styling of Flaminio Bertoni as evident from Citroën DS. After World War II with the disappearance of the French coach building industry, with the exception of Citroën, others stuck to following British and other popular trends till they gained financial stability. From the 1980s, manufactures like Renault cultivated their own strong design identities with designers like Patrick Le Quement demanding more freedom from engineering departments. Peugeot, which was dependent on Pininfarina since early post-war period, later established its own brand identity from 1980s onwards. Its other company Citroën still retains it distinctive French innovations in its designs. Today French designs are known for their innovativeness and forward looking.

Great Britain

1981 Ford Sierra with "jelly-mould" or "aero look" (low CD) styling was advanced for its time.

Great Britain was Europe's leading manufacturer of automobiles until the late-1960s. During that era there were more British-based automakers than in the rest of Europe combined. The British automobile industry catered to all segments ranging from compact, budget, sports, utility and luxury-type cars. Car design in Britain was markedly different from other European designs largely because British designers were not influenced by other European art or design movements, as well as the British clay modelers used a different sweep set.

British cars until World War II were sold in most of the British colonies. Innovations in vehicle packaging and chassis engineering combined with global familiarity with British designs meant vehicles were acceptable to public tastes at that time. British skilled resources like panel beaters, die machinists, and clay modelers were also available also partly due their involvement with motorsport industry.

Still during the 1960s British manufacturers sought professional help from the Italians, Giovanni Michelotti, Ercole Spada and Pininfarina.Notable British contributions to automobile designs were Morris Mini by Alec Issigonis, Several Jaguar Cars by Sir William Lyons, Aston Martin DB Series and several cars from Triumph and MG. Ford Europe based in Great Britain is notable for Ford Sierra, a creation of Uwe Bahnsen, Robert Lutz and Patrick le Quément. Other well known British designers were William Towns for Aston Martin designs and David Bache, for his Land Rover and Range Rover vehicles.

Germany

The 1972 BMW 2002 by Giovanni Michelotti

Germany is often considered the birthplace of industrial design with Bauhaus School of Design. However, the Nazi regime closed down the design school. Ferdinand Porsche and his family played a significant role in German design. Mercedes Benz passenger cars were also in luxury segment and played more importance to aesthetics. After the 1980s German design evolved into a distinctive Teutonic style often to complement their high engineered cars suited to Autobahns. But the early German design clues of present day owes some part to Italian designers like Giovanni Michelotti, Ercole Spada, Bruno Sacco and Giorgetto Giugiaro. During Mid and late 20th century one of the most influential coach builder/designer in Germany was Karmann.

German designs started gaining popularity after the 1980s, notable after the formation of Audi. Volkswagen, which was dependent on Marcello Gandini and Giorgetto Giugiaro and Karmann, later formed the contemporary design language along with Audi. BMW's foray into sports sedan marked a new trend in automobile design as it called for a sporty-looking everyday sedan with Giovanni Michelotti, later enhanced by Ercole Spada right into the 1980s, and Klaus Luthe till mid-1990s. The American born designer Chris Bangle hired by BMW in late-1990s to re-define the brand and he used new single press technology for compound curves adding controversial styling elements in his designs.

The Porsche family contributions were instrumental in the evolution of Porsche cars, while the Italian designer Bruno Sacco helped create various Mercedes Models from the 1960s till the 1990s.

Italy

Ferrari Testarossa from Pininfarina Studios by Leonardo Fioravanti

In Italy, where art is often considered a serious profession since Renaissance period, companies like Fiat and Alfa Romeo played a major role in car design. Many coach builders were dependent on these two major manufacturers. Italian manufacturers had a large presence in Motorsports leading to several sport car manufacturers like Ferrari, Lancia, Lamborghini, Maserati, etc. During late-1950s the elegant Italian designs gained global popularity coinciding with the modern fashion and architecture at that time around the world. Various design and technical schools in Turin turned out designers in large scale. By the late-1960s almost all Italian coach builders transformed into design studios catering to automakers around the world. The trend continued in the 1990s when the Japanese and Korean manufacturers sourced designs from these styling studios.One example is Pininfarina.

The most famous Italian designers whose designs services were sought globally are Giovanni Michelotti, Ercole Spada, Bruno Sacco, Marcello Gandini and Giorgetto Giugiaro.All the following designers helped to create the design foundations for most of the European brands in the post-world war II period, whose influence is still seen in present times.

Sweden (Scandinavian)

Ursaab, an early Saab concept illustrating an advanced headlamp treatment

Sweden has Volvo and Saab and the Scandinavian landscape required that cars had to be sturdy and withstand Nordic climate conditions. The Scandinavian design elements are known for their minimalism and simplicity. One of the early original Scandinavian designs was the Saab 92001 by Sixten Sason and Gunnar Ljungström.

Czechoslovakia

The 1934 Czechoslovakian Tatra T77 is the first serial-produced aerodynamically designed automobile designed by Hans Ledwinka and Paul Jaray Prior to World War and until early 1990s, Czechoslovakia had strong presence in the automotive industry with manufacturers like Skoda, Jawa, Tatra, CZ, and Zetor. Czech automobiles were generally known for their originality in mechanical simplicity and designs were remarkably Bohemian as evident from Tatra cars and Jawa motorcycles. During the Communist regime, design started falling back and ultimately the domestic automakers ended up as subsidiaries of EU-based companies.

Unit 17. INTERNAL COMBUSTION ENGINE AND ITS CHARACTERISTICS

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Выполните полный письменный перевод отрывка «Internal combustion engine».
4. Выполните реферативный перевод всего текста.

Internal combustion engine

The internal combustion engine is an engine in which the combustion of a fuel (normally a fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. This force is applied typically to pistons, turbine blades, or a nozzle. This force moves the component over a distance, transforming chemical energy into useful mechanical energy.

The term internal combustion engine usually refers to an engine in which combustion is intermittent, such as the more familiar four-stroke and two-stroke piston engines, along with variants, such as the six-stroke piston engine and the Wankel rotary engine. A second class of internal combustion engines use continuous combustion: gas turbines, jet engines and most rocket engines, each of which are internal combustion engines on the same principle as previously described.

The internal combustion engine (or ICE) is quite different from external combustion engines, such as steam or stirring engines, in which the energy is delivered to a working fluid not consisting of, mixed with, or contaminated by combustion products. Working fluids can be air, hot water, pressurized water or even liquid sodium, heated in some kind of boiler.

A large number of different designs for ICEs have been developed and built, with a variety of different strengths and weaknesses. Powered by an energy-dense fuel (which is very frequently gasoline, a liquid derived from fossil fuels). While there have been and still are many stationary applications, the real strength of internal combustion engines is in mobile applications and they dominate as a power supply for cars, aircraft and boats.

Applications

A 1906 gasoline engine Internal combustion engines are most commonly used for mobile propulsion in vehicles and portable machinery. In mobile equipment, internal combustion is advantageous since it can provide high power-to-weight ratios together with excellent fuel energy density. Generally using fossil fuel (mainly petroleum), these engines have appeared in transport in almost all vehicles (automobiles, trucks, motorcycles, boats, and in a wide variety of aircraft and locomotives).

Where very high power-to-weight ratios are required, internal combustion engines appear in the form of gas turbines. These applications include jet aircraft, helicopters, large ships and electric generators.

Nomenclature

At one time, the word, "Engine" (from Latin, via Old French, ingenium, "ability") meant any piece of machinery—a sense that persists in expressions such as siege engine. A "motor" (from Latin motor, "mover") is any machine that produces mechanical power. Traditionally, electric motors are not referred to as "Engines"; however, combustion engines are often referred to as "motors." (An electric engine refers to a locomotive operated by electricity.)

Types of internal combustion engine

Engines can be classified in many different ways: by the engine cycle used, the layout of the engine, source of energy, the use of the engine, or by the cooling system employed.

Engine configurations

Internal combustion engines can be classified by their configuration.

Common layouts of engines are:

Reciprocating:

Two-stroke engine

Four-stroke engine

Six-stroke engine

Diesel engine

Atkinson cycle

Miller cycle

Rotary:
Wankel engine

Continuous combustion:
Gas turbine
Jet engine (including turbojet, turbofan, ramjet, Rocket, etc.)

Operation

Four-stroke cycle (or Otto cycle):
1. Intake
2. Compression
3. Power
4. Exhaust

As their name implies, four-stroke internal combustion engines have four basic steps that repeat with every two revolutions of the engine:
(1) Intake stroke
(2) Compression stroke
(3) Power stroke and
(4) Exhaust stroke.

1. Intake stroke: The first stroke of the internal combustion engine is also known as the suction stroke because the piston moves to the maximum volume position (downward direction in the cylinder). The inlet valve opens as a result of piston movement, and the vaporized fuel mixture enters the combustion chamber. The inlet valve closes at the end of this stroke.

2. Compression stroke: In this stroke, both valves are closed and the piston starts its movement to the minimum volume position (upward direction in the cylinder) and compresses the fuel mixture. During the compression process, pressure, temperature and the density of the fuel mixture increases.

3. Power stroke: When the piston reaches the minimum volume position, the spark plug ignites the fuel mixture and burns. The fuel produces power that is transmitted to the crank shaft mechanism.

4. Exhaust stroke: In the end of the power stroke, the exhaust valve opens. During this stroke, the piston starts its movement in the minimum volume position. The open exhaust valve allows the exhaust gases to escape the cylinder. At the end of this stroke, the exhaust valve closes, the inlet valve opens and the sequence repeats in the next cycle. Four-stroke engines require two revolutions.

Many engines overlap these steps in time; jet engines do all steps simultaneously at different parts of the engines.

Unit 18. THE PROCESS OF COMBUSTION

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Расскажите на русском языке о работе автомобилей с учетом использования различных видов топлива.

Combustion

All internal combustion engines depend on the combustion of a chemical fuel, typically with oxygen from the air (though it is possible to inject nitrous oxide in order to do more of the same thing and gain a power boost). The combustion process typically results in the production of a great quantity of heat, as well as the production of steam and carbon dioxide and other chemicals at very high temperature; the temperature reached is determined by the chemical make up of the fuel and oxidisers (see stoichiometry), as well as by the compression and other factors.

The most common modern fuels are made up of hydrocarbons and are derived mostly from fossil fuels (petroleum). Fossil fuels include diesel fuel, gasoline and petroleum gas, and the rarer use of propane. Except for the fuel delivery components, most internal combustion engines that are designed for gasoline use can run on natural gas or liquefied petroleum gases without major modifications. Large diesels can run with air mixed with gases and a pilot diesel fuel ignition injection. Liquid and gaseous biofuels, such as ethanol and biodiesel (a form of diesel fuel that is produced from crops that yield triglycerides such as soybean oil), can also be used. Engines with appropriate modifications can also run on hydrogen gas, wood gas, or charcoal gas, as well as from so-called producer gas made from other convenient biomass. Recently, experiments have been made with using powdered solid fuels, such as the magnesium injection cycle.

Internal combustion engines require ignition of the mixture, either by spark ignition (SI) or compression ignition (CI). Before the invention of reliable electrical methods, hot tube and flame methods were used. Experimental engines with laser ignition have been built.

Gasoline Ignition Process

Gasoline engine ignition systems generally rely on a combination of a lead–acid battery and an induction coil to provide a high-voltage electric spark to ignite the air-fuel mix in the engine's cylinders. This battery is recharged during operation using an electricity-generating device such as an alternator or generator driven by the engine. Gasoline engines take in a mixture of air and gasoline and compress it to not more than 12.8 bar (1.28 MPa), then use a spark plug to ignite the mixture when it is compressed by the piston head in each cylinder.

Diesel Ignition Process

Diesel engines and HCCI (Homogeneous charge compression ignition) engines, rely solely on heat and pressure created by the engine in its compression process for ignition. The compression level that occurs is usually twice or more than a gasoline engine. Diesel engines will take in air only, and shortly before peak compression, a small quantity of diesel fuel is sprayed into the cylinder via a fuel injector that allows the fuel to instantly ignite. HCCI type engines will take in both air and fuel but continue to rely on an unaided auto-combustion process, due to higher pressures and heat. This is also why diesel and HCCI engines are more susceptible to cold-starting issues, although they will run just as well in cold weather once started. Light duty diesel engines with indirect injection in automobiles and light trucks employ glowplugs that pre-heat the combustion chamber just before starting to reduce no-start conditions in cold weather. Most diesels also have a battery and charging system; nevertheless, this system is secondary and is added by manufacturers as a luxury for the ease of starting, turning fuel on and off (which can also be done via a switch or mechanical apparatus), and for running auxiliary electrical components and accessories. Most new engines rely on electrical and electronic engine control units (ECU) that also adjust the combustion process to increase efficiency and reduce emissions.

Unit 19. TWO-STROKE CONFIGURATION

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Напишите перевод-аннотацию всех отрывков.

Two-stroke cycle

Engines based on the two-stroke cycle use two strokes (one up, one down) for every power stroke. Since there are no dedicated intake or exhaust strokes, alternative methods must be used to scavenge the cylinders. The most common method in spark-ignition two-strokes is to use the downward motion of the piston to pressurize fresh charge in the crankcase, which is then blown through the cylinder through ports in the cylinder walls.

Spark-ignition two-strokes are small and light for their power output and mechanically very simple; however, they are also generally less efficient and more polluting than their four-stroke counterparts. In terms of power per cm^3, a two-stroke engine produces comparable power to an equivalent four-stroke engine. The advantage of having one power stroke for every 360° of crankshaft rotation (compared to 720° in a 4-stroke motor) is balanced by the less complete intake and exhaust and the shorter effective compression and power strokes. It may be possible for a two-stroke to produce more power than an equivalent four-stroke, over a narrow range of engine speeds, at the expense of less power at other speeds.

Small displacement, crankcase-scavenged two-stroke engines have been less fuel-efficient than other types of engines when the fuel is mixed with the air prior to scavenging allowing some of it to escape out of the exhaust port. Modern designs (Sarich and Paggio) use air-assisted fuel injection which avoids this loss, and are more efficient than comparably sized four-stroke engines. Fuel injection is essential for a modern two-stroke engine in order to meet ever more stringent emission standards.

Research continues into improving many aspects of two-stroke motors including direct fuel injection, amongst other things. The initial results have produced motors that are much cleaner burning than their traditional counterparts. Two-stroke engines are widely used in snowmobiles, lawnmowers, string trimmers, chain saws, jet skis, mopeds, outboard motors and many motorcycles. Two-stroke engines have the advantage of an increased specific power ratio (i.e. power to volume ratio), typically around 1.5 times that of a typical four-stroke engine.

The largest internal combustion engines in the world are two-stroke diesels, used in some locomotives and large ships. They use forced induction (similar to super-charging, or turbocharging) to scavenge the cylinders; an example of this type of motor is the Wartsila-Sulzer turbocharged two-stroke diesel as used in large container ships. It is the most efficient and powerful internal combustion engine in the world with over 50 % thermal efficiency. For comparison, the most efficient small four-stroke motors are around 43 % thermal efficiency (SAE 900648); size is an advantage for efficiency due to the increase in the ratio of volume to surface area.

Common cylinder configurations include the straight or inline configuration, the more compact V configuration, and the wider but smoother flat or boxer configuration. Aircraft engines can also adopt a radial configuration which allows more effective cooling. More unusual configurations such as the H, U, X, and W have also been used.

Multiple crankshaft configurations do not necessarily need a cylinder head at all because they can instead have a piston at each end of the cylinder called an opposed piston design. Because here gas in- and outlets are positioned at opposed ends of the cylinder, one can achieve uniflow scavenging, which is, like in the four-stroke engine, efficient over a wide range of revolution numbers. Also the thermal efficiency is improved because of lack of cylinder heads. This design was used in the Junkers Jumo 205 diesel aircraft engine, using at either end of a single bank of cylinders with two crankshafts, and most remarkably in the Napier Deltic diesel engines. These used three crankshafts to serve three banks of double-ended cylinders arranged in an equilateral triangle with the crankshafts at the corners. It was also used in single-bank locomotive engines, and continues to be used for marine engines, both for propulsion and for auxiliary generators.

Wankel

The Wankel cycle. The shaft turns three times for each rotation of the rotor around the lobe and once for each orbital revolution around the eccentric shaft.

The Wankel engine (rotary engine) does not have piston strokes. It operates with the same separation of phases as the four-stroke engine with the phases taking place in separate locations in the engine. In thermodynamic terms it follows the Otto engine cycle, so may be thought of as a "four-phase" engine. While it is true that three power strokes typically occur per rotor revolution due to the 3:1 revolution ratio of the rotor to the eccentric shaft, only one power stroke per shaft revolution actually occurs; this engine provides three power 'strokes' per revolution per rotor giving it a greater power-to-weight ratio than piston engines. This type of engine is most notably used in the current Mazda RX-8, the earlier RX-7 and other models.

Gas turbines

A gas turbine is a rotary machine similar in principle to a steam turbine and it consists of three main components: a compressor, a combustion chamber and a turbine. The air after being compressed in the compressor is heated by burning fuel in it. About ⅔ of the heated air combined with the products of combustion is expanded in a turbine resulting in work output which is used to drive the compressor. The rest (about ⅓) is available as useful work output.

Jet engine

Jet engines take a large volume of hot gas from a combustion process (typically a gas turbine, but rocket forms of jet propulsion often use solid or liquid propellants, and ramjet forms also lack the gas turbine) and feed it through a nozzle which accelerates the jet to high speed. As the jet accelerates through the nozzle, this creates thrust and in turn does useful work.

Unit 20. ENGINE CYCLES

1. Прочитайте текст и познакомьтесь с его общим содержанием.

2. Выпишете термины автомобилестроения и переведите их на русский язык.

3. Составьте 10 вопросов к тексту и попросите своего товарища ответить на них.

Two-stroke

This system manages to pack one power stroke into every two strokes of the piston (up-down). This is achieved by exhausting and recharging the cylinder simultaneously.

The steps involved here are:

Intake and exhaust occur at bottom dead center. Some form of pressure is needed, either crankcase compression or super-charging.

Compression stroke: Fuel-air mix is compressed and ignited. In case of diesel: Air is compressed, fuel is injected and self-ignited.

Power stroke: Piston is pushed downward by the hot exhaust gases.

Two Stroke Spark Ignition (SI) engine:

In a two-stroke SI engine a cycle is completed in two strokes of a piston or one complete revolution (360º) of a crankshaft. In this engine the intake and exhaust strokes are eliminated and ports are used instead of valves. In this cycle, the petrol is mixed with lubricant oil, resulting in a simpler, but more environmentally damaging system, as the excess oils do not burn and are left as a residue. As the piston proceeds downward another port is opened, the fuel/air intake port. Air/fuel/oil mixtures come from the carburetor, where it was mixed, to rest in an adjacent fuel chamber. When the piston moves further down and the cylinder doesn't have anymore gases, fuel mixture starts to flow to the combustion chamber and the second process of fuel compression starts. The design carefully considers the point that the fuel-air mixture should not mix with the exhaust, therefore the processes of fuel injection and exhausting are synchronized to avoid that concern. It should be noted that the piston has three functions in its operation:

The piston acts as the combustion chamber with the cylinder and compresses the air/fuel mixture, receives back the liberated energy, and transfers it to the crankshaft.

The piston motion creates a vacuum that sucks the fuel/air mixture from the carburetor and pushes it from the crankcase (adjacent chamber) to the combustion chamber.

The sides of the piston act like the valves, covering and uncovering the intake and exhaust ports drilled into the side of the cylinder wall.

The major components of a two-stroke spark ignition engine are the:

Cylinder: A cylindrical vessel in which a piston makes an up and down motion.

Piston: A cylindrical component making an up and down movement in the cylinder.

Combustion chamber: A portion above the cylinder in which the combustion of the fuel-air mixture takes place.

Intake and exhaust ports: An intake port allows the fresh fuel-air mixture to enter the combustion chamber and an exhaust port discharges the products of combustion.

Crankshaft: A shaft which converts the reciprocating motion of the piston into a rotary motion.

Connecting rod: A rod which connects the piston with the crankshaft.

Spark plug: An ignition-source located at the cylinder head that is used to initiate the combustion process.

Operation: When the piston moves from bottom dead center (BDC) to top dead center (TDC) the fresh air and fuel mixture enters the crank chamber through the intake port. The mixture enters due to the pressure difference between the crank chamber and the outer atmosphere while simultaneously the fuel-air mixture above the piston is compressed.

Ignition: With the help of a spark plug, ignition takes place at the top of the stroke. Due to the expansion of the gases the piston moves downwards covering the intake port and causes the fuel-air mixture inside the crank chamber to be compressed. When the piston is at bottom dead center the burnt gases escape from the exhaust port.

At the time the transfer port is uncovered the compressed charge from the crank chamber enters into the combustion chamber through the transfer port. The fresh charge is deflected upwards by a hump provided on the top of the piston and removes the exhaust gases from the combustion chamber. Again the piston moves from bottom dead center to top dead center and the fuel-air mixture is compressed when both the exhaust port and transfer ports are covered. The cycle is repeated.

Advantages: • It has no valves or camshaft mechanism, hence simplifying its mechanism and construction • For one complete revolution of the crankshaft, the engine executes one cycle—the 4-stroke executes one cycle per two crankshafts revolutions. • Less weight and easier to manufacture. • High power-to-weight ratio.

Disadvantages: • The lack of lubrication system that protects the engine parts from wear. Accordingly, the 2-stroke engines have a shorter life. • 2-stroke engines do not consume fuel efficiently. • 2-stroke engines produce lots of pollution. • Sometimes part of the fuel leaks to the exhaust with the exhaust gases. In conclusion, based on the above advantages and disadvantages, the 2-stroke engines are supposed to operate in vehicles where the weight of the engine is required to be small and it is not used continuously for long periods of time.

Four-stroke

Idealized Pressure/volume diagram of the Otto cycle showing combustion heat input Qp and waste exhaust output Qo, the power stroke is the top curved line, the bottom is the compression stroke.

Engines based on the four-stroke ("Otto cycle") have one power stroke for every four strokes (up-down-up-down) and employ spark plug ignition. Combustion occurs rapidly and during combustion the volume varies little ("constant volume"). They are used in cars, larger boats, some motorcycles, and many light aircraft. They are generally quieter, more efficient, and larger than their two-stroke counterparts.

The steps involved here are:

Intake stroke: Air and vaporized fuel are drawn in.

Compression stroke: Fuel vapor and air are compressed and ignited.

Combustion stroke: Fuel combusts and piston are pushed downwards.

Exhaust stroke: Exhaust is driven out. During the 1st, 2nd, and 4th stroke the piston is relying on power and the momentum generated by the other pistons. In that case, a four-cylinder engine would be less powerful than a six- or eight-cylinder engine.

There are a number of variations of these cycles, most notably the Atkinson and Miller cycles. The diesel cycle is somewhat different.

Split-cycle engines separate the four strokes of intake, compression, combustion and exhaust into two separate but paired cylinders. The first cylinder is used for intake and compression. The compressed air is then transferred through a crossover passage from the compression cylinder into the second cylinder, where combustion and exhaust occur. A split-cycle engine is really an air compressor on one side with a combustion chamber on the other.

Previous split-cycle engines have had two major problems – poor breathing (volumetric efficiency) and low thermal efficiency. However, new designs are being introduced that seek to address these problems.

The Scuderi Engine addresses the breathing problem by reducing the clearance between the piston and the cylinder head through various turbo charging techniques. The Scuderi design requires the use of outwardly opening valves that enable the piston to move very close to the cylinder head without the interference of the valves. Scuderi addresses the low thermal efficiency via firing ATDC.

Firing ATDC can be accomplished by using high-pressure air in the transfer passage to create sonic flow and high turbulence in the power cylinder.

Diesel cycle

P-v Diagram for the Ideal Diesel cycle. The cycle follows the numbers 1-4 in clockwise direction.

Most truck and automotive diesel engines use a cycle reminiscent of a four-stroke cycle, but with a compression heating ignition system, rather than needing a separate ignition system. This variation is called the diesel cycle. In the diesel cycle, diesel fuel is injected directly into the cylinder so that combustion occurs at constant pressure, as the piston moves.

Otto cycle: Otto cycle is the typical cycle for most of the cars internal combustion engines, that work using gasoline as a fuel. Otto cycle is exactly the same one that was described for the four-stroke engine. It consists of the same four major steps: Intake, compression, ignition and exhaust.

Five-stroke

The British company ILMOR presented a prototype of 5-Stroke double expansion engine, having two outer cylinders, working as usual, plus a central one, larger in diameter, that performs the double expansion of exhaust gas from the other cylinders, with an increased efficiency in the gas energy use, and an improved SFC. This engine corresponds to a 2003 US patent by Gerhard Schmitz, and was developed apparently also by Honda of Japan for a Quad engine. This engine has a similar precedent in a Spanish 1942 patent (# P0156621), by Francisco Jimeno-Cataneo, and a 1975 patent (# P0433850) by Carlos Ubierna-Laciana (www.oepm.es). The concept of double expansion was developed early in the history of ICE by Otto himself, in 1879, and a Connecticut (USA) based company, EHV, built in 1906 some engines and cars with this principle, that didn't give the expected results.

Six-stroke

First invented in 1883, the six-stroke engine has seen renewed interest over the last 20 or so years.

Four kinds of six-stroke use a regular piston in a regular cylinder (Griffin six-stroke, Bajulaz six-stroke, Velozeta six-stroke and Crower six-stroke), firing every three crankshaft revolutions. The systems capture the wasted heat of the four-stroke Otto cycle with an injection of air or water.

The Beare Head and "piston charger" engines operate as opposed-piston engines, two pistons in a single cylinder, firing every two revolutions rather more like a regular four-stroke.

Brayton cycle

A gas turbine is a rotary machine somewhat similar in principle to a steam turbine and it consists of three main components: a compressor, a combustion chamber and a turbine. The air after being compressed in the compressor is heated by burning fuel in it, this heats and expands the air, and this extra energy is tapped by the turbine which in turn powers the compressor closing the cycle and powering the shaft.

Gas turbine cycle engines employ a continuous combustion system where compression, combustion, and expansion occur simultaneously at different places in the engine giving continuous power. Notably, the combustion takes place at constant pressure, rather than with the Otto cycle, constant volume.

Obsolete

The very first internal combustion engines did not compress the mixture. The first part of the piston down stroke drew in a fuel-air mixture, then the inlet valve closed and, in the remainder of the down-stroke, the fuel-air mixture fired. The exhaust valve opened for the piston upstroke. These attempts at imitating the principle of a steam engine were very inefficient.

Unit 21. FUELS AND OXIDIZERS

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Расскажите о видах топлива, используемых в автомобилях на английском языке.

Types of fuels and oxidizers

Engines are often classified by the fuel (or propellant) used.

Fuels

Nowadays, fuels used include:

Petroleum:

Petroleum spirit (North American term: gasoline, British term: petrol)

Petroleum diesel.

Autogas (liquified petroleum gas).

Compressed natural gas.

Jet fuel (aviation fuel)

Residual fuel

Coal:
Most methanol is made from coal.
Gasoline can be made from carbon (coal) using the Fischer-Tropsch process
Diesel fuel can be made from carbon using the Fischer-Tropsch process
Biofuels and vegoils:
Peanut oil and other vegoils.
Biofuels:
Biobutanol (replaces gasoline).
Biodiesel (replaces petrodiesel).
Bioethanol and Biomethanol (wood alcohol) and other biofuels (see Flexible-fuel vehicle).

Biogas

Even fluidized metal powders and explosives have seen some use. Engines that use gases for fuel are called gas engines and those that use liquid hydrocarbons are called oil engines; however, gasoline engines are also often colloquially referred to as "gas engines" ("petrol engines" in the UK).

The main limitations on fuels are that it must be easily transportable through the fuel system to the combustion chamber, and that the fuel releases sufficient energy in the form of heat upon combustion to make practical use of the engine.

Diesel engines are generally heavier, noisier and more powerful at lower speeds than gasoline engines. They are also more fuel-efficient in most circumstances and are used in heavy road vehicles, some automobiles (increasingly so for their increased fuel efficiency over gasoline engines), ships, railway locomotives and light aircraft. Gasoline engines are used in most other road vehicles including most cars, motorcycles and mopeds. Note that in Europe, sophisticated diesel-engined cars have taken over about 40 % of the market since the 1990s. There are also engines that run on hydrogen, methanol, ethanol, liquefied petroleum gas (LPG), biodiesel, wood gas & charcoal gas. Paraffin and tractor vaporizing oil (TVO) engines are no longer seen.

Hydrogen

Hydrogen could eventually replace conventional fossil fuels in traditional internal combustion engines. Alternatively fuel cell technology may come to deliver its promise and the use of the internal combustion engines could even be phased out.

Although there are multiple ways of producing free hydrogen, those methods require converting combustible molecules into hydrogen or consuming electric energy. Unless that electricity is produced from a renewable source and is not required for other purposes hydrogen does not solve any energy crisis. In many situations the disadvantage of hydrogen, relative to carbon fuels, is its storage. Liquid hydrogen has extremely low density (14 times lower than water) and requires extensive insulation whilst gaseous hydrogen requires heavy tankage. Even when liquefied, hydrogen has a higher specific energy but the volumetric energetic storage is still roughly five times lower than petrol. However, the energy density of hydrogen is considerably higher than that of electric batteries, making it a serious contender as an energy carrier to replace fossil fuels. The "Hydrogen on Demand" process (see direct borohydride fuel cell) creates hydrogen as it is needed, but has other issues such as the high price of the sodium borohydride which is the raw material.

Oxidizers

Since air is plentiful at the surface of the earth, the oxidizer is typically atmospheric oxygen which has the advantage of not being stored within the vehicle, increasing the power-to-weight and power to volume ratios. There are other materials that are used for special purposes, often to increase power output or to allow operation under water or in space.

Compressed air has been commonly used in torpedoes.

Compressed oxygen, as well as some compressed air, was used in the Japanese Type 93 torpedo. Some submarines are designed to carry pure oxygen. Rockets very often use liquid oxygen.

Nitromethane is added to some racing and model fuels to increase power and control combustion.

Nitrous oxide has been used with extra gasoline in tactical aircraft and in specially equipped cars to allow short bursts of added power from engines that otherwise run on gasoline and air. It is also used in the Burt Rutan rocket spacecraft.

Hydrogen peroxide power was under development for German World War II submarines and may have been used in some non-nuclear submarines and was used on some rocket engines (notably Black Arrow and Me-163 rocket plane).

Other chemicals such as chlorine or fluorine have been used experimentally, but have not been found to be practical.

Unit 22. ENGINE STARTING

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Расскажите на английском языке о том, как надо завести двигатель.
4. Сообщите об эффективности работы двигателя на английском языке.

Ways of engine starting

An internal combustion engine is not usually self-starting so an auxiliary machine is required to start it. Many different systems have been used in the past but modern engines are usually started by an electric motor in the small and medium sizes or by compressed air in the large sizes.

Measures of engine performance

Engine types vary greatly in a number of different ways:

energy efficiency

fuel/propellant consumption (brake specific fuel consumption for shaft engines, thrust specific fuel consumption for jet engines)

power-to-weight ratio

thrust to weight ratio

Torque curves (for shaft engines) thrust lapse (jet engines)

Compression ratio for piston engines, overall pressure ratio for jet engines and gas turbines

Energy efficiency

Once ignited and burnt, the combustion products hot gases have more available thermal energy than the original compressed fuel-air mixture (which had higher chemical energy). The available energy is manifested as high temperature and pressure that can be translated into work by the engine. In a reciprocating engine, the high-pressure gases inside the cylinders drive the engine's pistons.

Once the available energy has been removed, the remaining hot gases are vented (often by opening a valve or exposing the exhaust outlet) and this allows the piston to return to its previous position (top dead center, or TDC). The piston can then proceed to the next phase of its cycle, which varies between engines. Any heat that isn't translated into work is normally considered a waste product and is removed from the engine either by an air or liquid cooling system.

Internal combustion engines are primarily heat engines, and as such their theoretical efficiency can be calculated by idealized thermodynamic cycles. The efficiency of a theoretical cycle cannot exceed that of the Carnot cycle, whose efficiency is determined by the difference between the lower and upper operating temperatures of the engine. The upper operating temperature of a terrestrial engine is limited by the thermal stability of the materials used to construct it. All metals and alloys eventually melt or decompose, and there is significant researching into ceramic materials that can be made with greater thermal stability and desirable structural properties. Higher thermal stability allows for greater temperature difference between the lower and upper operating temperatures, hence greater thermodynamic efficiency.

The thermodynamic limits assume that the engine is operating under ideal conditions: a frictionless world, ideal gases, perfect insulators and operation for infinite time. Real world applications introduce complexities that reduce efficiency. For example, a real engine runs best at a specific load, termed its power band. The engine in a car cruising on a highway is usually operating significantly below its ideal load, because it is designed for the higher loads required for rapid acceleration. In addition, factors such as wind resistance reduce overall system efficiency. Engine fuel economy is usually measured in the units of miles per gallon (or fuel consumption in liters per 100 kilometers) for automobiles. The volume of hydrocarbon assumes a standard energy content.

Most steel engines have a thermodynamic limit of 37 %. Even when aided with turbochargers and stock efficiency aids, most engines retain an average efficiency of about 18 %–20 %. Rocket engine efficiencies are better still, up to 70 %, because they operate at very high temperatures and pressures and can have very high expansion ratios.

There are many inventions aimed at increasing the efficiency of IC engines. In general, practical engines are always compromised by trade-offs between different properties such as efficiency, weight, power, heat, response, exhaust emissions, or noise. Sometimes economy also plays a role in not only the cost of manufacturing the engine itself, but also manufacturing and distributing the fuel. Increasing the engine's efficiency brings better fuel economy but only if the fuel cost per energy content is the same.

Measures of fuel/propellant efficiency

For stationary and shaft engines including propeller engines, fuel consumption is measured by calculating the brake specific fuel consumption which measures the mass flow rate of fuel consumption divided by the power produced.

For internal combustion engines in the form of jet engines, the power output varies drastically with airspeed and a less variable measure is used: thrust specific fuel consumption (TSFC), which is the number of pounds of propellant that is needed to generate impulses that measure a pound force-hour. In metric units, the number of grams of propellant needed to generate an impulse that measures one kilonewton-second.

For rockets, TSFC can be used, but typically other equivalent measures are traditionally used, such as specific impulse and effective exhaust velocity.

Unit 23. AIR AND NOISE POLLUTION

1. Прочитайте текст и познакомьтесь с его общим содержанием.

2. Выпишете термины автомобилестроения и переведите их на русский язык.

3. Побеседуйте в форме диалога на английском языке о проблемах загрязнения окружающей среды автомобилями.

Air pollution

Internal combustion engines such as reciprocating internal combustion engines produce air pollution emissions, due to incomplete combustion of carbonaceous fuel. The main derivatives of the process are carbon dioxide CO_2, water and some soot – also called particulate matter (PM). The effects of inhaling particulate matter have been studied in humans and animals and include asthma, lung cancer, cardiovascular issues and premature death. There are, however, some additional products of the combustion process that include nitrogen oxides and sulfur and some uncombusted hydrocarbons, depending on the operating conditions and the fuel-air ratio.

Not all of the fuel will be completely consumed by the combustion process; a small amount of fuel will be present after combustion, some of which can react to form oxygenates, such as formaldehyde or acetaldehyde, or hydrocarbons not initially present in the fuel mixture. The primary causes of this is the need to operate near the stoichiometric ratio for gasoline engines in order to achieve combustion and the resulting "quench" of the flame by the relatively cool cylinder walls, otherwise the fuel would burn more completely in excess air. When running at lower speeds, quenching is commonly observed in diesel (compression ignition) engines that run on natural gas. It reduces the efficiency and increases knocking, sometimes causing the engine to stall. Increasing the amount of air in the engine reduces the amount of the first two pollutants but tends to encourage the oxygen and nitrogen in the air to combine to produce nitrogen oxides (NO_x) that has been demonstrated to be hazardous to both plant and animal health. Further chemicals released are benzene and 1,3-butadiene that are also particularly harmful; and not all of the fuel burns up completely, so carbon monoxide (CO) is also produced.

Carbon fuels contain sulfur and impurities that eventually lead to producing sulfur monoxides (SO) and sulfur dioxide (SO_2) in the exhaust which promotes acid rain. One final element in exhaust pollution is ozone (O_3). This is not emitted directly but made in the air by the action of sunlight on other pollutants to form "ground level ozone", which, unlike the "ozone layer" in the high atmosphere, is regarded as a bad thing if the levels are too high. Ozone is broken down by nitrogen oxides, so one tends to be lower where the other is higher.

For the pollutants described above (nitrogen oxides, carbon monoxide, sulphur dioxide, and ozone), there are accepted levels that are set by legislation to which no harmful effects are observed – even in sensitive population groups. For the other three: benzene, 1,3-butadiene, and particulates, there is no way of proving they are safe at any level so the experts set standards where the risk to health is, "exceedingly small".

Noise pollution

Significant contributions to noise pollution are made by internal combustion engines. Automobile and truck traffic operating on highways and street systems produce noise, as do aircraft flights due to jet noise, particularly supersonic-capable aircraft. Rocket engines create the most intense noise.

Idling

Internal combustion engines continue to consume fuel and emit pollutants when idling so it is desirable to keep periods of idling to a minimum. Many bus companies now instruct drivers to switch off the engine when the bus is waiting at a terminus.

In the UK (but applying only to England), the Road Traffic (Vehicle Emissions) (Fixed Penalty) Regulations 2002 (Statutory Instrument 2002 No. 1808) introduced the concept of a "stationary idling offence". This means that a driver can be ordered "by an authorised person ... upon production of evidence of his authorisation, require him to stop the running of the engine of that vehicle" and a "person who fails to comply ... shall be guilty of an offence and be liable on summary conviction to a fine not exceeding level 3 on the standard scale". Only a few local authorities have implemented the regulations, one of them being Oxford City Council.

Unit 24. ELECTRIC VEHICLES

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Сделайте сообщение на английском языке о достоинствах и недостатках электромобилей.

Electric vehicles and their types

An electric vehicle (EV), also referred to as an electric drive vehicle, uses one or more electric motors or traction motors for propulsion. Three main types of electric vehicles exist, those that are directly powered from an external power station, those that are powered by stored electricity originally from an external power source, and those that are powered by an on-board electrical generator, such as an engine (a hybrid electric vehicle), or a hydrogen fuel cell. Electric vehicles include electric cars, electric trains, electric lorries, electric aeroplanes, electric boats, electric motorcycles and scooters and electric spacecraft.

Electric vehicles first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline cars of the time. The internal combustion engine (ICE) is the dominant propulsion method for motor vehicles but electric power has remained commonplace in other vehicle types, such as trains and smaller vehicles of all types.

During the last few decades, environmental impact of the petroleum-based transportation infrastructure, along with the peak oil, has led to renewed interest in an electric transportation infrastructure. Electric vehicles differ from fossil fuel-powered vehicles in that the electricity they consume can be generated from a wide range of sources, including fossil fuels, nuclear power, and renewable sources such as tidal power, solar power, and wind power or any combination of those. Currently, though, there are more than 400 coal power plants in the U.S. alone. However it is generated, this energy is then transmitted to the vehicle through use of overhead lines, wireless energy transfer such as inductive charging, or a direct connection through an electrical cable. The electricity may then be stored on board the vehicle using a battery, flywheel, or supercapacitors. Vehicles making use of engines working on the principle of combustion can usually only derive their energy from a single or a few sources, usually non-renewable fossil fuels. A key advantage of electric or hybrid electric vehicles is regenerative braking and suspension; their ability to recover energy normally lost during braking as electricity to be restored to the on-board battery.

In 2003, the first mass-produced hybrid gasoline-electric car, the Toyota Prius, was introduced worldwide, in the same year GoinGreen in London launched the G-Wiz electric car, a quadricycle that became the world's best selling EV, and the first battery electric car produced by a major auto company, the Nissan Leaf debuted in December 2010. California auto maker Fisker Automotive was the first to introduce a premium luxury Electric Vehicle with extended range, the Fisker Karma. Other major auto companies have electric cars in development, and various nations around the world are building pilot networks of charging stations to recharge them.

History

Electric motive power started with a small drifter operated by a miniature electric motor, built by Thomas Davenport in 1835. In 1838, a Scotsman named Robert Davidson built an electric locomotive that attained a speed of four miles per hour (6 km/h). In England a patent was granted in 1840 for the use of rails as conductors of electric current, and similar American patents were issued to Lilley and Colten in 1847.

Between 1832 and 1839 (the exact year is uncertain), Robert Anderson of Scotland invented the first crude electric carriage, powered by non-rechargeable primary cells.

By the 20th century, electric cars and rail transport were commonplace, with commercial electric automobiles having the majority of the market. Over time their general-purpose commercial use reduced to specialist roles, as platform trucks, forklift trucks, ambulances, tow tractors and urban delivery vehicles, such as the iconic British milk float; for most of the 20th century, the UK was the world's largest user of electric road vehicles.

Electrified trains were used for coal transport, as the motors did not use precious oxygen in the mines. Switzerland's lack of natural fossil resources forced the rapid electrification of their rail network. One of the earliest rechargeable batteries – the nickel-iron battery – was favored by Edison for use in electric cars.

Electric vehicles were among the earliest automobiles, and before the preeminence of light, powerful internal combustion engines, electric automobiles held many vehicle land speed and distance records in the early 1900s. They were produced by Baker Electric, Columbia Electric, Detroit Electric, and others, and at one point in history out-sold gasoline-powered vehicles.

In the 1930s, National City Lines, which was a partnership of General Motors, Firestone, and Standard Oil of California purchased many electric tram networks across the country to dismantle them and replace them with GM buses. The partnership was convicted of conspiring to monopolize the sale of equipment and supplies to their subsidiary companies conspiracy, but were acquitted of conspiring to monopolize the provision of transportation services. Electric tram line technologies could be used to recharge BEVs and PHEVs on the highway while the user drives, providing virtually unrestricted driving range. The technology is old and well established (see : Conduit current collection, Nickel-iron battery). The infrastructure has not been built.

Experimentation

In January 1990, General Motors' President introduced its EV concept two-seater, the "Impact", at the Los Angeles Auto Show. That September, the

California Air Resources Board mandated major-automaker sales of EVs, in phases starting in 1998. From 1996 to 1998 GM produced 1117 EV1s, 800 of which were made available through three-year leases.

Chrysler, Ford, GM, Honda, Nissan and Toyota also produced limited numbers of EVs for California drivers. In 2003, upon the expiration of GM's EV1 leases, GM crushed them. The crushing has variously been attributed to 1) the auto industry's successful federal court challenge to California's zero-emissions vehicle mandate, 2) a federal regulation requiring GM to produce and maintain spare parts for the few thousands EV1s and 3) the success of the oil and auto industries' media campaign to reduce public acceptance of electric vehicles.

A movie made on the subject in 2005-2006 was titled Who Killed the Electric Car? and released theatrically by Sony Pictures Classics in 2006. The film explores the roles of automobile manufacturers, oil industry, the U.S. government, batteries, hydrogen vehicles, and consumers, and each of their roles in limiting the deployment and adoption of this technology.

Ford released a number of their Ford Ecostar delivery vans into the market. Honda, Nissan and Toyota also repossessed and crushed most of their EVs, which, like the GM EV1s, had been available only by closed-end lease. After public protests, Toyota sold 200 of its RAV EVs to eager buyers; they now sell, five years later, at over their original forty-thousand-dollar price. This lesson did not go unlearned; BMW of Canada sold off a number of Mini EV's when their Canadian testing ended.

The production of the Citroën Berlingo Electrique stopped in September 2005.

Reintroduction

With increasing prices of gasoline, electric vehicles are hitting the mainstream.

Major car makers, such as Ford, Daimler AG, Toyota Motor Corp., General Motors Corp., Renault SA, Peugeot-Citroen, VW, Nissan and Mitsubishi Corp., are developing new-generation electric vehicles.

Electricity sources

There are many ways to generate electricity, of varying costs, efficiency and ecological desirability.

Connection to generator plants

Direct connection to generation plants as is common among electric trains, trolley buses, and trolley trucks (See also : overhead lines, third rail and conduit current collection).

Unit 25. HYBRID ELECTRIC VEHICLES

1. Прочитайте текст и познакомьтесь с его общим содержанием.

2. Выпишете термины автомобилестроения и переведите их на русский язык.

3. Побеседуйте в форме полилога на английском языке о гибридных автомобилях.

Onboard generators and hybrid electric vehicle

(See articles on diesel-electric and gasoline-electric hybrid locomotion for information on electric vehicles using also combustion engines).

- renewable sources such as solar power: solar vehicle
- generated on-board using a diesel engine: diesel-electric locomotive
- generated on-board using a fuel cell: fuel cell vehicle
- generated on-board using nuclear energy: nuclear submarines and aircraft carriers

It is also possible to have hybrid electric vehicles that derive electricity from multiple sources. Such as:

- on-board rechargeable electricity storage system (RESS) and a direct continuous connection to land-based generation plants for purposes of on-highway recharging with unrestricted highway range
- on-board rechargeable electricity storage system and a fueled propulsion power source (internal combustion engine): plug-in hybrid

Another form of chemical to electrical conversion is fuel cells, projected for future use.

For especially large electric vehicles, such as submarines, the chemical energy of the diesel-electric can be replaced by a nuclear reactor. The nuclear reactor usually provides heat, which drives a steam turbine, which drives a generator, which is then fed to the propulsion. (See Nuclear Power)

A few experimental vehicles, such as some cars and a handful of aircraft use solar panels for electricity.

Onboard storage

These systems are powered from an external generator plant (nearly always when stationary), and then disconnected before motion occurs, and the electricity is stored in the vehicle until needed.

on-board rechargeable electricity storage system (RESS), called Full Electric Vehicles (FEV). Power storage methods include:

- chemical energy stored on the vehicle in on-board batteries: Battery electric vehicle (BEV);

- static energy stored on the vehicle in on-board electric double-layer capacitors;
- kinetic energy storage: flywheels.

Batteries, electric double-layer capacitors and flywheel energy storage are forms of rechargeable on-board electrical storage. By avoiding an intermediate mechanical step, the energy conversion efficiency can be improved over the hybrids already discussed, by avoiding unnecessary energy conversions. Furthermore, electro-chemical batteries conversions are easy to reverse, allowing electrical energy to be stored in chemical form.

Electric motor

The power of a vehicle electric motor, as in other vehicles, is measured in kilowatts (kW). 100 kW is roughly equivalent to 134 horsepower, although most electric motors deliver full torque over a wide RPM range, so the performance is not equivalent, and far exceeds a 134 horsepower (100 kW) fuel-powered motor, which has a limited torque curve.

Usually, direct current (DC) electricity is fed into a DC/AC inverter where it is converted to alternating current (AC) electricity and this AC electricity is connected to a 3-phase AC motor. For electric trains, DC motors are often used.

Vehicle types

It is generally possible to equip any kind of vehicle with an electric powertrain.

Hybrid electric vehicle

A hybrid electric vehicle combines a conventional (usually fossil fuel-powered) powertrain with some form of electric propulsion. Common examples include hybrid electric cars such as the Toyota Prius.

Unit 26. ON- AND OFF-ROAD ELECTRIC VEHICLES

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Представьте перевод-аннотацию текстов.

Types of on- and off-road electric vehicles

Electric vehicles are on the road in many functions, including electric cars, electric trolleybuses, electric buses, electric trucks, electric bicycles, electric motorcycles and scooters, neighborhood electric vehicles, golf carts, milk floats, and forklifts. Off-road vehicles include electrified all-terrain vehicles and tractors.

Railborne electric vehicles

The fixed nature of a rail line makes it relatively easy to power electric vehicles through permanent overhead lines or electrified third rails, eliminating the need for heavy onboard batteries. Electric locomotives, electric trams/street cars/trolleys, electric light rail systems, and electric rapid transit are all in common use today, especially in Europe and Asia.

Since electric trains do not need to carry a heavy internal combustion engine or large batteries, they can have very good power-to-weight ratios. This allows high speed trains such as France's double-deck TGVs to operate at speeds of 320 km/h (200 mph) or higher, and electric locomotives to have a much higher power output than diesel locomotives. In addition they have higher short-term surge power for fast acceleration and using regenerative braking can put braking power back into the electrical grid rather than wasting it.

Maglev trains are also nearly always electric vehicles.

Airborne electric vehicles

Since the beginning of the era of aviation, electric power for aircraft has received a great deal of experimentation. Currently flying electric aircraft include manned and unmanned aerial vehicles.

Seaborne electric vehicles

Electric boats were popular around the turn of the 20th century. Interest in quiet and potentially renewable marine transportation has steadily increased since the late 20th century, as solar cells have given motorboats the infinite range of sailboats. Submarines use batteries (charged by diesel or gasoline engines at the surface), nuclear power, or fuel cells to run electric motor driven propellers.

Spaceborne electric vehicles

Electric power has a long history of use in spacecraft. The power sources used for spacecraft are batteries, solar panels and nuclear power. Current methods of propelling a spacecraft with electricity include the arcjet rocket, the electrostatic ion thruster, the Hall effect thruster, and Field Emission Electric Propulsion. A number of other methods have been proposed, with varying levels of feasibility.

Energy and motors

Most large electric transport systems are powered by stationary sources of electricity that are directly connected to the vehicles through wires. Electric traction allows the use of regenerative braking, in which the motors are used as brakes and become generators that transform the motion of, usually, a train into electrical power that is then fed back into the lines. This system is particularly advantageous in mountainous operations, as descending vehicles can produce a large portion of the power required for those ascending. This regenerative system is only viable if the system is large enough to utilise the power generated by descending vehicles.

In the systems above motion is provided by a rotary electric motor. However, it is possible to "unroll" the motor to drive directly against a special matched track. These linear motors are used in maglev trains which float above the rails supported by magnetic levitation. This allows for almost no rolling resistance of the vehicle and no mechanical wear and tear of the train or track. In addition to the high-performance control systems needed, switching and curving of the tracks becomes difficult with linear motors, which to date has restricted their operations to high-speed point to point services.

Unit 27. PROPERTIES OF ELECTRIC VEHICLES

1. Прочитайте текст и познакомьтесь с его общим содержанием.
2. Выпишете термины автомобилестроения и переведите их на русский язык.
3. Сделайте сообщение на английском языке о видах батарей в автомобилях.

Types and properties of electric vehicles

Components

The type of battery, the type of traction motor and the motor controller design vary according to the size, power and proposed application, which can be as small as a motorized shopping cart or wheelchair, through pedilecs, electric motorcycles and scooters, neighborhood electric vehicles, industrial fork-lift trucks and including many hybrid vehicles.

Energy sources

Although electric vehicles have few direct emissions, all rely on energy created through electricity generation, and will usually emit pollution and generate waste, unless it is generated by renewable source power plants. Since electric vehicles use whatever electricity is delivered by their electrical utility/grid operator, electric vehicles can be made more or less efficient, polluting and expensive to run, by modifying the electrical generating stations. This would be done by an electrical utility under a government energy policy, in a timescale negotiated between utilities and government.

Fossil fuel vehicle efficiency and pollution standards take years to filter through a nation's fleet of vehicles. New efficiency and pollution standards rely on the purchase of new vehicles, often as the current vehicles already on the road reach their end-of-life. Only a few nations set a retirement age for old vehicles, such as Japan or Singapore, forcing periodic upgrading of all vehicles already on the road.

Electric vehicles will take advantage of whatever environmental gains happen when a renewable energy generation station comes online, a fossil-fuel power station is decommissioned or upgraded. Conversely, if government policy or economic conditions shifts generators back to use more polluting fossil fuels and internal combustion engine vehicles (ICEVs), or more inefficient sources, the reverse can happen. Even in such a situation, electrical vehicles are still more efficient than a comparable amount of fossil fuel vehicles. In areas with a deregulated electrical energy market, an electrical vehicle owner can choose whether to run his electrical vehicle off conventional electrical energy sources, or strictly from renewable electrical energy sources (presumably at an additional cost), pushing other consumers onto conventional sources and switch at any time between the two.

Electric vehicle battery

Automotive battery.

An electric vehicle battery (EVB) or traction battery is a rechargeable battery used for propulsion of battery electric vehicles (BEVs). Traction batteries are used in forklifts, electric Golf carts, riding floor scrubbers, electric motorcycles, full-size electric cars, trucks and vans, and other electric vehicles.

Electric vehicle batteries differ from starting, lighting, and ignition (SLI) batteries because they are designed to give power over sustained periods of time. Deep cycle batteries are used instead of SLI batteries for these applications. Traction batteries must be designed with a high ampere-hour capacity. Batteries for electric vehicles are characterized by their relatively high power-to-weight ratio, energy to weight ratio and energy density; smaller, lighter batteries reduce the weight of the vehicle and improve its performance. Compared to liquid fuels, all current battery technologies have much lower specific energy; and this often impacts the maximum all-electric range of the vehicles.

Batteries are usually the most expensive component of BEVs. The cost of battery manufacture is substantial, but increasing returns to scale lower costs. Since the late 1990s, advances in battery technologies have been driven by demand for laptop computers and mobile phones, with consumer demand for more features, larger, brighter displays, and longer battery time driving research and development in the field. The BEV marketplace has reaped the benefits of these advances.

Traction batteries are routinely used all day, and fast–charged all night. Forklifts, for instance, are usually discharged and recharged every 24 hours of the work week.

The predicted market for automobile traction batteries is over $37 billion in 2020.

On an energy basis, the price of electricity to run an EV is a small fraction of the cost of liquid fuel needed to produce an equivalent amount of energy (energy efficiency). The cost of replacing the batteries dominates the operating costs.

Lead-acid

Flooded lead-acid batteries are the cheapest and most common traction batteries available, usually discharged to roughly 80 %. They will accept high charge rates for fast charges. Flooded batteries require inspection of electrolyte level and replacement of water.

Traditionally, most electric vehicles have used lead-acid batteries due to their mature technology, high availability and low cost (exception: some early EVs, such as the Detroit Electric, used a nickel-iron battery.) Like all batteries, these have an environmental impact through their construction, use, disposal or recycling. On the upside, vehicle battery recycling rates top 95 % in the United States. Deep-cycle lead batteries are expensive and have a shorter life than the vehicle itself, typically needing replacement every 3 years.

Lead-acid batteries in EV applications end up being a significant (25-50 %) portion of the final vehicle mass. Like all batteries, they have significantly lower energy density than petroleum fuels-in this case, 30-40 Wh/kg. While the difference isn't as extreme as it first appears due to the lighter drive-train in an EV, even the best batteries tend to lead to higher masses when applied to vehicles with a normal range. The efficiency (70-75 %) and storage capacity of the current generation of common deep cycle lead acid batteries decreases with lower temperatures, and diverting power to run a heating coil reduces efficiency and range by up to 40 %. Recent advances in battery efficiency, capacity, materials, safety, toxicity and durability are likely to allow these superior characteristics to be applied in car-sized EVs.

Charging and operation of batteries typically results in the emission of hydrogen, oxygen and sulfur, which are naturally occurring and normally harmless if properly vented. Early Citicar owners discovered that, if not vented properly, unpleasant sulfur smells would leak into the cabin immediately after charging.

Nickel metal hydride

Nickel-metal hydride batteries are now considered a relatively mature technology. While less efficient (60-70 %) in charging and discharging than even lead-acid, they boast an energy density of 30-80 Wh/kg, far higher than lead-acid. When used properly, nickel-metal hydride batteries can have exceptionally long lives, as has been demonstrated in their use in hybrid cars and surviving NiMH RAV4EVs that still operate well after 100,000 miles (160,000 km) and over a decade of service. Downsides include the poor efficiency, high self-discharge, very finicky charge cycles, and poor performance in cold weather.

GM Ovonic produced the NiMH battery used in the second generation EV-1, and Cobasys makes a nearly identical battery (ten 1.2 V 85 Ah NiMH cells in series in contrast with eleven cells for Ovonic battery). This worked very well in the EV-1. Patent encumbrance has limited the use of these batteries in recent years.

Zebra

The sodium or "zebra" battery uses a molten chloroaluminate ($NaAlCl_4$) sodium as the electrolyte. This chemistry is also occasionally referred to as "hot salt". A relatively mature technology, the Zebra battery boasts an energy density of 120Wh/kg and reasonable series resistance. Since the battery must be heated for use, cold weather doesn't strongly affect its operation except for in increasing heating costs. They have been used in several EVs. Zebras can last for a few thousand charge cycles and are nontoxic. The downsides to the Zebra battery include poor power density (<300 W/kg) and the requirement of having to heat the electrolyte to about 270 °C (520 °F), which wastes some energy and presents difficulties in long-term storage of charge.

Zebra batteries have been used in the Modec vehicle, commercial vehicle since it entered production in 2006.

Lithium ion

Lithium-ion (and similar lithium polymer) batteries, widely known through their use in laptops and consumer electronics, dominate the most recent group of EVs in development. The traditional lithium-ion chemistry involves a lithium cobalt oxide cathode and a graphite anode. This yields cells with an impressive 200+ Wh/kg energy density and good power density, and 80 to 90 %

charge/discharge efficiency. The downsides of traditional lithium-ion batteries include short cycle lives (hundreds to a few thousand charge cycles) and significant degradation with age. The cathode is also somewhat toxic. Also, traditional lithium-ion batteries can pose a fire safety risk if punctured or charged improperly. These laptop cells don't accept or supply charge in cold conditions, and so expensive and energy inefficient systems are necessary to warm them up. The maturity of this technology is moderate. The Tesla Roadster uses "blades" of traditional lithium-ion "laptop battery" cells that can be replaced individually as needed.

Most other EVs are utilizing new variations on lithium-ion chemistry that sacrifice energy and power density to provide fire resistance, environmental friendliness, very rapid charges (as low as a few minutes) and very long lifespans. These variants (phosphates, titanates, spinels, etc.) have been shown to have a much longer lifetime, with A123 expecting their lithium iron phosphate batteries to last for at least 10+ years and 7000+ charge cycles, and LG Chem expecting their lithium-manganese spinel batteries to last up to 40 years.

Much work is being done on lithium ion batteries in the lab. Lithium vanadium oxide has already made its way into the Subaru prototype G4e, doubling energy density. Silicon nanowires, silicon nanoparticles, and tin nanoparticles promise several times the energy density in the anode, while composite and superlattice cathodes also promise significant density improvements.

Battery cost and parity

The cost of the battery when distributed over the life cycle of the vehicle (compared with an up to 10 years life cycle of an internal combustion engine vehicle) can easily be more than the cost of the electricity. This is because of the high initial cost relative to the life of the batteries. Using the 7000 cycle or 10 year life given in the previous section, 365 cycles per year would take 19 years to reach the 7000 cycles. Using the lower estimate of a ten year life gives 3650 cycles over ten years giving 146000 total miles driven. At $500 per kWh an 8 kWh battery costs $4000 resulting in $4000/146000 miles or $0.027 per mile. In reality a larger pack would be used to avoid stressing the battery by avoiding complete discharge or 100 % charge. Adding a 2 kWh in battery adds $1000 to the cost resulting in $5000/146000 miles or $0.034/mile.

Scientists at Technical University of Denmark paid $10,000USD for a certified EV battery with 25kWh capacity, with no rebates or overprice. Two out of 15 battery producers could supply the necessary technical documents about quality and fire safety. Estimated time is 10 years before battery price comes down to 1/3 of present. Battery professor Poul Norby states that lithium batteries will need to double their energy density and bring down the price from $500 (2010) to $100 per kWh capacity in order to make an impact on petrol cars.

A solution to the range problem is detailed in an article on Battery Exchange and explains how the total battery needs would be reduced by using a battery exchange or battery swap system http://www.members.cox.net/rdoctors/evs.html. This requires substantial investment in setting up exchange stations but would allow for the use of lighter batteries as they would not be required to provide many miles of use. Lighter batteries make the ecar system far more efficient and lower overall costs.

The LiFePO4 technology has yielded batteries that have a higher miles/$ over the life of the packs but they require a complex control system. The manufacture of the batteries is still being developed and is not a reliable source.

Some batteries can be leased or rented instead of bought (see Think Global).

Toyota Prius 2012 plug-in's official page declare 21 kilometres (13 mi) of autonomy and a battery capacity of 5.2 kWh with a ratio of 4 kilometres (2.5 mi) /(kW·h).

ЗАКЛЮЧЕНИЕ

В результате изучения настоящего пособия студенты познакомились с информацией о строительстве дорог, используемых строительных материалах и методах сооружения автострад, а также с историей автомобилестроения и техническими характеристиками автомобилей различных типов. Материал пособия позволяет сделать выводы о том, какие автомобили являются более надежными и удобными в эксплуатации.

Выполнение заданий тренировочных упражнений создало возможность не только накопить необходимый лексический материал, но и помогло реализовать его в устной речи в виде диалогов на профессиональную тему и презентаций с использованием Интернета.

Все это в целом создает возможность активного общения с деловыми партнерами в нашей стране и за рубежом.

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