Набережночелнинский институт Казанского (Приволжского) Федерального Университета

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TECHNICAL TRANSLATION IN USE

Учебное пособие

Набережные Челны
2015

УДК 811.111'25(075.8)
ББК 81.432.1-8я73
Б 17

Печатается по решению учебно-методического совета Набережночелнинскгого институт К(П)ФУ

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Б 17 Technical Translation in Use: учебное пособие / Л.В. Базарова, К.Н. Гатауллина. – Набережные Челны: Издательско-полиграфический центр, 2015. – 165 с.

Данное пособие предназначено для студентов 3-4 курсов, обучающихся по направлениям подготовки «Филология», «Перевод, переводоведение». Учебное пособие состоит из лекционного материала и текстов, каждый из которых посвящен определенной области науки и техники, а именно: машиностроению, самолетостроению, приборостроению, электронике, медицине, физике и химии. Основными целями данного пособия являются ознакомление студентов с основными особенностями научно-технического текста, развитие навыков установления эквивалентности при переводе на русский язык научно-технических текстов и расширение запаса знаний в области науки и техники.

УДК 811.111(076)
ББК 81.432.1-9я73

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ПРЕДИСЛОВИЕ

Данное пособие по научно-техническому переводу предназначено для студентов 3-4 курсов дневной формы обучения, обучающихся по направлениям подготовки «Филология», «Перевод, переводоведение».

Учебное пособие состоит из тематического и практического блоков. В первом разделе содержится основная теоретическая информация о научно-техническом переводе, лексических и грамматических особенностях научного стиля, видах технической документации. В практическом блоке приводятся тексты соотвествующей тематики, перечень активной лексики, необходимой для последующей работы над специальной литературой. Большое внимание уделяется работе с текстами в виде обсуждений вопросов для закрепления активной тематической лексики, для формирования умений выделить, оценить и интерпретировать основные факты текста.

При отборе текстов авторы учитывали, прежде всего, профессионально-ориентированный характер текстов, актуальность информации, доступность, соответствие уровню подготовки студентов.

GENERAL ISSUES OF TECHNICAL TRANSLATION

LECTURE 1
TYPES OF TRANSLATION

1. Classification criteria.
2. Stages of the process of translation.

1. Classification criteria.

There are some criteria for classifying translation:

1) The first one is based on *who does the translation*. These days translation may be done by a human translator or by computer.

2) *Form of speech*: according to this criterion, translation as a written form, sight translation (or translation-at-sight, on-sight translation) as the oral translation of written text, and interpreting as oral translation of oral discourse are differentiated.

3) *Source text perception*: a translator can see or hear the text.

4) *Time lapse between the source text perception and translation:* consecutive and simultaneous interpreting.

5) *Number of languages in translation situation:* one-way or two-way translation.

6) *Direction of translation:* direct translation, that is, translation into the mother-tongue, and inverse translation, or translation into a foreign language.

7) *Methods of interpreting:* note-taking interpretation, phrase-by-phrase interpretation

2. Stages of the process of translation.

Firstly, for the purpose of establishing its authorship and secondly, for reaching a linguistic form which is accepted for translation, *editing the source text* is particularly important in the case of inscriptions on metal, stones or other materials generally found on archaeological sites.

Interpretation of the source text.

Two types of interpretation are recognized here: interpretation within one language, and interpretation in a new (i. e. different) language.

The first type is seen in giving the text (or part of it), a reading which goes with the lexis, grammar and the meaning of the text in its linguistic and social context. It depends on the linguistic systems and contexts of the source language, it is an analysis-synthesis process at different levels of linguistic analysis. The translator, as a human agent, is the only interpreter of the to-be-translated text.

Interpretation in a new language.

It is the essence of translation. Interpretation in a new language is defined as transformulating a linguistic / verbal text, or part of it, after interpreting it, to a language other than its own. The end product, interpretation in a new language, is a new text, the translated text, which is the most vital part of the translator's task.

Formulating the translated text.

Formulation is a stage of the translation process in which the translator chooses the lexis and structures that would make meaningful sentences functioning in a narrow co-text as elements of a well structured text. It is the stage during which the translated text gradually takes form.

Three aspects of the formulation of the translated text can be studied and evaluated in the light of the acceptable use in the TL. There are: collection, semantic field, and sentence and text grammar, as they are realized and accepted in the TL.

Editing the translated text.

This is the final stage in the translation process. The editing of the formulation takes the form of a careful checking of possible slips of the tongue or other inaccuracies. It also involves a comparison between the translation product on the one hand and the prevailing linguistic features and cultural norms in the text type in the TL on the other.

LECTURE 2
TECHNICAL TRANSLATION STUDIES

1. Misconceptions about Technical translation.
2. Scientific versus technical translation.

1. Misconceptions about Technical translation

Technical translation includes economics, law, business etc.

In reality, “technical” means precisely that, something to do with technology and technological texts. In discussing technical translation it is useful to make the distinction between specialised and technical translation. For example, religion has a very specific terminology and very definite conventions, styles and document structures but it is never regarded as “technical”. The tendency among certain theorists to include texts such as legal, financial and economic within the field of technical translation is less than helpful not least because each area has its own unique characteristics, requirements and constraints. Simply because a field or subject area has unique or specialised terminology does not make it technical. Therefore, technical translation deals with texts on subjects based on applied knowledge from the natural sciences.

Technical translation is all about terminology.

This particular misconception is not unique to those uninvolved in technical translation. Pinchuck (1977) claims that vocabulary is the most significant linguistic feature of technical texts. This is true as terminology is the most immediately noticeable aspect of a technical text and indeed it gives the text the “fuel” it needs to convey the information. Nevertheless, Newmark (1988) has claimed that terminology accounts for at most just 5-10% of the total content of technical texts yet there is a disproportionate amount of attention devoted to terminology and lexical issues in technical translation.

According to Lee-Jahnke (1998), there are two things that are essential in order to learn how to deal with technical texts:

- know the text structure in the different languages
- know the subject area

Style doesn’t matter in technical translation.

The problem stems from differing opinions of the nature of style and the popular belief that it relates exclusively to literature. If we look at style from a literary point of view, then it does not have any place in technical translation. But if we regard style as the way we write things, the words we choose and the *way* we construct sentences, then style is equally, if not more, important in technical translation than in other areas. As Korning Zethsen (1999) asserts, literary texts “do not hold a monopoly on expressivity and creativity”. To illustrate this, consider a leaflet containing instructions for using a product. The limited space available requires both the author and translator alike to express information in a way which is sufficiently clear, simple and concise so as to allow readers to understand the information completely and quickly but which nevertheless conveys all of the necessary facts.

In many cases, the importance or even existence of style in technical texts goes completely unacknowledged, due largely to the belief that because technical language is functional, it must be “plain” and stripped of any form of style or linguistic identity. In reality, however, technical translation is a highly complex endeavour and style is one of its most important facets.

Technical translation is not creative; it is simply a reproductive transfer process. While technical translation is undoubtedly more restricted in range than aesthetic translation it is much too easy to overestimate and exaggerate its apparent simplicity. But in order to convey information in an appropriate and effective way, technical translators have to find novel and creative linguistic solutions to ensure successful communication. That this task is often hampered by a restricted vocabulary and stylistic constraints merely makes the achievement all the more impressive.

Technical translation is all about conveying specialised information.

The main concern for technical translators is to make sure that information is conveyed accurately but they are also responsible for ensuring that the information is presented in the correct form, that it is complete and that the information can be used correctly and effectively. Technical translation involves detailed knowledge of the source and target cultures, target language conventions, text type and genre conventions, register, style, detailed understanding of the audiences.

2. Scientific vs. Technical Translation

Despite the obvious connection between the two, i.e. they both deal with information based, to varying degrees, on the work of scientists, scientific translation is quite distinct from technical translation. Certainly, they both contain specialised terminology and, on the surface, deal with complicated scientific subject matter (to an extent) but it is all too easy to overestimate these apparent similarities at the expense of other.

Scientific relates to science which is defined by the Chambers Dictionary as "knowledge ascertained by observation and experiment, critically tested, systematised and brought under general principles" (Chambers 1992). *Technical* relates to technology which is defined as by the Concise Oxford English Dictionary as "the application of scientific knowledge for practical purposes". Thus we can say that scientific translation relates to pure science in all of its theoretical glory while technical translation relates to how scientific knowledge is actually put to practical use. The differentiation between scientific and technical translation is also acknowledged by the information sciences.

Technical translation (and technical communication, which will be covered later on) can be characterised at a basic level on the basis of:

1. subject matter

2. type of language
3. purpose

So we can, for example, translate a scientific paper which deals with the concept of electromotive force. The difference is the way in which the knowledge is used and presented. And this is a fundamental difference between scientific and technical translation and one which also affects the type of language used in the texts.

Scientific language can be quite formal (think of journal papers) and will often have considerable range, just like a literary text. Such texts will also see the use of various rhetorical strategies, Greek and Latin terms and expressions as well as various affixes and compound terms.

The following examples illustrate the type of literary language use which can be found in scientific texts.

In the splendour of a moonless night, far from the pollution of the sky by artificial lighting, the first revelation is that of the stars.

Pinchuck refers to technical language as “workshop language”, which is somewhere between scientific and general language. It is less regulated, less literary and even colloquial on occasion but always strictly functional.

Scientific texts will be conceptually more difficult and will be more abstract than other types of text. They will, however, have more standardised terms which are easier to look up and they are likely to be better written than texts on other levels. Technology-based texts will be more concrete, will contain less information in more space, they will be more colloquial and will feature concepts which are easier to understand. In addition to this, there will be products and processes in the external world which can be referred to. In other words, technical texts can rely on world or background knowledge to a greater extent.

LECTURE 3
SOURCE AND TARGET-ORIENTATED APPROACHES TO TRANSLATION

1. Source-orientated Approaches to Translation:
a) equivalence. Levels and types of equivalence;
b) functionalism.
2. Target-orientated Approaches to Translation:
a) relevance;
b) Scopos theory.

1. Source-Orientated Approaches to Translation

Equivalence

The idea of equivalence forms the basis of many theories of translation and by implication, definitions of translation quality. While there are numerous definitions and types of equivalence, they all rely on one thing: a link or bond between the source and target texts. As Catford (1965:49) explains "the TL text must be relatable to at least some of the situational features to which the SL text is relatable". According to Catford, a translation does not necessarily have to consist of target language elements with the same meaning as the source language elements but ones which have the greatest possible amount of overlap across the different levels of equivalence.

Levels of Equivalence

According to Koller, equivalence can occur on the following levels:

1. *Denotational Meaning,* namely the object or concept being referred to. In texts such as user guides, equivalence on this level is relatively easy to achieve because we need to keep referring back to the product the reader is learning to use.

2. *Connotational Meaning*, which is, according to Koller divided into language level, dialect, style, frequency, value and emotional tone. Equivalence on this level can sometimes prove problematic where, for example, the enthusiastic and informal tone adopted by the source text may be culturally unacceptable in the target language.

3. *Textual Norms,* which are typical language features of texts like patents, legal documents, business letters etc. Textual norms may include the use of the second person to address the readers of user guides or the use of passive constructions to describe experiments in scholarly journals.

4. *Pragmatic Meaning*, which includes reader expectations

Komissarov (1977) also proposes a series of levels on which translation equivalence can occur. These levels are as follows:

1. Equivalence on the level of the general meaning or message. Aside from the general communicative intention, there is no tangible equivalence on the basis of situational, grammatical or lexical factors.

2. In addition to the preceding level, this type of

equivalence identifies a particular situation in both texts.

3. Building on the preceding levels, equivalence on this level maintains factors or elements which describe the situation established in level 2.

4. As well as all of the information presented as a result of the preceding levels of equivalence, this level establishes semantic and syntactic equivalence in that the majority of the source text words have corresponding target language lexical items and the syntax is transformationally related.

5. This level of equivalence displays a close parallelism between the source and target texts on all levels of language.

Types of Equivalence

The most well known types of equivalence are formal and dynamic equivalence posited by Nida (1964). Formal equivalence is concerned with the message in terms of its form and content. With this type of equivalence the message in the target language should match the different elements in the source language as closely as possible, be they lexical, syntactic, stylistic, phonological.

Dynamic equivalence on the other hand is based on the notion that the target text should have the same effect on its audience as the source text had on its own audience. With this type of equivalence the emphasis is not so much on finding a target language match for a source language message but rather on creating the same relationship between the target audience and the message as that which existed between the source language audience and the message (Nida 1964:159). By using this type of equivalence it is hoped to produce a target text which is natural and idiomatic and which focuses on the target language culture. According to this definition of equivalence, a successful translation needs to capture the sense of the source text and not just the words.

Other types of equivalence include *referential equivalence* whereby the equivalence centres on the ST and TT words referring to the same ex- tratextual entities in the “real world”. *Connotative equivalence* is used to describe the relationship between ST and TT words which result in the same or similar associations or connotations in the minds of the reader. *Text-normative equivalence* involves source language and target language words being used in the same or similar contexts in their respective languages.

Functionalism

In an attempt to escape the restrictive and often limited approaches to translation based on theories of equivalence, translation theorists such as Reiss (1971) and House (1981) changed the focus from being entirely source-based to include some aspects of the target text. To be precise, their attention centred on the function of the target text. Such an approach moves away from the bottom-up linguistic approaches of equivalence-based theories and instead involves pragmatic and situational aspects of the translation process.

Functionalism as a general ideology based on extralinguistic, pragmatic and communicative factors of translation.

House (1981) adopts a functionalist approach and defines two types of translation: *covert* and *overt.* A covert translation is one where the text function is preserved and the reader is not aware that the text is a translation. An overt translation, on the other hand, does not maintain the text function of the original and the readers are somehow aware that it is a translation and not the original language text. In order to determine whether functional equivalence has been achieved, Houses proposes that the source text be analysed first so that the target text can be compared against it.

Nord (1991:23) argues that the function of the target text cannot be "arrived at automatically from an analysis of the source text". Instead, it needs to be defined pragmatically by the purpose of the intercultural communication. Fawcett (1997:107) maintains that there is no need to link text function and translation strategy. He maintains that just because it is possible to identify the function of a text, there is no "logical or translation-scientific imperative" on a translator to shape and govern translation decisions on the basis of the function.

2. Target-Orientated Approaches to Translation

Relevance

Relevance theory does provide compelling support for taking the cognitive abilities of readers into account to improve translation.

At the heart of relevance theory is Gutt's distinction between interpretive and descriptive language use and it is this distinction which is most relevant in terms of technical translation. Interpretive language use, according to Gutt, refers to an utterance which is intended to represent what someone else thinks or says. In the context of translation, an interpretive translation is one which has some form of link or relationship with the source text. Descriptive language use, on the other hand, is intended to be an accurate representation of what the writer or speaker believes to be true. In the context of translation, a descriptive translation is intended to function as an independent and autonomous target language text whose readers will not be aware of the existence of a source text.

Relevance theory does provide some useful insights into technical translation:

- a communicative approach which concentrates on the needs and expectations of the target audience

- the minimax principle which states that people do not want to spend more time and effort than is absolutely necessary in order to retrieve information from a text.

Skopos Theory

Skopos theory is linked with the functionalist approach to translation but differs fundamentally in that where functionalist approaches such as Reiss's (1971) and House's (1981) maintain that the function of the target must be the same as the original, Skopos theory recognises that this is not always practical or desirable. Skopos theory holds that the prospective function is determined by the initiator / customer, their view of the target audience along with the situational and cultural background. Skopos theory states "that one must translate consciously and consistently, in accordance with some principle respecting the target text.

LECTURE 4
THE TRANSLATION PROCESS AND NATURE OF TECHNICAL DOCUMENTATION

1. Technical translation as a communicative service.
2. The nature of technical documentation.

1. Technical translation as a communicative service

The purpose of technical translation is to present new technical information to a new audience, not to reproduce the source text or reflect its style or language. Technical translation is a communicative service provided in response to a very definite demand for technical information which is easily accessible (in terms of comprehensibility, clarity and speed of delivery).

As a communicative service or act, translation inevitably involves people. At the most basic level, we can say that this communicative act involves the author, the translator and the reader. This is the standard way of examining the translation process.

In reality, several parties are involved in the process. This has been addressed by authors such as Vermeer and Nord but it is necessary here to emphasise the important roles played by the various stakeholders. Conscious of the fact that the majority of non-literary documentation is not produced as a result of some desire or intention on the part of the author, Nord (1991:42ff) distinguishes between the sender and text producer (author).

An interesting point is made by Nord (1997:21) who claims that unless a source text was produced specifically to be translated, the source text author has no immediate involvement in the translation process. This poses something of a problem because in the current climate with multilingual, multinational companies and legislation requiring documents in multiple languages, it is difficult to imagine a case where it does not occur to someone during the production of documentation that it may be translated at some stage, even if it is just a distant prospect. Thus, the stakeholders in the technical translation process are not simply the author, translator and reader. If we examine the practical circumstances surrounding the production of multilingual documentation, we can propose a number of other parties:

- Document Initiator
- Writer/Text Producer
- Translation Initiator
- Translator
- User

The *Document Initiator* is the person or entity responsible for the production of the original source language document. In the case of product documentation, this is invariably the company that manufactures the product. The Document Initiator's aim here is to have documentation that will help users learn how to use the product effectively, safely and efficiently. This can be motivated by a genuine desire to help users, to provide a "complete" product, to improve the company's competitiveness and reputation, to reduce calls to technical support or simply to comply with legal requirements.

The Document Initiator then instructs the *Writer*(who may be in-house or a freelance contractor) to produce the documentation. The Writer either receives a detailed brief from the Document Initiator or develops a document specification on the basis of interviews with the Document Initiator and/or the Writer's own expertise. Working to this specification, the Writer gathers information from a variety of sources such as white papers, project outlines, hand-written notes, product specifications and marketing materials and processes them to produce a text which then goes through a number of iterations which is tested at each stage for content, clarity and ideally usability. The completed document is returned to the Document Initiator and distributed to customers.

The *Translation Initiator* is the person or entity responsible for starting the translation process. This is generally the Document Initiator but it can be argued that the Translation Initiator may be a different department or manager within the same company. The motivations for the translation process are similar to those for the document production process. The Translation Initiator sends the document and some form of instructions to the Translator.

While strictly saying the *Translator* is the next step, in reality this is not always the case. Frequently, texts will be sent to *translation agencies* or *localization vendors* who will then send the document to a translator.

It is the *User* who, according to Holz-Manttari (1984:111), is the decisive factor in the production of a target text. Where technical documents are translated, there are two sets of users: the source language user and the target language user. Although both users are on the surface quite different in terms of their needs, i.e. documents in the respective languages, they share certain macro-aims, e.g. learn how to use the product. However, this may need to be achieved in different ways. This is where the technical writer and the technical translator share a common purpose to determine what their respective users want. In order to translate effectively, a translator needs to fully understand and know the users (Reiss & Vermeer 1984: 101).

2. The Nature of Technical Documentation

In an attempt to clarify the nature of technical writing and what is actually produced, it would be useful to look at the general characteristics of technical documentation. Markel (2003) provides a good general overview of technical documentation and its production. To begin with, technical documentation always addresses specific readers. Technical documents are produced taking into account the age profile, job, experience, knowledge, seniority, tasks, problems, aims and objectives. The content, approach, structure, level of detail, style, terminology etc. are all tailored to this profile.

The way in which technical documentation is produced is also important, according to Markel, in defining its nature. The very nature of the company, its culture, goals and organisation, are reflected in the types of documents that company produces. For example, a company with a rigid and formal hierarchy may tend to favour formal and structured memos as a way of communicating between staff rather than informal emails or a simple chat over a cup of coffee.

Another, more immediately obvious characteristic of technical documentation is the way it uses design to improve the appearance and readability of documents. By manipulating the design and layout of a document, we can make it easier for readers to navigate through the document and find the information they need as well as making it easier to understand. As part of this design process, technical documents will often contain a combination of text and graphics to make the document more stimulating and to communicate and reinforce potentially difficult concepts and processes.

We can categorise technical publications as follows:

- Procedural documents such as assembly instructions, instructions for operation etc.
- Descriptive and explanatory documents such as descriptions of products and services; explanations of processes, concepts etc.; progress reports.
- Persuasive or evaluative documents such as research proposals or engineering projects, product or service evaluations as well as reports recommending actions or policies
- Investigative documents such as reports which are intended to present new knowledge etc.

LECTURE 5
THE ACTUAL LANGUAGE OF TECHNICAL DOCUMENTATION

1. Lexical structure
2. Sentence structure
3. Style

1. Lexical structure

The actual language of technical documentation is probably the most critical factor in determining its quality and effectiveness. Indeed, the text provides the sensory stimulus which conveys the information to the readers' brains. However, just like language itself, the factors which govern how effectively the text is used are equally vast. There are guidelines, rules and regulations which are aimed at improving the standard of language.

Clarity and Word Choice

Reminiscent of the old adage "less is more", a commonly held tenet of technical writing is that texts should be as brief and concise as possible and writers should eschew verbosity (D'Agenais & Carruthers 1985:100-101; Weiss 1985:148-9, 152). According to Weiss (1985:148) the most frequent "offenders" with regard to verbosity are what he calls "smothered verbs". A smothered verb, also known as a nominalization, is a verb that has been converted into a noun, e.g. "they conducted an investigation" instead of "they investigated". Nominalisations involve using a phrase where a single word would have sufficed and also encourage the use of unwieldy passive constructions.

However, it is possible to compress text to such an extent that it becomes incomprehensible or ambiguous. The notion that text can become ambiguous as a result of excessive compression is mentioned by Ramey (1989) who describes the incidence of Escher effects in texts. Escher effects - named after Escher's famous two faces result in a phrase or piece of text having two or more possible meanings and force readers to truly study the text in order to ascertain or deduce which meaning of the text is the intended one.

The following example illustrate Escher effects in text: *input mode*

Each of these examples can have a number of possible interpretations. Taking the first example we can see that "input" can be read either as a verb or as a noun. So it is conceivable that one reader will regard "input mode" as a command - that the reader is required to input or specify the mode. Meanwhile, another reader may regard "input mode" as a state where "input" modifies or qualifies "mode".

The specific type of words used in a text can play an important role in its quality. D'Agenais & Carruthers (1985:106) suggest that positive words be used instead of negative words because negative words have an undesirable effect on readers. The authors give the following example which is admittedly a little contrived but which does illustrate the point:

- Lock the door when you leave.
- Don't neglect to lock the door when you leave.

So, words can be used to smooth the transition from idea to idea, sentence to sentence and paragraph to paragraph. The purpose of this is to avoid abrupt changes which can leave readers wondering where to go next.

Simplicity of language can be obscured by a number of word choice factors: jargon, euphemisms, neologisms and abbreviations / acronyms.

Jargon

Indeed, specialised terminology is essential in order to avoid ambiguity and to accurately communicate ideas and concepts. However, this terminology can also be an irritation when misused (White 1996:192). The problem is, according to Mancuso that "experts use too much jargon in documents meant for less well informed audiences". The general consensus is that jargon should be used in a way that is appropriate to the abilities and level of knowledge of the audience (Mancuso 1990:186-7; White

1996:192). Where it is essential that jargon be used, the specialised terms should be properly defined (Mancuso 1990:186).

Euphemisms

Euphemisms are figures of speech which are used to describe things using milder, less unpleasant terms. They are generally used to soften or lessen the impact of harsh or unpleasant words or ideas. Euphemisms are frequently longer words or phrases and their meaning or relation to the actual object or action being referred to is less than obvious.

The problem with euphemisms is that while they are often quite clever, creative, linguistically interesting and occasionally amusing, they obscure meaning, confuse readers and generally make the text less accessible. In addition, because of their size, they make the text longer and more cluttered (Mancuso 1990:191).

Neologisms

Neologisms are, according to Mancuso (1990:197), the work of "arrogant" authors who like to create new words. Mancuso continues by saying that these newly created words are generally only understood by the author and a few others and they confound most readers. Admittedly, such a view is quite extreme and occasionally neologisms are necessary; they should, however, be used sparingly.

Acronyms and Abbreviations

Acronyms and abbreviations can affect the clarity and accessibility of a text in much the same way as jargon. Although many computer-related acronyms and abbreviations are becoming more widely known than they used to be (Mancuso *ibid),* many are not yet in common usage. Thus, according to D'Agenais & Carruthers (1985:109), those that are not commonplace and understood by everyone should be explained. A popular way of dealing with acronyms and abbreviations is to use a glossary which explains them (Mancuso 1990:197; D'Agenais & Carruthers 1985:109).

Of course, clarity can also be affected by the ambiguous use of "ordinary" words. Ambiguity usually arises, according to White (1996:190), as a result of one or more of the following problems:

Improper word choice

Using ambiguous words which can have more than one meaning in a particular context.

Ambiguous relationships

Using co-ordinating conjunctions such as "and" when a subordinate relationship is intended.

2. Sentence structure

In this case, the issue of repetition and redundancy is worth examining. Firstly, we need to distinguish between repetition and redundancy. Repetition involves repeating words and phrases throughout a document in order to reinforce information, reiterate product benefits or to get readers to do or remember something. There is a definite purpose to repetition - perhaps merely to assist in the habit formation process (Raskin 2000:18-21). Redundancy, on the other hand, is "stated or implied repetition with no purpose" (Mancuso 1990:202). Redundancy can take the form of superfluous adverbs, unnecessary emphasis or repeating information in a different form.

The flow of information in sentences is also of great importance with regard to the readability of the text. Indeed, Weiss (1985:150) argues that "the secret of the readable sentence is that the ‘payload’ of the sentence [...] is at the end”. The payload is essentially the most important part of information the author wants to convey using the sentence. The reason why the payload should be at the end is, according to Weiss, that the last part of the sentence is the best remembered by readers. Similarly, in the case of instructions, a cause-effect format should be adopted (SAP 1997:4ff). Accordingly we would, for example, rewrite the following sentence:

The tab marked Properties allows users to configure the modem's settings.

as

To configure the modem settings, click the Properties tab .

Parallelism

Parallelism is a phenomenon which is widely recognised as a fundamental issue in sentence structure (D’Agenais & Carruthers 1985:104; Mancuso 1990:231; White 1996:182). Essentially, parallelism means that parts of a sentence which are similar, or parallel, in meaning should be parallel in structure. Parallel constructions can also be described as instances where two or more groups of words share the same pattern (White 1996:182).

If you want to open a file, click Open.
If you want to close a file, click Close.

Parallelism can also occur in lists as shown below:

To connect to the Internet you will need:

- *a modem to connect to your PC*
- *drivers for your modem*

- *a telephone line*
- *a dial-up account from an ISP*

When there is a lack of parallelism, some of the grammatical elements in a sentence do not balance with the other elements in the sentence or another sentence. What makes this undesirable, apart from potential grammatical errors, is that it distracts the reader and prevents the message from being read quickly and clearly (Mancuso 1990:232).

We can illustrate how a lack of parallelism can affect the clarity and readability of a section of text. What were once clear sentences, become the following confusing examples:

If you want to open a file, click Open.

The Close button should be pressed to close a file.

To connect to the Internet you will need:

- *a modem to connect to your PC*
- *drivers for your modem*
- *a telephone line must be available.*
- *also, contact an ISP to get a dial-up account*

Parallelism is not just important in avoiding grammatical and comprehension problems, it is also very useful in reinforcing ideas and learning. The grammatical symmetry of parallelisms helps readers remember information more easily (White 1996:183).

3. Style

It is generally acknowledged that a conversational style of writing is the best approach when producing and translating user guides. Mancuso (*ibid*.) ventures by way of an explanation, that the way we normally write is generally unsuitable for explaining ideas. When we explain ideas orally, we are concise, to the point and we avoid awkward or complicated constructions. Indeed, D'Agenais & Carruthers *(ibid)* maintain that most people communicate better when they are speaking than when they are writing. A possible reason for this is, according to the authors, that people tend to "write to impress rather than to express".

Using a conversational style does not, however, give authors free rein to use slang, to be excessively informal or to be imprecise or ambiguous. While oral communication has the benefit of instant feedback from the receiver's reactions, written communication does not have this aid and so the potential for misunderstanding must be minimised.

Verbs

Verbs are the engines of sentences - they make the sentences meaningful and make a text more than just a list of words. The way in which verbs are used affects the way the text works and how easily the reader assimilates information. We can categorise our examination of verbs as follows:

- Strong / weak verbs
- Active / passive voice
- Imperatives
- Compound verbs

Strong and Weak Verbs

The differentiation between strong and weak verbs can be quite subjective and is rather elusive. It would, perhaps, be easier to define the two terms using a number of examples of strong and weak verbs. Mancuso (1990:174) suggests that strong verbs might include *weld, singe, salivate, bulldoze* and *inject.* Weak verbs, he continues, include the various forms of the verb *to be* and the verbs *do, make, provide* and *include.* Strong verbs, he maintains create images; they add a sense of action to a text. On the other hand, weak verbs say little, if anything and result in the reader having to spend more time "deciphering meaning rather than reading it" *(ibid).*

From the examples given below, we can see that strong verbs are those that actually reflect the function or action in question. The following sentence is rewritten to illustrate examples of strong and weak verbs:

The function of the hard disk is to allow you to store data.

The hard disk stores data.

The benefit of using strong verbs is that it allows readers to understand information more quickly. Additionally, as can be seen in above example, strong verbs allow for more concise constructions.

Nominalisations, i.e. verbs that have been transformed into nouns, are just as unhelpful as weak verbs in that they obscure meaning and add to the workload of readers. An example of this would be as follows:

The setup program results in an update of the registry.

If we remove the nominalization, we get the following:

The setup program updates the registry.

Active and Passive Voice

The terms "active" and "passive" voice are old metaphors for certain grammatical constructions. Active voice constructions contain subjects that "do something". These constructions have positive connotations of action, dynamism, energy and determination (White 1996:181). Passive voice constructions, on the other hand, contain subjects that do not do anything. These constructions have the opposite connotations to active voice constructions. The passive voice is typified by the following characteristics:

- The subject is acted upon.
- The predicate generally contains an auxiliary verb that is in the form of to be.
- The sentence contains a prepositional phrase

While it may be helpful to switch between active and passive voice in order to emphasise either the subject or the logical object (White 1996:182), it is widely held that the passive voice interferes with the clarity of sentences (White *ibid.;* Mancuso 1990:156-171; D'Agenais & Carruthers 1985:1023). It is also more difficult for readers to understand the sentence because of problems with identifying the actor and also because of delayed meaning (Mancuso 1990:166-7).

Imperatives

Using the active voice in conjunction with the imperative mood is an important strategy in procedural texts where the reader is required to either perform certain tasks or refrain from carrying out certain actions. In contrast to constructions that do not use the imperative, there is no confusion as to who is to carry out the task because the second person pronoun *you* is implicit (Price 1984:103). Take, for example, the following sentence:

The necessary drivers must be installed on the PC.

From this sentence it is not clear who is supposed to perform the task. Is it the reader or is it someone from the IT department? It would be better to phrase the sentence as follows:

Install the necessary drivers on the PC.

TEXTS FOR READING PRACTICE

"AUTOMATION AND AUTOMOBILE INDUSTRY"

AUTOMOBILE

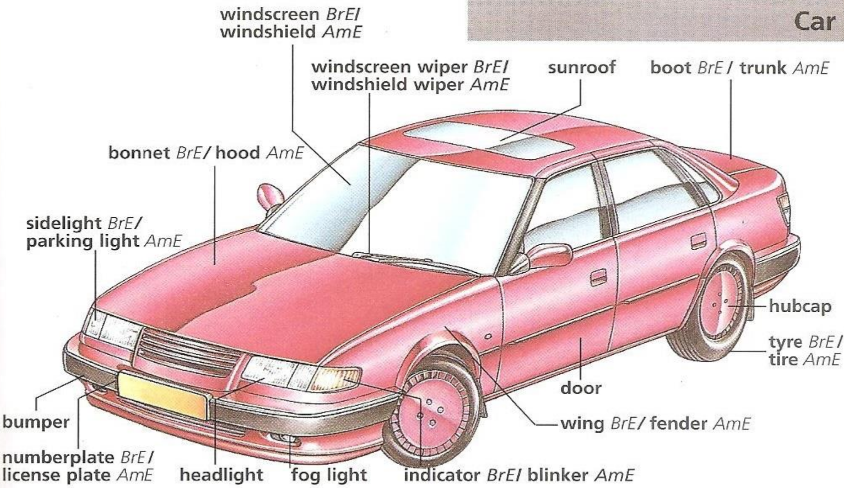
The modern automobile is a complex technical system employing subsystems with specific design functions. Some of these consist of thousands of component parts that have evolved from breakthroughs in existing technology or from new discoveries such as electronic computers, high-strength plastics, and new alloys of steel and nonferrous metals, as well as from factors such as air pollution, safety legislation, and foreign competition.

Passenger cars have emerged as the primary means of family transportation, with the total number in use worldwide expected to reach half a billion in the l990s. Approximately 500 different models have been offered annually to U.S. car buyers, about half domestic and half foreign in origin. New designs have been brought into the market more quickly in recent years than in the past to permit manufacturers to capitalize on their proprietary technological advances. With more than 30 million new units built each year worldwide, manufacturers have been able to split up the total into many very small segments that nonetheless remained economical to market,

New technical developments are recognized to be the key to successful competition, Research and development engineers and scientists have been employed by all automobile manufacturers and suppliers to improve the car body, chassis, engine, drive train, vehicle control systems, occupant safety, and environmental emissions, and further work by the industry is necessary to meet the needs of the 21st century.

Vehicle design depends to a large extent on its intended use. Automobiles for off- road use in countries that lack service facilities must be durable, simple systems with high resistance to severe overloads and extremes in operating conditions. Conversely, the customers for products that are intended for the high-speed, limited-access road systems in Europe and North America expect more passenger comfort options, increased engine performance, and optimized high-speed handling and vehicle stability. Stability depends principally on the distribution of weight between the front and rear wheels, the height of the centre of gravity and its position relative to the aerodynamic centre of pressure of the vehicle, suspension characteristics, and whether front or rear wheels are used for propulsion. Weight distribution depends principally on the location and size of the engine. The common practice of front-mounted engines exploits the stability that is more readily achieved with this layout. The development of aluminum engines and new manufacturing processes have, however, made it possible to locate the engine at the rear without necessarily compromising stability.

SAFETY SYSTEMS From its beginnings, the automobile posed serious hazards to public safety. Vehicle speed and weight provided an impact capacity for occupants and pedestrians that produced great numbers of fatalities (13,000 in 1920) and serious injuries. During the 20th century, the rates of death and injury declined significantly in terms of vehicle miles (in the United States, for example, the rate of fatalities declined from 5.7 to 2.2 per 100,000,000 vehicle miles between 1966 and 1990). Because of the increased number of vehicles on the road, however, total fatalities have declined only slightly (from 53,000 down to 47,000 in the same example period). Most fatal accidents occur on either city streets or secondary roads. Federal expressway systems are relatively safer. Driver training, vehicle maintenance, highway improvement, and law enforcement were identified as key areas with potential for improving safety, but the basic design of the vehicle itself and the addition of special safety features received increased attention. Safety features of automobiles come under two distinct headings: accident avoidance and occupant protection.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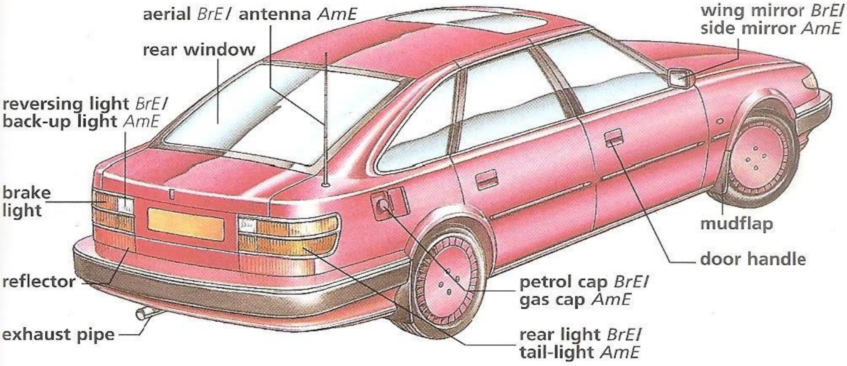
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side mirror AmE
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gas cap AmE
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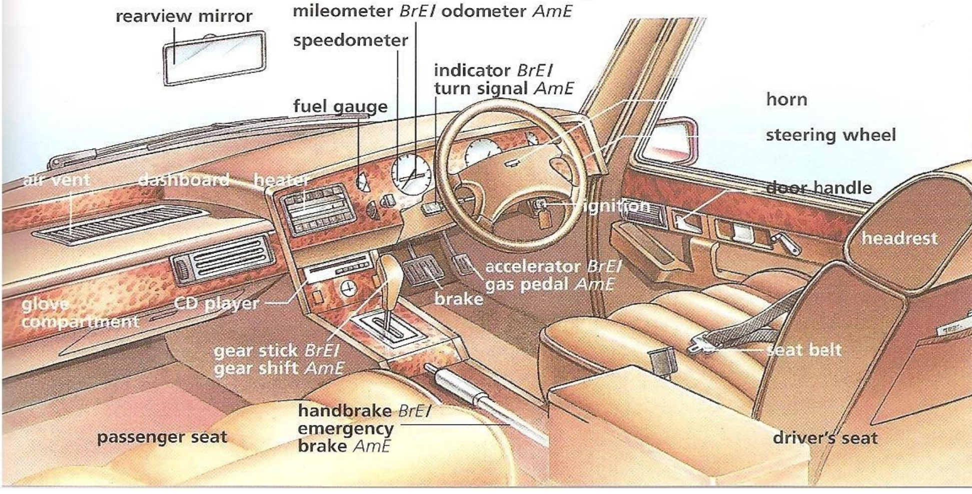
rear light BrE/
tail-light AmE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steering wheel
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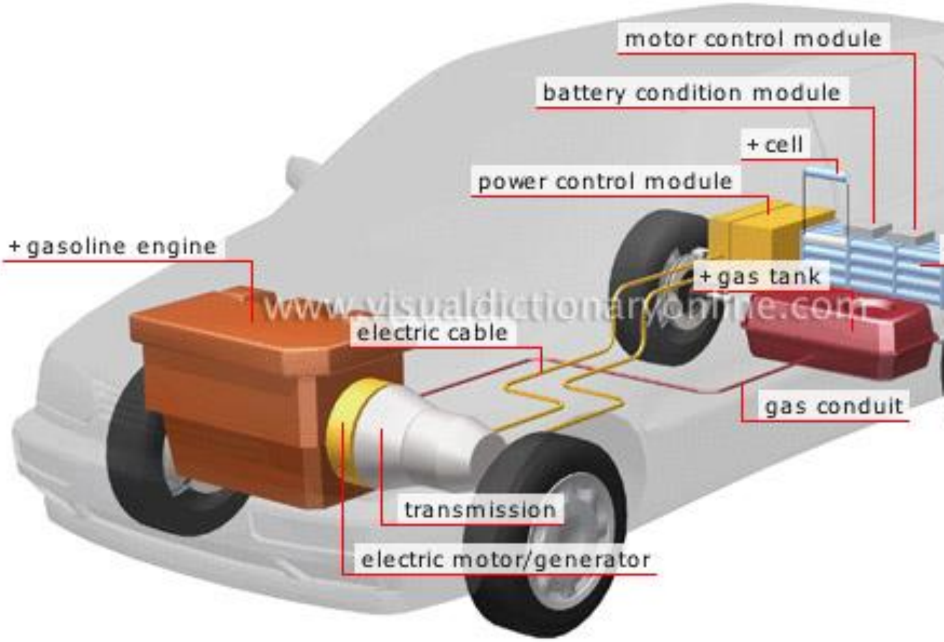
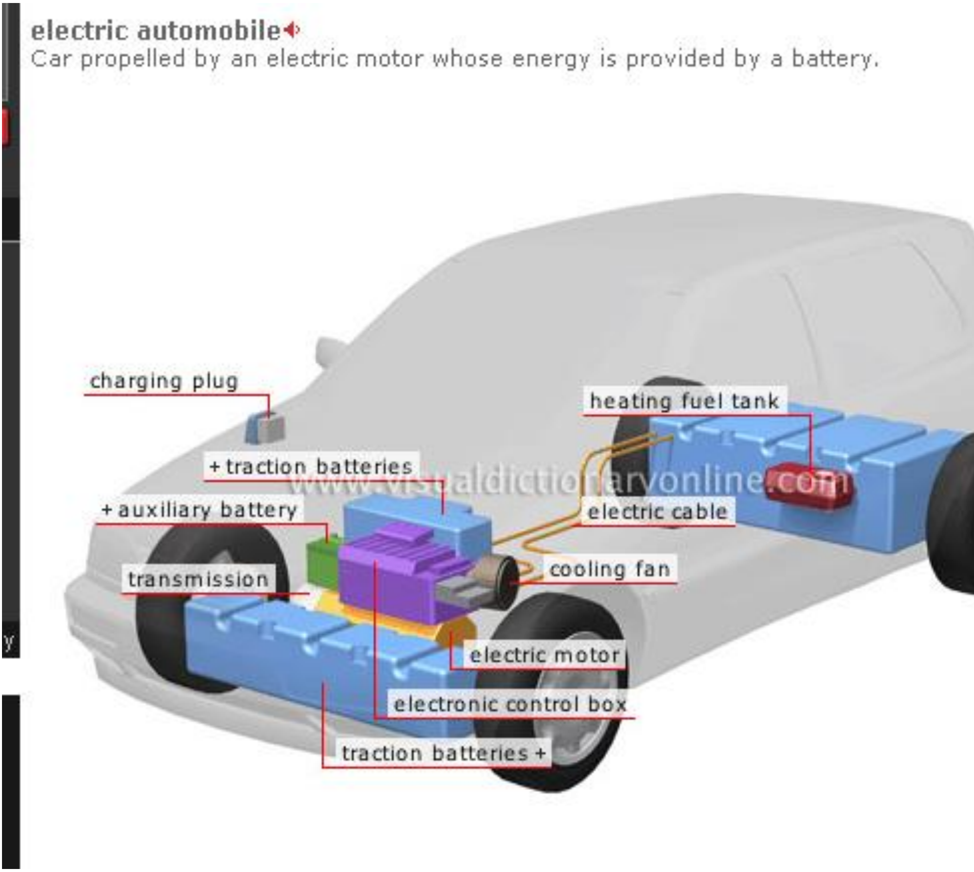
dashboard
heater
ignition
door handle
headrest
accelerator BrE/
gas pedal AmE
brake
glove
compartment
CD player
seat belt
gear stick BrE/
gear shift AmE
handbrake BrE/
emergency
brake AmE
passenger seat
driver's seat

hybrid automobile

Car powered by an internal combustion engine and an electric motor, reducin
consumption and polluting emissions.



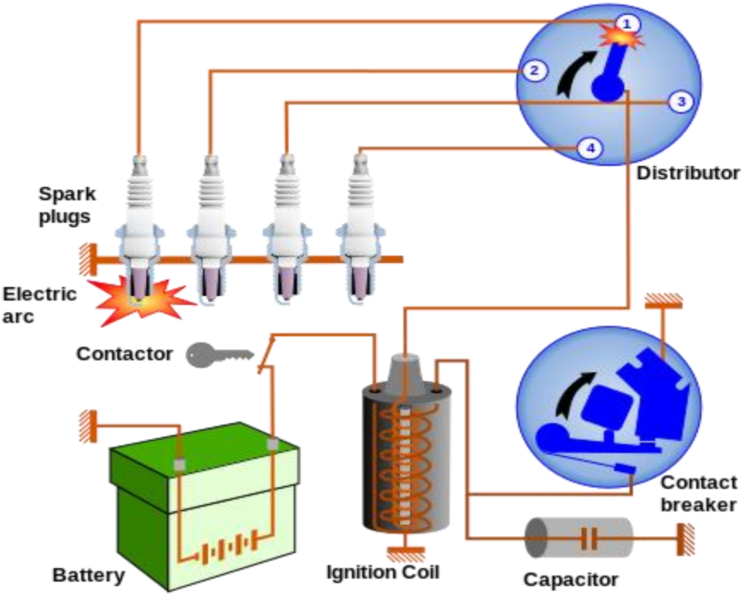


IGNITION SYSTEM

The purpose of the ignition system is to supply sparks across the point of the spark plugs to ignite the combustible mixture in the cylinders. The principal units in the ignition circuit are the battery, ammeter, tell-tale light, ignition switch, ignition coil, distributor, spark plugs and the necessary wires which connect these parts. The distributor shaft is rotated by the engine camshaft.

Note that there are two circuits, called primary and secondary, or low tension and high tension, respectively. The primary circuit carries low voltage and the secondary circuit high voltage. Ordinarily the primary circuit operates 12-14 volts while the high voltage circuit may produce up to 20.000 volts. Thousands of volts are required in the secondary circuit in order to force the current through the extremely high resistance of the air gap between the spark plug parts. The low-voltage current in the primary circuit is changed to high voltage current in the secondary circuit by means of an induction coil which is more commonly called an ignition coil.

The ignition coil contains two coils of wire. One coil is part of the low tension circuit and the other is part of the high tension circuit. The two coils are called low and high tension windings or primary and secondary winding, respectively. The magnetic field created by current in the low tension winding completely permeates the high tension winding. The magnetic field represents magnetic energy in storage obtained from the electric current in the low tension circuit. The stored magnetic energy which completely surrounds both the high and low tension windings remains in storage just as long as current continues to flow through the low tension circuit. However, the breaker points are snapped open, the current stops flowing and the magnetic field collapses. But while collapsing, its energy is transformed back into electrical energy in both low and high tension windings, producing a very high voltage in the secondary winding and a moderate voltage in the primary winding. It is as though the magnetic energy surrounding the wires of the windings "drains" into the windings and somehow turns its energy into an electric current.


Distributor
Spark
plugs
Electric
arc
Contactor
Battery
Ignition Coil
Capacitor
Contact
breaker

spark plug

Electric device whose two electrodes produce the spark necessary to ignite the air/gasoline mixture in the cylinder.

Active vocabulary

spark plug – свеча зажигания

combustible mixture – горючая смесь

ignition coil – катушка зажигания, трансформатор зажигания

distributor shaft, camshaft – распределительный вал

air gap – воздушный зазор

to dress the breaker point – зачищать контакт прерывателя

Questions for discussion

1. What can you say about ignition system? What’s the aim of it?

2. What’s the difference between primary and secondary circuits?

3. What’s the ignition coil?

HOW KIA MOTORS IS REINVENTING ITSELF?

Kia Motors didn't make a good first impression when it arrived in the U.S. some 20 years ago. One critic described the 1996 Kia Sephia as "very cheap-looking,” finding "no compelling reason to own it." The company was also plagued with serious recalls. The 1999 Kia Sportage, for example, had six separate recalls for faulty headlights, seatbelts, second/third row seat stability, wiring and brakes.

So how did a Korean car company plagued with design and safety issues, as well as a bankruptcy in 1997, manage to become one of the fastest growing brands in the U.S. and the runner-up for the 2015 J.D. Power Initial Quality study?

REESTABLISHING TRUST

When Hyundai Motors bought Kia following its bankruptcy in 1998, the executives realized the brand was doomed to fail in the U.S. if they didn't somehow restore consumer confidence. One of their first moves was to establish a three-part warranty deal with the hopes that buyers would be more willing to overlook Kia's problematic technical past if they received a guarantee against future hiccups. (See also, The 5 Best Corporate Comebacks.)

REVITALIZED COMMITMENT TO QUALITY

A comprehensive warranty policy would have only exacerbated Kia's troubles if the cars continued to malfunction. The next step was to revamp how the Korean motor company approached the concept of quality in both mechanics and design.

In 1999, Chung Mong-Koo, who had previously worked in Hyundai's industrials, metallurgy and service divisions, became chairman and CEO. Taking a hands-on approach, Chung personally visited several of the company's production plants in the U.S., using an interpreter to point out mechanical problems associated with many of Hyundai and Kia's vehicles to U.S. executives.

The company went so far as to create a Global Command and Control Center in Korea that monitors live feeds of every assembly plant around the world in real-time. This gives headquarters a means to immediately address any problems or production issues that may arise.

Kia even put a cap on the number of cars produced each year – 7 million – in order to ensure quality production and employee discipline.

"All of the people I meet at Hyundai [of which Kia is a subsidiary] are hell-bent on making sure quality is getting better all the time," Asian auto industry expert Michael Dunne told strategy-business.com. "This special mind-set ... says that 'we will be best at what we do, wherever we go and whatever it takes.'" (For more, see: Investing Basics: Flight To Quality.)

SAVVY MARKETING

Although Kia and Hyundai headquarters in South Korea largely control the technical side of the company, the American division has much more autonomy when it comes to its marketing efforts.

One of its more memorable forays was the Kia Soul Shuffle campaign, which featured a trio of dancing CGI hamsters that apparently took wardrobe advice from the film comedy Malibu's Most Wanted. Kia incentivized consumers to submit their own videos of them doing the Kia Soul Shuffle to the company's social media channels in return for prizes and rewards.

The auto company has also heavily invested in sports advertising as well, striking up deals with high-volume sporting events such as NBC's Sunday Night Football and the 2014 FIFA World Cup in Brazil. Kia has also become the NBA’s official automotive partner, with Lebron James and Blake Griffin serving as two of the brand's high-profile ambassadors.

THE BOTTOM LINE

Kia Motors has come a long way in reestablishing itself in the American automotive industry, shedding its past as a cheap, unreliable manufacturer in favor of progressive design and award-winning reliability and quality. If it weren't for a renewed focus on quality and efficiency, Kia very well could have gone the route of Daewoo.

<u>Active vocabulary</u>

faulty headlights - бракованные фары

be plagued with smth - быть обеспокоинным

the runner-up - занимающий второе место; конкурирующая компания, выпускающая аналогичную продукцию

hiccup - проблема, техническая неисправность

warranty policy - гарантийное условие

hands-on approach - практический подход

assembly plant - сборочное производство, сборочный цех put a cap on smth - ограничивать, установить лимит на что-то

savvy marketing - хитроумный/грамотный маркетинг

incentivize - заинтересовывать

<u>Questions for discussion</u>

1. What matters was KIA Motors plagued with?
2. What does a hands-on approach mean in case of KIA Motors?
3. What is the gist of a savvy marketing?

WILL TESLA CARS EVER BE AFFORDABLE?

Tesla Motors (TSLA) automobiles are highly sought after. Tesla's high performance, all-electric cars also command a very high price tag.

The Model S sedan was originally unveiled in 2009 with a manufacturer's suggested retail price (MSRP) of $57,400. The new 2015 Model S starts at $71,000 but can run as high as $105,000 as features are added. The Tesla Roadster Sport which was produced from 2008-2012 had a sticker price starting at $101,500.

To put this into perspective, the average price for a new mid-sized sedan in the United States starts at around $18,000. At these high prices are Tesla's electric cars reserved exclusively for the wealthy? Will Tesla cars ever be affordable? The answer is probably yes. (For more, see: Why are Tesla Cars So Expensive?)

WHY TESLAS ARE SO EXPENSIVE

Teslas are currently very expensive for a number of reasons. The first is the simple law governing prices: supply and demand.

The demand for Teslas is very high, with a waitlist for backordered vehicles that is growing steadily. The company is also breaking sales records every month as it struggles to produce enough new vehicles to meet demand.

This high level of demand is due in part to the green energy movement. Because Teslas are not hybrids, but all-electric, they do not consume gasoline and do not directly pollute the air with carbon dioxide. (It is worth mentioning, however, that CO2 is still a by-product of the electricity generated to charge the car's batteries.) Demand is also driven by Tesla's attractive design, which includes high-tech features and a dashboard that consists of a digital touch display. (For more, see: What Drives Consumer Demand for Tesla?)

At the same time, Tesla does not own a series of factories capable of building enough cars to satisfy the current demand. This is in contrast to traditional automakers which have numerous production facilities spread around the world.

The other major reason for Teslas' high sticker price is the expensive nature of the battery technology that powers the vehicles. Batteries are the most expensive single component of these cars, carrying a current cost of around $500 per kilowatt-hour. A base model Model S has around 60 kilowatt-hours of capacity, meaning that approximately $30,000, or 42.25%, of the sales price is due to the battery packs. (See also: Ways To Indirectly Invest In Tesla’s Momentum.)

HOW TESLAS WILL BECOME AFFORDABLE

Increasing the capacity to supply new vehicles is already in the works. Tesla has announced construction of a 'gigafactory' in the Nevada desert, allowing it to scale up production to a large degree. Economic theory suggests that this move alone will begin to put some downward pressure on the price, bringing it more in line with its cost of production.

Competition from other companies is also likely to put pressure on the price to fall. The Chevrolet Volt is just one example of traditional car companies entering the electric vehicle fray. While they have a long history of producing hybrid electric cars, the demand for all-electric vehicles can be satisfied by companies other than Tesla. Right now, Tesla has a first mover advantage in that traditional car makers have been reluctant to invest in all-electric lines. With Tesla's success, however, these automobile makers are now anxious to take away some of its market share. (See also: Who Are Tesla's Main Competitors?)

Battery technology is also improving, which will lower the cost of production and pass savings on to the consumer. Since Tesla produced its first cars, the cost of battery packs has fallen by around 50%, and at the same time, storage capacity has increased by more than 60%.

The company is in the process of continuing to increase the energy efficiency of the batteries, further causing the price to fall from $500 per kWh to about $200 per kWh in the future, a 60% increase in efficiency. There is a lot of investment going into research and development to improve battery technology, both inside Tesla and among other researchers worldwide. The hope is that eventually the cost of battery power will be able to compete with the cost of gasoline to fuel cars.

THE BOTTOM LINE

Tesla's vehicles are very expensive compared to gasoline-powered cars. This is due to a high level of demand that exceeds its production capacity, the fact that it has very few competitors, and a high cost of production largely attributable to the price of battery power. The prices should drop, however, as each of these three factors is addressed. Tesla is building out its production capacity which will allow it to produce more cars when those factories go online.

Traditional car companies are also signaling that they plan to begin mass production of all-electric vehicles. Finally, research and development in battery technology is bringing down the cost of production, making the single most expensive component of these cars more affordable. In just a few years, electric cars may be just as affordable as their gas guzzling counterparts.

Active vocabulary

be unveiled -быть презентованным

backordered vehicles - автомобили невыполненные в срок

by-product - побочный продукт

enter the electric vehicle fray -вступать в борьбу за производство электрических автомобилей

Questions for discussion

1. What can account for increasing popularity of e-cars?
2. What are the reasons for a very high price tag?
3. What is it due to that Tesla cars are getting affordable?
4. How has battery technology changed?

Each aircraft has its own tailored maintenance program, from light to intermediate to heavy checks. These checks are designated by letters, such as A, B, C, D, L, or Q.

One 747-200 took about eight years to accumulate some 36,000 hours of flying time. When it did, it was time to head to the hangar for a heavy check, sometimes called a D check. The goal is to, as much as possible, return an entire airframe to its original condition. A D check takes between 15,000 and 35,000 hrs. of labor, and can put a plane out of service for 15 to 30 days, or more. The total cost averages between $1 million and $2 million.

What a D Check Involves

Once the aircraft is parked inside the hangar - a huge complex of aircraft service areas, support shops, and warehouses - the maintenance team goes to work. Worktables, platforms, and scaffolds are rolled into position for access to otherwise unreachable areas of the plane. Seats, floors, walls, ceiling panels, galleys, lavatories, and other equipment are opened or removed from the aircraft to permit close inspection. The aircraft is essentially gutted. Following step-by-step instructions, workers examine the aircraft for signs of metal cracks and corrosion. Whole sections of the aircraft’s landing gear, hydraulic systems, and engines may be replaced.

Over time, in-flight vibrations, fuselage pressurization cycles and the jolts of thousands of takeoffs and landings cause cracks in the metal structure of the aircraft. To address this problem, aviation employs diagnostic principles similar to those used in the field of medicine. Both use such tools as radiology, ultrasonics, and endoscopy to detect what the human eye cannot see.

A sheet of X-ray film is placed at a desired point on the engine exterior. Next, a long metal tube is placed inside the hollow shaft that runs the length of the engine. Finally, a pill of radioactive iridium 192— a powerful isotope—no bigger than a pencil eraser, is cranked into the tube to expose the X-ray film. The developed film helps to reveal cracks and other flaws that may require that the engine be repaired or replaced.

During the D check, samples of the aircraft's fuel and its hydraulic fluids are sent for laboratory analysis. If microorganisms are found in the fuel sample, antibiotics are prescribed. To kill jet-fuel bugs— fungi and bacteria that can get into fuel tanks through the air, water, and fuel—the tanks are treated with a biocide, a form of antibiotic. This treatment is important because the by-products of microbial growth can corrode the protective coatings on the surface of the tanks. Fuel probes in the tanks can also be affected and thus cause the pilots to receive inaccurate fuel gauge readings.

As a result of normal wear, vibrations, and internal seal damage, fuel tanks can develop leaks. Looking somewhat like a scuba diver without flippers, a specialist dons special cotton coveralls, puts on a respirator connected to a fresh-air supply, and takes tools, sealant, and a safety light with him. Through a small opening in the bottom of the wing, he squeezes his way into the defueled wing tank locates the source of the fuel- tank leak, and seals it.

Built into the wings of the plane, the fuel tanks of a 747 are a maze of walled compartments connected by small openings. Fuel tanks are no place for the claustrophobic. BOING 747-400 can hold more than 210,000 liters of fuel. This fuel capacity makes it possible to fly extremely long routes nonstop, such 5 from San Francisco, California, U.S.A., to Sydney, Australia - a distance of 12,000 kilometers.

Three stories above the ground on the flight deck, an avionics technician inspects a built-in test-pattern display on the TV-like weather radar indicator screen. Pilots use this instrument to detect and avoid thunderstorms and turbulence that may be as far 500 kilometers ahead of the airplane.

During the D check, safety equipment, such as life vests and emergency lighting, is checked or replaced. When a check of the passenger emergency oxygen system is under way, oxygen masks dangle like oranges on branches. Jet airplanes routinely cruise at altitudes of 6 to 11 kilometers above the earth, where the oxygen content and the atmospheric pressure are insufficient to sustain life. How is this problem solved? The aircraft's pressurization system draws in outside air and then compresses it. This air is finally supplied to the cabin at an acceptable temperature. If the air pressure in the cabin falls below safe levels, oxygen masks automatically drop from overhead compartments. The emergency oxygen is supplied to the passengers until the aircraft descends to an altitude where the emergency oxygen is no longer needed. On some airplanes, oxygen masks are stowed in passenger seat-back compartments, not in overhead compartments.

A heavy maintenance check is also the time to install new cabin walls and ceiling panels as well as to replace carpets, curtains and seat cushion covers. Galley equipment is disassembled, cleaned, and sanitized.

Active vocabulary

Heavy check, D check – ежедневная проверка

Galley – бортовая кухня

Fuselage – фюзеляж, корпус самолета

Biocide - биоцид (химреагент для разрушения водных бактерий)

fuel gauge reading – показатели бензиномера

Questions for discussion

1. When does the time fo heavy checks come?
2. What is the D check aimed at?
3. Could you describe the D check?
4. What other diagnostic principles are employed during the checks?
5. What are the aircraft's fuel samples sent for laboratory analysis for?
6. How do they check safety equipment?

SHIPPER'S PERSPECTIVE ON PIPELINE TRANSPORTATION

Shipper's objectives

Export route for the Timan-Pechora production.

Ability to realise world market prices for shipped crude oil.

Economic transportation option - Tariffs lower than at present.

Technically / environmentally reliable transportation route KomiArcticOil.

Russian company formed in November 1991.

Partners; British Gas - 50%; KomiTEK - 40%; UNGG - 10%.

Capital and Operating Costs - over $450 million.

Drilled - over 30 wells.

Pipelines - over 50 km built.

CPF built for entire field production.

Production increase - from 4,000 to 35,000 bopd.

Effective transportation system

Require to address producers' needs:

Tariffs should be optimized;

Transparent access and tariff methodology;

System capable of handling current and additional volumes.

Tariffs

Should be stable.

Should be low enough to attract additional upstream investment.

Should reward volume dedication.

Tariffs - Outlook

Long-term transportation contracts:

provide stability;

tariff should be lower than current;

tariff should be based on realistic oil price and netbacks (not on unjustified price rise);

lower tariff would reward volume commitment;

producer should not be penalized for cut in production resulting from no fault of his own.

Alternative transportation routes:

railway;

other pipeline projects, e.g. Baltic Pipeline project.

Tariffs from shipper's perspective

Factors:

long distances,

low oil price,

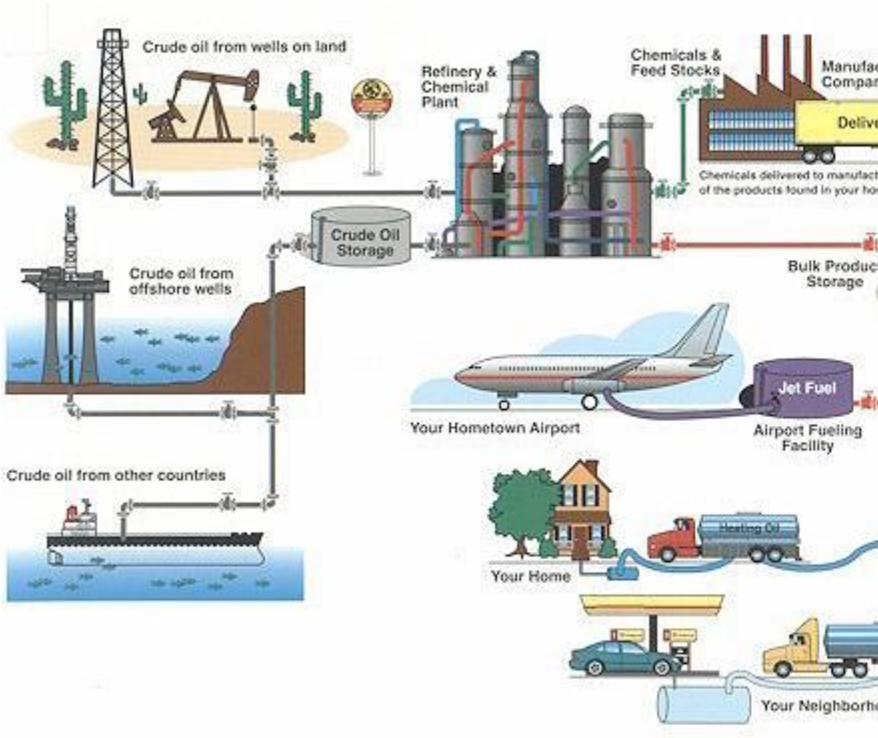
need for investment return

through export access,

low overall government take (taxes and tariffs),

"tariffs-volumes" relationship (lower volumes should not translate into higher tariffs).

Any increase in tariffs will be disproportionately detrimental to a project's economics.



Active vocabulary

crude oil - неочищенная нефть

handle - транспортировать,

CPF- crude processing facility - установка подготовка нефти (УПН)

detrimental - убыточный, неблагоприятный

Questions for discussion

1. What is the difference between a pipeline that moves oil and a pipeline that moves natural gas?
2. How safe are pipelines?
3. How are pipeline leaks prevented or minimized?

4. What causes pipeline failures to occur?

5. Who is liable for cleaning up a pipeline spill?

6. What are the regulatory requirements to build a pipeline?

7. What are the implications of new pipelines for landowners?

8. What are a pipeline company's obligations after construction?

9. What happens when a pipeline is no longer needed and is abandoned?

UNMANNED OIL RIGS – ARE THEY THE WAY OF THE FUTURE?

Robotic Drilling Systems (RDS) has developed an innovative autonomous robotic drilling rig for unmanned drilling operations. The RDS system sets new standards with increased safety and cost-effective planning and drilling, and can be implemented on existing as well as new drilling structures both offshore and on land.

Technology innovation has been making leaps and bounds in our time. The future of the oil and gas industry is harnessing the use of unmanned oil production methods both on land and at sea. Unmanned rigs are technologies that can be monitored by fewer workers, specifically calibrated to the needs of an individual well, and operated from a distance.

Companies such as Statoil, Enegi Oil, Wood Group, and China Offshore Oil Engineering Company (COOEC) are interested in the application of unmanned buoys to tap small reservoirs off the coasts of Scotland, Ireland, England, and Norway that are too expensive to justify the use of fully-manned rigs. Enegi Oil estimates that 88 such fields exist in the North Sea. Unico, Inc. has developed a pump with the added perks of being quieter and less visually distracting for use on land, and Robotic Drilling Systems (RDS) has developed a robotic system that works on any well, anywhere.

UNMANNED OIL RIGS – ON LAND

In the United States, the iconic "nodding donkey" or "pumpjack" well has been used for decades – the design was invented by the Lufkin Foundry and Machine Company in 1925. This particular pump design is responsible for production of two-thirds of the world's operating wells. However, parts for these pumps are dangerous to assemble and dismantle. They also tend to have issues when they are running dry, which can cause damage to expensive parts that are hard to access during maintenance.

Expanding on the needs of the oil and gas industry to integrate unmanned rigs, Unico, Inc. has come up with the Linear Rod Pump (LRP) system – quiet, low cost to transport and install, easily handled by two people, and controlled by a flux vector inverter drive, the LRP system is ideal for places where a "nodding donkey" would be noisy and could detract from the landscape. With the LRP system, companies can drill in neighbourhoods and parking lots for untapped oil reservoirs without disturbing residents. The most effective feature is the remote unmanned monitoring. Adding to the prospects of lower production costs and fewer worker casualties, this technological advance is a necessity in the future of oil production on land.

Robotic Drilling Systems (RDS), funded by Odfjell Drilling, has also developed a robotic drilling system. RDS says, “The new system sets new standards with increased safety and cost-effective planning and drilling.” The flexible rig can be used on both existing wells and new ones, and it can be used on land, at sea, or even in space. RDS signed an agreement with NASA in 2012 to design their fully-automated technology, and use it to position itself with satellite coordinates, erect structures on its own, drill a well, and continue on to the next site.

AT SEA

A Normally Unmanned Installation (NUI) is a remotely-operated offshore oil and gas platform. NUIs still need maintenance but instead of keeping the staff on the rig, they are serviced by a larger platform nearby. Mr. Richard Selwa, chairman and founder of Unmanned Production Buoy (UPD), has been working to develop a method of tapping small oil finds offshore that are either uneconomic to produce with fully-manned rigs or are leftovers from bigger operations.

In the fall of 2013, UPD signed an agreement with Amec to construct three unmanned floating platforms. Selwa’s buoy design was inspired by the “nodding donkey” pumps he observed in the state of Wyoming. Mr. Selwa says, “It was seeing that process at work and saying, ‘Actually it’s much simpler. It’s a standardized technology. Why don’t we just put that offshore?’” Mr. Selwa cites that the biggest advantage to his design is the use of heat provided by burning gas out of the well itself for temperature-based stabilization instead of the more commonly utilized pressure-based approach – saving costs and reducing worker injuries. Implementation of UPD’s floating rigs in the North Sea is set for 2016, with many more prospects and possibilities ahead.

In February 2015, Statoil announced they will be utilizing an unmanned wellhead platform for phase I of the Oseberg Future development project off the coast of Norway, which will be controlled from the Oseberg field centre. Ivar Aasheim, Senior Vice President of Field Development, says, "The platform will have high-quality equipment to reduce the need for maintenance during the operations phase. Consequently, we are planning for only two short maintenance campaigns per year, which will be carefully planned and performed in good-weather seasons."

In April 2015, Enegi Oil predicted that the demand for these types of structures will increase, and has been working with Advanced Buoy Technology Oil & Gas (ABTOG) to also start tapping small reservoir locations in the North Sea.

The benefits of operating unmanned oil structures are substantial, abundant, and quickly catching on. At the rate which technology continues to advance, we predict that unmanned oil rigs will take a giant leap.

Active vocabulary

oil rigs - буровые вышки
drilling rig -буровая вышка
cost-effective - экономичный
make leaps and bounds -зд.: стремительно развиваться
harness - привлекать; использовать
well - скважина
dismantle - демонтировать
running dry - сухой ход

flux vector inverter drive – инверторный привод векторного потока

on the site -на производственной площадке

maintenance - техническое обслуживание

catch on - становиться популярным

Questions for discussion

1. What is the technological breakthrough in the oil and gas industry?

2. Why is the robotic system is beneficial being used on land?

3. What advantages does the robotic system bring at sea platforms?

"INSTRUMENT-MAKING INDUSTRY"

TRANSFORMERS

The device by which A. C. voltage is changed is called a transformer. It is known that when the strength of the current flowing in a coil alters, an e. m. f. is induced in any other coil the turns of which are linked to the changing flux. Suppose that an alternating current flows in the first coil; as the current rises, an e. m. f. is induced in one direction in the second coil, and as it falls, an e. m. f. is induced in the opposite direction. An alternating current in the first coil therefore produces an alternating e. m. f. of the same frequency in the second coil. If the circuit of the second coil is completed, the induced e. m. f. will cause a current to flow.

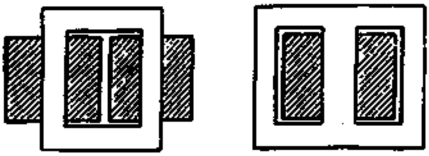


Fig. 1. Transformers

The winding connected to the source of alternating current is called the primary winding, and that in which the e. m. f. is induced, the secondary winding.

Fig. 1 shows sections of two types of transformers, the shaded areas indicating the space occupied by the windings. In both cases the core is laminated; a number or thin stampings being stacked together to provide the necessary cross-sectional area. The form shown of the left is known as a core-type transformer. Half of each winding is placed on each limb, the primary and secondary being either wound one on top of the other, or else split into small sections arranged alternately on the core. The form shown on the right is known as a shell-type transformer. The core has three limbs, the centre one of which carries the windings, while the other two form parallel return paths for the magnetic flux.

Three-phase currents may be transformed by means of a separate transformer on each phase or by means of a special three-phase transformer. The latter has a separate limb of the core and a separate primary and secondary winding for each phase. As in the case of generator windings, the three primaries and three secondaries may be either star or delta connected.

Active vocabulary

Current - ток

Coil – катушка

e.m.f. – электродвижущая сила (ЭДС)

Changing flux – переменный поток

Primary winding – первичная обмотка

Laminate – расщеплять, расслаивать

Cross-sectional area – эффективная поверхность рассевания

Core-type transformer – стержневой трансформер

Limb – токоотвод, магнитопровод

Magnetic flux – магнитный поток

Three-phase current – трехфазный ток

<u>Questions for discussion</u>

1. How does a transformer work?
2. What is the difference between a core-type and shell-type transformer?

ELECTRIC MOTORS

The simple wire loop connected to a two-section commutator is hardly suitable for running as a motor, owing to the supply being short-circuited when both brushes make contact with the same half of the commutator. This difficulty does not arise when the number of commutator segments is increased and most commercial D. C. generators can be made to run as motors.

The effect of armature reaction in a motor is opposite to that in a generator, and in order to allow for it, the brushes are given an angle of lag instead of an angle of lead; that is, they are moved from the mid position in a direction contrary to that of rotation. As in the case of the generator, interpoles are often employed to ensure sparkless commutation. When the armature of a motor rotates, the conductors cut the magnetic field, and an e.m.f. is produced in them just as it is in the case of a generator. This back e.m.f. opposes the applied e. m. f., the difference between them being the voltage which drives the current through the armature resistance. If we multiply the back e. m. f. by the armature current, we obtain the electrical equivalent (in watts), of the mechanical power developed by the motor.

Motors, like generators, may be either series, shunt or compound wound. The speed of a shunt-wound motor does not vary much with the changes in the load, but that of a series-wound motor falls as the load increases.

Note that the direction of rotation of a motor is not reversed by reversing the supply current, because this would change the polarity of both the field and the armature. To reverse the rotation it is necessary to reverse the connections of either the field or the armature, but not both. The speed of a motor can be varied by varying the strength of the field, the speed increasing as the field is weakened. The field strength can be controlled in the same way as that of a generator, i. e. by a resistance, in series with the field-magnet winding of a shunt-wound machine or in parallel with that of a series- wound machine.

Active vocabulary

Direct-current – постоянный ток

Field magnet – магнитный индуктор

Armature – якорь

Brush gear – щеточный привод

Short-circuited –короткозамкнутый

Angle of lag – угол запаздывания по фазе

Angle of lead – угол опережения по фазе

Sparkless communication - безыскровая работа

Shunt wound motor – двигатель шунтового (параллельного) возбуждения

Compound wound motor – двигатель постоянного тока смешанного возбуждения

Questions for discussion

1. What are essential parts of a direct-current motors?
2. What are designed to ptocet a motor?
3. How does the ammature work differ in motor differ from that in a generator?
4. How can the speed of a motor be varied?

"MECHANICAL ENGINEERING"

COUPLINGS AND CLUTCHES

Couplings and clutches are intended to connect shafts or other revolving parts and in modern mechanical engineering they form integral components of almost all machines. Couplings and clutches link together the shafts of turbines and generators, prime movers and driving mechanisms, as well as the shafts of separate units and assemblies effect smooth or instantaneous starting stopping, reversing and gear change of machines; protect against overload and racing and prevent reverse rotation.

Hence the great diversity of types of couplings and clutches and the continuous development of new designs.

Clutches are employed to connect and disconnect shafts during their relative motion (under load) or at standstill. According to the forces which keep them engaged, clutches may be divided into four groups: friction, claw (toothed) electromagnetic fluid, and electromagnetic powder, and hydraulic clutches. Depending on the manner in which clutches are operated they are subdivided into those controlled by an operator directly or by means of auxiliary force, and power controlled clutches.

Advantages of Welded Work over Riveted Work

The application of welding instead of riveting to make permanent joints has a number of advantages, the chief being economy of material and labour. Metal is saved due to: a) the lighter weight of members joined by welding (the weight of welds comprises about 1-1,5 per cent of the work weight while the weight of rivets is about 3.5-4 per cent);

(b) the better utilization of metal due to the absence of holes which weaken the- effective sections;

(c) the possibility of a wide use of butt-joined seams requiring no additional elements such as straps.

The use of welding instead of riveting saves on an average 10 to 20 per cent in weight.

Less labour is required because it is no longer necessary to lay out, punch or drill the holes. Besides riveting is much more complicated and less productive job than welding which can be often largely automated.

Active vocabulary

Coupling – сцепка

Clutche – сцепка

Revolving part – вращающаяся часть

Claw (toothed) electromagnetic fluid

Hydraulic clutch – гидравлическая муфта сцепления

Welded – приваренный

Riveted – клепанный

Butt-joint seam – стыковой шов

Strap – крепежная планка

Questions for discussion

1. What job do couplings and clutches do?
2. What are clutchers broken down into?
3. What are the advantages of welded work?

ENGINEERING MATERIALS

1. Materials used in mechanical engineering consist chiefly of metals, alloys and plastics, which have almost completely replaced timber largely used in the past. Rubber is employed for some purposes — mainly for fittings, packings, and washers. Leather is also used for washers, pump-plungers and driving belts.

2 . Metals of various types and their alloys are by far the most widely used materials. One of the oldest is cast iron, which is made from iron-ore by smelting it in a kiln or chamber, called a “blast furnace”. Run off into sand moulds and cooled, the cast iron forms blocks called pigs.

3. Cast iron is strong in compression but weak in

tension. It is therefore used for making bases for machinery, stands, engine bed-plates, framework for machines, brackets, pedestal bodies, bearing-housings, gear-wheels, pulleys, intricate casings for machinery, engine cylinders, domestic utensils, fire-grades and architectural fittings of an ornamental nature, or anything in which tensile stress in not involved.

4. Steel is produced by melting cast iron (pigs) and refining it to remove some of the carbon and other impurities. Special kinds of steel comprise mild or structural steel, alloy steel, stainless steel, carbon (or tool) steel, self-(or air-) hardening tool steel, heat- resisting steel, and many others.

5. One method of preventing a nut from loosening is to fit what is termed a spring washer. There are several forms of these, and each claims its particular merit. When placed in position on a bolt, and the nut screwed on, the nut screwed on, the reaction of the spring, as it is compressed, exerts pressure against the nut and prevents the latter from turning and working loose.

6. When two shafts have their axes set at right angles to each other, the shafts may be driven, or rotate by the use of bevel gears. If it is desired to rotate one shaft at a different speed from the other, a bevel gear-wheel and bevel pinion would be used.

Active vocabulary

Timber – лес, лесоматериал

Pump-plunger – поршень насоса

Kiln – печь для обжига

Blast furnace – доминая печь

Engine bed-plate – фундаментная рама двигателя

Bracket – качающаяся рама
Bearing – housing – гнездо под подшипник
Pulley – шкив
Tensile stress – растягивающее напряжение
Impurities – примеси
Nut - гайка
Spring washer – пружинная гайка
Bevel gear – коническая ведомая шестерня
Bevel pinion – ведущая коническая шестерня

Questions for discussion

1. What are the engineering materials?
2. Where is cast iron used?
3. How is steel produced?

TRANSMITTERS, CONTROLLERS AND SWITCHES

TRANSMITTERS

Differential pressure transmitters, except for transmitters furnished with diaphragm seals or measuring level, shall be provided with five (5)-valve manifolds. And pressure transmitter shall be prepared with 2-valve manifolds with bleed valve.

As a rule, conventional type transmitter with local indicator is owner preference. However, smart type with hart communication shall be applied where several process operating mode exist and/or instrument range change is required according to the operation requirement.

Regards with the above, conventional type shall be applied for ESD.

Where the transmitters are furnished with diaphragm seals, the process connections shall normally be flanged as far as possible. Pancake type remote diaphragm seal is preferable, where is possible to select.

All process wetted parts of pressure transmitters and differential pressure transmitters including manifolds shall be type 316 stainless steel or better. Other materials shall be used as required by the process conditions.

PNEUMATIC INDICATING CONTROLLERS

Where the controls are performed locally, pneumatic indicating controllers, which receive pneumatic signal from the transmitters, shall normally be applied. The input signal, set point and output signal shall be indicated on the controllers. The controllers shall be furnished with an automatic-manual transfer system and the control action, direct or reverse, shall be changeable. The measurement element shall usually be bronze bellows.

SWITCHES

All process wetted parts of switches, such as level switches, pressure switches, temperature switches, shall be selected to meet the process conditions.

The contact shall be of the micro switch type, Single Pole Double Throw (SPDT) as a minimum. For IS applications, the contacts shall be gold plated and the rating shall be max. 30 VDC 0.1A. For non-IS applications, the contacts rating shall not be less than 30 VDC 0.2A.

Active vocabulary

Bleed valve – воздуховыпускной клапан

ESD – электростатический разряд

Diaphragm seal – разделительная мембрана

wetted parts – детали проточной части

pneumatic indicating controller – контролер пневматически показывающего прибора

Single Pole Double Throw (SPDT) – однополюсной переключатель на два направления

IS – насыщенный ток

Questions for discussion

1. Would you describe transmitters?
2. What are the pneumatic indicating controllers?
3. What kind of swithcers do you know?

"ELECTRONICS"

SPECIFICATIONS

1. Interpreter

The personal talking interpreter that translates up to 10,500 individual words and 65000 phrases across English, German, Spanish and Italian.

2. Sanyo TRS 6100

Small lightweight microcassette tape recorder. Complete with external "tie-pin" type microphone, earphones, microcassette and wallet.

3. Disc Players AIWH DX P50

16 track programmable CD player with remote control unit. LCD display with track and playing time. Operates with batteries or from mains.

4. Sony DZ 5

16 track programmable CD player with digital graphic equalizer surround sound bass boost and dynamic low volume sound. 4 different play modes. LCD track time and signal processor windows. Operated from mains or rechargeable battery pack.

5. Camcorder JVC GR AXIO

Compact VHS-C video camera with quick response auto focus and auto macro. 8x power zoom. One touch shooting. Includes carrying case.

6. Computer PSION SERIES 3

World's most powerful pocket-sized computer with up to 4 Megabytes of memory. Built-in word-processor for document management, data-base referral, automatic dialing, etc. Can be connected to PCs.

7. CD Portables. TEAC Stereo Radio Cassette with CD Player

Features CD player with 32 program memory, AM/FM stereo radio, twin cassette with high speed dubbing and continuous play, super bass control for enriching bass sound and high power speakers.

I. Sanyo Stereo Radio Twin Cassette with CD Player

Features a 10 key remote control with motor driven volume control AM/FM radio twin cassette deck with auto reverse and continuous play, CD player with 20 memory programme, skip and search function and high quality speakers.

9. Masuda 48 cm Cordless Remote Colour TV

Has a 3-year warranty. Features direct access cordless remote control, VHF/UHF

electronic tuning, on-screen display for volume, channel and timer, audio/video input connections and high focus picture tube.

10. Sony 51 cm Remote Control Colour TV

Features a large 51 cm screen with flat black Trinitron picture tube, PAL and NTSC inputs, and infrared remote control.

II. Roland EPS

A new concept in electronic pianos. It is perfect for beginners to advanced players as it has a 61 note keyboard with the enhanced playability and expressiveness of higher- class pianos, in a portable package. Headphones valued $ 33 are provided.

11. Samsung 68 cm Remote Control Stereo Colour TV with Teletext

Features the latest in styling and design with flat square, powerful stereo speakers, teletext, full function remote control and on-screen display. Stand optional extra.

“MEDICINE”

A STICKING POINT FOR SURGEONS

POSTOPERATIVE ADHESIONS ARE A GRAVE AND COMMON SIDE-EFFECT OF SURGERY, SAYS DR THOMAS STUTTAFORD

There are few doctors who have not consulted Bailey and Love’s Short Practice of Surgery at some time in their career.

Many, even after years of practicing medicine, still don't like to venture too far without a copy to hand. It is always a relief, after seeing a patient go home, to look up their condition in Bailey and Love and find that no important factor in the case has been neglected.

The title Short Practice of Surgery is a misnomer. It is a weighty tome with

1,348 graphically illustrated, well-written pages covering every aspect of surgery. Even so, in the index there is no mention of adhesions and bands, two complications of surgery that frequently cause serious postoperative troubles. The appropriate pages are there, for everything is covered in Bailey and Love somewhere or other, but can be traced only by looking in the index under "intestinal obstruction".

Too often the pain and intestinal dysfunction caused by adhesions are dismissed, yet their consequences may be dire. Adhesions are initially complex strands or bands of fibrin, which is a sticky, proteinous mass similar to that which holds blood clots together. If it doesn't dissolve, it forms rough, fibrous strands.

The bands develop after surgery and join together tissues and other organs lying in the peritoneal sac – the anatomical bag that holds the intestines and other abdominal organs.

The initial fibrin strands usually disappear as the guts, or other organs, recover from surgery. But less often the fibrin, instead of dissolving, becomes permanent and forms thick bands that link previously separate organs.

The adhesions are painful, partly because they prevent free movement of the organs and partly because they stretch sensitive nerve fibres. Too often adhesions also lead to bowel obstruction, especially after gynaecological or pelvic surgery. There is a danger that adhesions will result in obstruction of the Fallopian tubes and infertility.

One authority has suggested that adhesions are implicated in one in five cases of secondary infertility in women.

Adhesions are also responsible for between 65 and 75 per cent of cases of obstruction of the small bowel, and are associated with up to half of all cases of chronic pelvic pain.

Research, presented at the recent sixth annual symposium on the peritoneum in Amsterdam, showed that more than 60 per cent of surgeons regard adhesions as a significant problem in their practice. Even so, only half of these surgeons regularly use anti-adhesive products, and fewer than one in ten discusses the consequences of adhesions with patients before they have surgery.

It was hoped that the introduction of laparoscopic (keyhole) surgery would reduce the incidence of adhesions, as during such operations the guts are less generally pulled about. These hopes have been dashed. A recent study has found that the number of readmissions to treat adhesions is slightly greater after keyhole surgery than after the abdomen has been opened with a traditional incision. The one time of laparoscopic surgery that seems to carry little risk of adhesions formation is sterilization. Operations to treat appendicitis, together with gynaecological surgery, are the most common causes of postoperative adhesions.

The only form of treatment once an adhesion has formed is further surgery.

Over the years of wide variety of substances have been instilled into the peritoneal cavity to prevent adhesion formation. Recently two products have exited the interest of surgeons. Adept, a 4 per cent solution of icodexrtin, has bee shown to reduce adhesions postoperatively. Icodextrin is already widely used in renal dialysis, demonstrating its safety and tolerability. It can be used in either keyhole or open surgery, is compatible with antibiotics and has already been accepted in much of the European Union as an anti-adhesion preventive. It is infused slowly ay the end of the surgery, and is also used during the operation to irrigate surfaces of the organs. Adrian Lower, a London consultant gynaecologist with an interest in laparoscopic surgery and adhesions – and, incidentally, also a former regular naval and TA yeomanry officer – says that Adept is the first method with a proven record in reducing the number of adhesions caused by surgery.

Surgeons are also looking forward to hearing the result of final clinical trials of AdSurf. Manufactured by Britannia Pharmaceuticals, AdSurf is a dry powder that is sprayed into the peritoneal cavity before closing the abdomen. The powder melts at body temperature and coats all the internal surfaces, preventing the formation of adhesions. The causes of surgical adhesions are little understood, but it is known that alterations to the blood supply during surgery, infection, some drugs being taken by the patient at the time of surgery, rough handling, and the introduction of foreign material such as talc, starches, gauze and silk may all precipitate adhesions.

Professor Stephen Holgate, of Southampton University, said recently that there was now evidence that even a suggestion of latex allergy was an important factor in the formation of adhesions. Adhesions could therefore be the only obvious manifestation of an allergy to latex.

Active vocabulary

postoperative adhesions – послеоперационные спайки

grave side effect of surgery – серьезное послеоперационное последствие

intestinal obstruction – кишечная непроходимость

blood clots - тромбы

fibrous strands – пучок волокон

bands – связки

peritoneal sac – брюшная полость

abdominal organs – органы брюшной полости

bowel obstruction - кишечная непроходимость

pelvic surgery – операция на органах таза

infertility – бесплодие

laparoscopic surgery – лапароскопическая операция

incision - надрез

instill into peritoneal cavity – вводить в брюшную полость

renal dialysis - гемодиализ

compatible with antibiotics – совместимый с антибиотиками

precipitate adhesions – вызывать спайки

Questions for discussion

1. What are the grave surgery complications?
2. How can you account for their dire consequencies?
3. Do doctors do anything the prevent adhesions?
4. What breakthrough can reduce post operational adhesions?
5. What are other solutions for the matter in question?

THERAPY. BRONCHIAL ASTHMA

Report of a Case

A 24-year-old housewife. First she had episodes of wheezing at 5 following successive attacks of measles, mumps, and chicken-pox. Perennial mild wheezing recurred during her early childhood in Missouri. After a move to the California coast at the age of 11, she had no asthmatic symptoms for more than two years. When she moved inland, asthmatic symptoms returned but were easily controlled with intermittent use of inhaled isoproterenol. At 21 she was first hospitalized for moderately severe asthma which necessitated treatment with corticosteroids. Thereafter she had continual wheezing and mild dyspnea with exacerbation during relatively cold and damp months, at times of emotional upset, and after exposure to tobacco smoke. Symptoms were not aggravated by exposure to animal or house dust. She used to take aspirin for headache without ill effect.

During the week prior to her first admission to the clinic in November 1970, difficulty in breathing had progressed to the point that she was inhaling isoproterenol every 60 minutes at least.

At the physical examination she was in distress with laboured breathing. Her chest was distended and there was increased resonance to percussion; there were diffused inspiratory and expiratory rhonchi (coarse dry rales in the bronchial tubes) and wheezes throughout her chest. Isoproterenol inhalation was discontinued, and epinephrine and intravenous administration of amynophyline and corticosteroids was instituted. Five days later, inhalation of isoproterenol produced a slight improvement. Chest x-ray films changed for the best too.

Active vocabulary

Wheezing, dyspnea – одышка

Successive attacks – последующие приступы

Measles – корь

Mumps – свинка

Chicken-pox – ветряная оспа

Perennial mild wheezing – продолжительная неострая одышка

To recur – рецидивировать

Intermittent use – периодическое использование

To inhale – вдыхать

Exacerbation – обострение

Ill effect – побочное действие

Laboured breathing – затрудненное дыхание

Intravenous administration – внутривенное введение препарата

Questions for discussion

1. What had she suffered by 21?
2. How did her condition proceed?
3. What assuaged her condition?

CARDIOVASCULAR EVENT WITH ATHEROTHROMBOSIS

Ph. Gabriel Steg, MD; Deepak L. Bhatt, MD; Peter W. F. Wilson, MD; Ralph D'Agostino, Sr, MD; E. Magnus Ohman, MD; Joachim Rother, MD; Chiau-Suong Liau, MD, PhD; Alan T.

Hirsch, MD; Jean-Louis Mas, MD; Yasuo Ikeda, MD; Michael J. Pencina, PhD; Shinya Goto, MD; for the REACH Registry Investigators

ABSTRACT

Context Few data document current cardiovascular (CV) event rates in stable patients with atherothrombosis in a community setting. Differential event rates for patients with documented coronary artery disease (CAD), cerebrovascular disease (CVD), or peripheral arterial disease (PAD) or those at risk of these diseases have not been previously evaluated in a single international cohort.

Objective To establish contemporary, international, 1-year CV event rates in outpatients with established arterial disease or with multiple risk factors for atherothrombosis.

REACH (The Reduction of Atherothrombosis for Continued Health Registry) is a prospective cohort of 68 236 patients with either established atherosclerotic arterial disease (CAD, PAD, CVD; n = 55 814) or at least 3 risk factors for atherothrombosis (n = 12 422), who were enrolled from 5587 physician practices in 44 countries in 2003-2004.

Main Outcome Measures Rates of CV death, myocardial infarction (MI), and stroke.

Results As of July 2006, 1-year outcomes were available for 95.22% (n = 64 977) of participants. Cardiovascular death, MI, or stroke rates were 4.24% overall: 4.69% for those with established atherosclerotic arterial disease vs 2.15% for patients with multiple risk factors only. Among patients with established disease, CV death, MI, or stroke rates were 4.52% for patients with CAD, 6.47% for patients with CVD, and 5.35% for patients with PAD. The incidences of the end point of CV death, MI, or stroke or of

hospitalization for atherothrombotic event(s) were 15.20% for CAD, 14.53% for CVD, and 21.14% for PAD patients with established disease. These event rates increased with the number of symptomatic arterial disease locations, ranging from 5.31% for patients with risk factors only to 12.58% for patients with 1, 21.14% for patients with 2, and 26.27% for patients with 3 symptomatic arterial disease locations ($P<.001$ for trend).

Conclusions In this large, contemporary, international study, outpatients with established atherosclerotic arterial disease, or at risk of atherothrombosis, experienced relatively high annual CV event rates. Multiple disease locations increased the 1-year risk of CV events.

INTRODUCTION

Atherothrombosis (coronary artery disease [CAD], cerebrovascular disease [CVD], and peripheral arterial disease [PAD]) is associated with the main causes of mortality on a worldwide scale.

Thus far, most of the information available on atherothrombosis risk has been derived from single regional locales (such as studies conducted in Europe or North America), often confined to a single subtype of patient (patients with CAD, previous stroke patients without PAD), and generally limited to hospitalized patients (as opposed to outpatients or individuals in primary care) or to patients in clinical trials (as opposed to patients in the community).

The REACH (Reduction of Atherothrombosis for Continued Health) Registry has been established to circumvent these limitations by recruiting and following up a large cohort of outpatients with a history of, or who are at high risk of developing, atherothrombosis. The REACH Registry aims to study contemporary outpatient populations from various regions of the world to describe the demographic characteristics and management as well as to determine the risk of cardiovascular (CV) events in the global population and in each clinical subgroup. This article describes the characteristics and outcomes of patients for whom 1-year follow-up data were available and reports the association between multiple symptomatic locations of atherothrombosis (ie, polyvascular disease) and CV event rates.

METHODS

The design, including the strategy for selecting physicians, collecting follow-up data, and ensuring data quality, and the baseline description of the REACH Registry have been published. Briefly, consecutive outpatients aged at least 45 years with established CAD, CVD, or PAD or patients with at least 3 atherothrombotic risk factors (multiple risk factors only) were enrolled by their physician over an initial 7-month recruitment period. The patients were from 5587 physician practices in 44 countries and were enrolled between December 2003 and June 2004. Due to regulatory requirements in Japan, enrollment in that country was delayed and occurred between August and December 2004.

Follow-up

At 12 months (plus or minus 3 months) after enrollment, data were collected from participating physicians regarding patients' clinical outcomes, vascular endovascular procedures, employment status, weight, and current smoking status, as well as whether patients were taking medications regularly since baseline for long-term disease. The current report is based on a database lock of July

21, 2006, for analysis of the 1-year follow-up. Events were not adjudicated; however, reports of ischemic stroke and transient ischemic attack had to be sourced from a neurologist or hospital to ensure a reliable diagnosis.

Cardiovascular death included fatal stroke, fatal myocardial infarction (MI), and other cardiovascular death. *Other cardiovascular death* included other death of cardiac origin; pulmonary embolism; any sudden death, including unobserved and unexpected death (eg, while sleeping) unless proven otherwise by autopsy; death following a vascular operation, vascular procedure, or amputation (except for trauma or malignancy); death attributed to heart failure; death following a visceral or limb infarction; and any other death that could not be definitely attributed to a nonvascular cause or hemorrhage. Any MI or stroke followed by death, whatever the cause, in the subsequent 28 days was considered as a fatal MI or fatal stroke.

RESULTS

Of the 68 375 patients enrolled in the REACH Registry, 68 236 entered the follow- up phase, with 139 (0.20%) patients withdrawing consent early. As of the database lock on July 21, 2006, 1-year follow-up was available for 64 977 (95.22%) of the patients who had entered the follow-up stage.

All-cause mortality was 2.58% overall at 1 year, with 2.81% of patients having established arterial disease compared with 1.51% of patients having multiple risk factors only (with >3 risk factors). A total of 63.95% of those deaths were from CV causes. The overall combined CV death, MI, or stroke rate at 1 year was 4.24% (95% confidence interval [CI], 3.97%-4.51%), ranging from 2.15% (95% CI, 1.84%-2.46%) of patients with multiple risk factors only to 6.47% (95% CI, 5.96%-6.97%) of patients enrolled with CVD. Cardiovascular event rates for the total population, for each of the CAD, CVD, and PAD subsets.

Event rates were consistently and markedly lower for patients with multiple risk factors only than for patients with established arterial disease. Patients with PAD had the highest CV mortality; CAD patients had the highest nonfatal MI rate, and the highest nonfatal stroke rate was seen among patients with CVD. The end points of CV death/MI/stroke or hospitalization for atherothrombotic event(s) were 12.81% (95% CI, 12.38%-13.23%) in the total patient population, 14.41% (95% CI, 13.93%-14.89%) in the population with established arterial disease, and 5.31% (95% CI, 4.86%-5.75%) in the population with multiple risk factors only. In the overall stable population with established arterial disease, approximately 1 in 7 patients had a major event (CV death, MI, and stroke) or was hospitalized for a CV event or revascularization procedure within a year of enrollment.

Major CV end points were also examined by geographic region. Although the adjusted rates reported show overall consistency across geographic regions, with extremes of CV death rates ranging from 0.74% in Japan to 2.90% in Eastern Europe, there are some differences. Japan has the lowest rates of CV death and of nonfatal MI but higher rates of nonfatal stroke compared with North America, Western Europe, and Australia. The observed combined rates of CV death, MI, or stroke ranged from 3.13% in Australia to 7.62% in Eastern Europe. In all geographic regions, the rate of the triple end point of CV death, MI, or stroke exceeded the anticipated 3% event rate.

Conclusions

The high event rates observed in this large, stable, contemporary outpatient cohort of patients with established atherosclerotic arterial disease or with multiple atherothrombotic risk factors indicate that continued efforts are needed to improve secondary prevention and clinical outcomes. Initiatives to improve adherence to evidence-based guidelines and care are an important tool in this respect. In addition, the strong association of asymptomatic and symptomatic multiple locations of atherothrombosis with event rates suggests that atherothrombosis should be addressed as a global arterial disease in patients.

Active vocabulary

cardiovascular - сердечно-сосудистый

community setting - амбулаторные условия

coronary artery disease - ишемическая болезнь сердца (ИБС)

cerebrovascular disease - церебро-васкулярное заболевание (ЦВЗ)

peripheral arterial disease - периферическая артериальная болезнь

cohort - когорт (группа людей)

myocardial infarction - инфаркт миокарта

clinical trials - клиническое тестирование

autopsy - вскрытие

hemorrhage - кровопотеря;кровотечение

Questions for discussion

1. What is REACH Registry?

2. What methods are used?
3. What follow-up data is requiered?
4. What results are obtained?

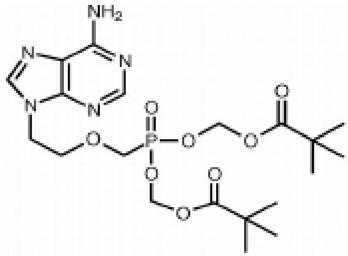
“CHEMISTRY”

HEPSERA

DESCRIPTION

HEPSERA is the tradename for adefovir dipivoxil, a diester prodrug of adefovir. Adefovir is an acyclic nucleotide analog with activity against human hepatitis B virus (HBV).

The chemical name of adefovir dipivoxil is 9-[2 [bis[(pivaloyloxy)methoxy]phosphinyl]methoxy]ethyl]adenine. It has a molecular formula of C 20 H 32 N 5 O 8 P, a molecular weight of 501.48 and the following structural formula:



Adefovir dipivoxil is a white to off-white crystalline powder with an aqueous solubility of 19 mg/mL at pH 2.0 and 0.4 mg/mL at pH 7.2. It has an octanol/aqueous phosphate buffer (pH 7) partition coefficient (log p) of 1.91.

HEPSERA tablets are for oral administration. Each tablet contains 10 mg of adefovir dipivoxil and the following inactive ingredients: sodium, lactose monohydrate, magnesium stearate, pregelatinized starch, and talc.

Mechanism of Action:

Adefovir is an acyclic nucleotide analog of adenosine monophosphate. Adefovir is phosphorylated to the active metabolite, adefovir diphosphate, by cellular kinases. Adefovir diphosphate inhibits HBV DNA polymerase (reverse transciptase) by competing with the natural substrate deoxyadenosine triphosphate and by causing DNA chain termination after its incorporation into viral DNA. The inhibition constant (K i) for adefovir diphosphate for HBV DAN polymerase was 0.1 μM. Adefovir diphosphate is a weak inhibitor of human DNA polymerases (alpha) and (gamma) with K i values of 1.18 μM and 0.97 μM, respectively.

CLINICAL PHARMACOLOGY

Pharmacokinetics:

The pharmacokinetics of adefovir have been evaluated in healthy volunteers and patients with chronic hepatitis B. Adefovir pharmacokinetics are similar between these populations.

Absorption:

Adefovir dipivoxil is a diester prodrug of the active moiety adefovir. Based on a cross study comparison, the approximate oral bioavailability of adefovir from a 10 mg single dose of HEPSERA is 59%.

INDICATIONS AND USAGE

HEPSERA is indicated for the treatment of chronic hepatitis B in adults with evidence of active viral replication and either evidence of persistent elevations in serum aminotransferases (ALT or AST) or histologically active disease.

This indication is based on histological, virological, biochemical, and serological responses in adult patients with HBeAg+ and HBeAg- chronic hepatitis B with compensated liver function, and in adult patients with clinical evidence of lamivudine-resistant hepatitis B virus with either compensated or decompensated liver function.

CONTRAINDICATIONS

HEPSERA is contraindicated in patients with previously demonstrated hypersensitivity to any of the components of the product.

PRECAUTIONS

Drug Interactions

Since adefovir is eliminated by the kidney, co-administration of HEPSERA with drugs that reduce renal function or compete for active tubular secretion may increase serum concentrations of either adefovir and/or these co-administered drugs.

Apart from lamivudine, trimethoprim/sulfamethoxazole and acetaminophen, the effects of co-administration of HEPSERA with drugs that are excreted renally, or other drugs known to affect renal function have not been evaluated.

Patients should be monitored closely for adverse events when HEPSERA is co-administered with drugs that are excreted renally or with other drugs known to affect renal function.

Ibuprofen 800 mg three times daily increased adefovir exposure by approximately 23%. The clinical significance of this increase in adefovir exposure is unknown.

While adefovir does not inhibit common CYP450 enzymes, the potential for adefovir to induce CYP450 enzymes is not known.

The effect of adefovir on cyclosporine and tacrolimus concentrations is not known.

DURATION OF TREATMENT

The optimal duration of HEPSERA treatment and the relationship between treatment response and long-term outcomes such as hepatocellular carcinoma or decompensated cirrhosis are not known.

OVERDOSAGE

Doses of adefovir dipivoxil 500 mg daily for 2 weeks and 250 mg daily for 12 weeks have been associated with gastrointestinal side effects. If overdose occurs the patient must be monitored for evidence of toxicity, and standard supportive treatment applied as necessary.

Following a 10 mg single dose of HEPSERA, a four-hour hemodialysis session removed approximately 35% of the adefovir dose.

DOSAGE AND ADMINISTRATION

The recommended dose of HEPSERA in chronic hepatitis B patients with adequate renal function is 10 mg, once daily, taken orally, without regard to food. The optimal duration of treatment is unknown.

HOW SUPPLIED

HEPSERA is available as tablets. Each tablet contains 10 mg of adefovir dipivoxil. The tablets are white and debossed with "10" and "GILEAD" on one side and the stylized figure of a liver on the other side. They are packaged as follows: Bottles of 30 tablets (NDC 61958-0501-1) containing desiccant (silica gel) and closed with a child-resistant closure.

Do not use if seal over bottle opening is broken or missing.

Active vocabulary

Adefovir dipivoxil – адевофир дипивоксил (противовирусное средство)

Diester prodrug – сложный диэфир предшественника лекарства

Aqueous solubility –растворимость в воде

For oral administration – для преорального применения, внутреннего применения

Sodium – натрий оксибат

Monohydrate – моногидрад, олноводный

Magnesium stearate – стеарат магния

Pregelatinized starch – клейстеризованный крахмал

Inhibit polymerase – ингибировать полимеразу

Cellular kinases – клеточная кеназа

Be evaluated in smb – быть оцененным на ком-то

Cross study comparison - результаты перекрестного исследования

Bioavailability - биодоступность

Indication and usage – показания к применению

Histological - гистологический

Virological - виросологический

Serological – серологический

Hypersensitivity to – гиперчувствительность к

Precautions – меры предосторожности

Co-administration of smth with smth – одновременное назначение

Excrete renally выводить почками

Adverse events – побочные явления

Long-term outcomes – отдаленные результаты

Hepatocellular carcinoma – печеночно-клеточный рак

Decompensated cirrhosis – декомпенсированный церроз

Gastrointestinal side effects – желудочно-кишечные побочные действия

Be monitored for evidence of toxicity – осуществлять наблюдение на предмет токсического действия

How supplied – форма выпуска

Be available as tablets – выпускаться в виде таблеток

Store – хранение

Questions for discussion

1. What is HESPERA?
2. How is a person to administer it?
3. What precautions is a person to consider?
4. What is to be done in case of overdosage?

MINIMIZING RISKS WITH RECYCLED WATER

With water becoming a more precious commodity, chemical process industries (CPI) and municipalities are searching for ways to conserve it. Recycling is the most common solution, but is not without its problems. Recycling municipal drinking water, for example, has led to deteriorating quality. In addition, in sensitive applications, such as electronics processing (CE, June, p.30) or pharmaceutical production, using recovered process water adds to the risk of product contamination.

To get the most out of their water, CPI plant operators routinely use recycled water for cooling. In fact, cooling uses more water, on a volume basis, then any other CPI plant application, explains Matt Kogut, director of cooling water treatment service at BetzDearborn (Trevose, Pa).

However, even with a “nonsensitive” application such as cooling, using recycled water can hurt equipment performance. It can also result in logistical problems, says Mike Geraghty, director of marketing at Calgon Corp. (Pittsburgh, Pa). During successive water reuse cycles, contaminants build up in cooling systems, leading to scale formation, corrosion and microbial deterioration. These problems mean water pipe damage, lower heat transfer and cooling efficiency, and wasted money.

Simple solutions are no longer possible. Acids, typically added to water to help prevent scale deposition, pose operator safety problems and can promote pipe corrosion.

In response, more alkaline systems have been introduce to prevent corrosion and eliminate some of the problems caused by using acid. BetzDearborn, for example, offers Continuum AEC-alkyl epoxy carboxylate, an organic calcium carbonate scale inhibitor that does not contain phosphorous. It can handle water at pH levels of 7.8 and above. Similarly, Calgon’s organic pHreedom system can operate at pH levels between 8.5 to 9.2. Nalco (Naperville, Ill.) also offers an alkaline phosphate for higher pH ranges.

However, alkaline systems can increase the likelihood of scale formation. At the same time, environmental regulations governing corrosion inhibitors and antimicrobial agents have eliminated the old “pour and treat” approach. Finding the right combination of chemical and equipments to solve cooling water problems is more-complex than ever, a fact that is increasing the use of outsourcing for process water treatment.

For example, for decades, effective water treatment meant simply using chemical inhibitors, such as zinc chromate. However, last March, the U.S. Environmental Protection Agency (EPA; Washington, D.C.) banned all chromium-based water treatments for industrial process cooling towers (CE, March, p.65). Motivating the ban were the facts that hexavalent chromium, a key component in the chemical treatment, causes lung cancer, and that zinc, a heavy metal, can easily accumulate in water.

Fortunately, chemical producers had started working on more environmentally friendly alternatives five to six years before the ban. Currently, phosphate systems are being used in place of chromate-based treatments.

However, there is no single solution for all water systems. The key to solving the problem is to find a combination for chemicals that reduce or eliminate the cathodic and anodic reactions, to reduce the metal loss that can result in corrosion. Companies, such a Calgon, Nalco and BetzDearborn have all developed various phosphate treatments depending on the characteristics of the water, such as pH and calcium carbonate levels.

For waters with high calcium carbonate and neutral pH levels, using a combination of ortho- and polyphosphates is preferable. Orthophosphates are anodic inhibitors that combine with the iron to form a coating of highly insoluble iron phosphate precipitate inside the pipe.

Cathodic reactions, meanwhile, can be controlled using ortho- and polyphosphates. At the cathodic metal surface, the pH is relatively high, since hydroxyl ions are released as a result of the reaction between oxygen and free electrons. The ortho- and polyphosphates can combine with the calcium from the calcium carbonate to form a precipitate that inhibits corrosion. Several available systems work for hard waters. Some products include Dynacool III from Nalco, Dianodic II from BetzDearborn and Conductor XLP from Calgon.

While phosphates are more acceptable that zinc chromate, they, too, pose some environmental problems. High levels of phosphate discharge can cause algae to bloom, chocking off oxygen in the water and suffocating remaining organisms. Thus, the levels of phosphate discharged must be regulated.

In Germany, strict fines are levied for discharging phosphates. For this market, Nalco has developed low-phosphate or phosphate-free alternatives. Because they cost more than phosphate systems, the phosphate alternatives are not yet popular throughout the U.S., says Mary Kay Kaufmann, general marketing manager for Nalco's water and waste water division. However, she expects to see the formulation gain acceptance over the next few years, as EPA begins to examine U.S. phosphate regulations.

Active vocabulary

Chemical process industry - химическая промышленность

Scale formation – образование накипи

Corrosion – коррозия, ржавчина

Alkaline system – щелочная система

Hexavalent chromium – шестивалентный хром

Anodic inhibitors – анодный замедлитель коррозии

Coating for highly insoluble iron phosphate покрытие для высоко не растворимого фосфата железа

Cathodic reaction – катодная реакция

Precipitate – осадок

To inhibit, suffocate – подавлять

Fines are levied – взимаются штрафы

Alga (sg), algae (pl) – водоросли

Questions for discussion

1. What probles does recycling water harbor?
2. What chemicals have been used in water treatment systems?
3. What is a key solution for the matter?

ESTERS OF CARBOXYLIC ACIDS

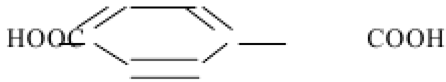
Many esters of carboxylic acids and saturated hydrocarbons possess pleasant odors and are often found in plants, accounting for the fragrance of flowers and the flavour of fruits and berries. Some of these esters can be prepared artificially and are widely used under the name of "fruit essences" in confectionery, in the manufacture of soft drinks, perfumes, etc.

Isoamyl acetate CH3COOC5H11 (oil of pears) is used as a solvent for celluloid.

Certain derivatives of acrylic acid CH2=CH-COOH, an easily polymerized unsaturated acid, have acquired great industrial importance. One of them is methyl methacrylate CH2=C(CH3)-

COOCH3. The polymers of this ester are transparent solids resistant to heat and light. They are used to prepare sheets of strong and light organic glass or plexiglass widely used for the manufacture of various goods.

Theraphthalic acid, a dibasic carboxylic acid of the aromatic series has the structural formula



The condensation product of the dimethyl ester of this acid with ethylene glycol is used for the manufacture of lavsan, an artificial fibre.

The polymer of ethylene is called polyethylene, or polythene. It is a white pliable substance resistant to concentrated acids and alkalis.

Polymerization of various compounds containing even bonds is widely used in the chemical industry for the preparation of various kinds of synthetic products – plastics, chemical fibres, artificial resins, synthetic rubbers, lubricants, etc.

Ethylene is the first member of the ethylene hydrocarbon or olefin series. The subsequent members of this series are propylene C3H6, butylene C4H8, etc.

The main source of ethylene and its homologues is the gases formed during the cracking of oil products.

Cellulose (C6H10O5) x is the chief constituent of the shells of plant cells. In some types of cellulose the value of x is about 1,500. Cellulose contains hydroxyl groups in its molecules and therefore forms ethers and esters.

Artificial fibre is fibre produced by the chemical treatment of natural fibres (mainly cellulose), while synthetic fibre is the name given to fibre prepared from specially synthesized chemical materials.

In the acetate method an acetone solution of acetyl cellulose is forced through dies into a current of warm air. The acetone evaporates, and the jets of solution change into fine threads of acetate fibre.

Capron is a polycondensate of aminocapronic acid. Part of the molecule of this substance is represented below:

$$-NH-(CH_2)_5-CO-$$

Nylon or anide is obtained by the condensation of dibasic adipic acid HOOC-(CH2)4-COOH and hexamethylene diamine NH2-(CH2)6-NH2 by heating them together under pressure.

Both these starting materials are derived from phenol (C6H5OH) by catalytic reduction and after treatment.

Active vocabulary

Esters of carboxylic acids – сложный эфир карбоновых кислот

Saturated hydrocarbons – насыщенный углеводород

Isoamyl acetate –изоамиловый эфир уксусной кислоты

Plexiglass – плексигласовый

Dibasic – двухосновной

Ethylene glycol - этиленгликоль

Hydroxyl group – гидроксильная группа

Die – мундштук

Acetate fiber – ацетатное волокно

Questions for discussion

1. Where can esters of carboxylic acid be come across?
2. What is polymerization used for?

"PHYSICS"

MEASURING TEMPERATURE

There are in general use today four different temperature scales. These are the Fahrenheit, Rankine, Centigrade and Kelvin or absolute. On the Fahrenheit scale the boiling point of water is 212°, freezing point – 32°4 the equivalent points on the Centigrade (sometimes called Celsius) scale are 100° and 0°. On the Rankine scale 672° and 492° and on the absolute scale temperature is measured in degrees Centigrade from the point at which molecular motion ceases. Absolute zero is - 273.1° C.

The thermometers are all identically made but each has a different scale. In the United States, the Fahrenheit scale is commonly used in civil life, and the Rankine scale by engineers. The Centigrade and Kelvin scales are used in all countries for scientific measurements.

It is frequently necessary to change temperature readings from one temperature scale to another.

Fahrenheit reading = 9/5 x Centigrade reading + 32 and Centigrade reading = (Fahrenheit reading-32) x 5/9.

There are formulas for such changes:

$F° = 32°+9/5\ C°$ $C° = 5/9(F°-32°)$

32°F = 0°C 5°F= 18°C (room temperature)

$T°K = t°C+273°$

To change the Fahrenheit (or Rankine) scale into the Kelvin scale, the Fahrenheit scale is changed to the Centigrade scale and then to Kelvin.

F - C - K K

The first and still most widely used hotness measuring instrument is the simple "liquid-in-glass" thermometer. The volume of liquid expands when hot so that increasing hotness is indicated by extension of the column of liquid (mercury or alcohol) in the glass stem of thermometer. The stem has a very narrow uniform bore or capillary which is sealed at the "top" end. The space above the liquid is evacuated. At the "lower" end of the stem the capillary connects to the bulb or reservoir of liquid. This bulb is placed in contact with the sample.

The common thermometer uses a liquid as an agent to measure temperature and retains the liquid in a glass bulb. At temperatures below - 39°C mercury freezes and becomes a solid. At high temperatures glass melts and becomes a liquid. For both of these temperature extremes, electrical thermometers are commonly used. These instruments operate upon the principle that the resistance a wire offers to a flow of electric current through it changes with temperature. The higher temperature, the greater is the resistance.

In a diagram of an electrical thermometer called a thermocouple is illustrated. This temperature recording device is based upon a principle, discovered in 1821, known as the thermoelectric effect. Two pieces of a wire, one copper and one iron are joined together at the ends to form a complete loop. When one junction is heated and the other is kept cool, an electric current flows around the loop. The greater the difference in temperature between the two junctions, the greater is the electric current.

Diagram represents a thermocouple connected by wires to an ammeter. If the junction of the thermocouple is first placed in melting ice and then in boiling water, the two scale readings of the ammeter can be marked 0°C and 100°C at the appropriate points. These determine the scale of the instrument.

Thermocouples are not always made of copper and iron. Any two different metals when brought into contact will exhibit a thermoelectric effect. For every high temperature measurements, platinum and platinum-iridium alloys are used, because of their very high melting point temperatures.

A set of thermocouples, when connected form what is commonly called a thermopile. Thermocouples containing several hundred elements can be made so sensitive that they will detect the heat of a candle flame several hundred feet away.

Active vocabulary

Platinum –iridium alloys – платино-иридиевый сплав

Thermopile – термодатчик

Questions for discussion

1. How do temperature scales differ ?
2. What is the first thermometer?
3. How does an electrical thermometer work?

STEEL

Steel is an alloy consisting mostly of iron, with a carbon content between 0.2 and 1.7 or 2.04% by weight (C:1000-10,8.67Fe), depending on grade. Carbon is the most cost-effective alloying material for iron, but various other alloying elements are used such as manganese, chromium, vanadium, and tungsten. Carbon and other elements act as a hardening agent, preventing dislocations in the iron atom crystal lattice from sliding past one another. Varying the amount of alloying elements and form of their presence in the steel (solute elements, precipitated phase) controls qualities such as the hardness, ductility and tensile strength. The maximum solubility of carbon in iron (in austenite region) is 2.14% by weight, occurring at 1149 °C; higher concentrations of carbon or lower temperatures will produce cementite. Alloys with higher carbon content than this are known as cast iron because of their lower melting point. Steel is also to be distinguished from wrought iron containing only a very small amount of other elements, but containing 1-3% by weight of slag in the form of particles elongated in one direction, giving the iron a characteristic grain. It is more rust-resistant than steel and welds more easily.

With the invention of the Bessemer process in the mid-19th century, steel became a relatively inexpensive mass-produced good. Today, steel is a major component in buildings, tools, automobiles, and appliances.

MATERIAL PROPERTIES

Iron, like most metals, is not usually found in the Earth's crust in an elemental state. Iron can be found in the crust only in combination with oxygen or sulfur. Typical iron- containing minerals include Fe_2O_3—the form of iron oxide found as the mineral hematite, and FeS_2—pyrite (fool's gold). Process, known as smelting, was first applied to metals with lower melting points. Copper melts at just over 1000 °C, while tin melts around 250 °C. Cast iron—iron alloyed with greater than 1.7% carbon—melts at around 1370 °C. Unlike copper and tin, liquid iron dissolves carbon quite readily. So that smelting results in an alloy containing too much carbon to be called steel.

To tailor the resulting properties other materials are often added to the iron/carbon mixture. Nickel and manganese in steel make austenite more chemically stable. Chromium increases hardness and melting temperature. Vanadium also increases hardness while reducing the effects of metal fatigue. Large amounts of chromium and nickel (often 18% and 8%, respectively) are added to stainless steel to inhibit corrosion. Tungsten interferes with the formation of cementite, allowing martensite to form with slower quench rates, resulting in high speed steel. On the other hand sulfur, nitrogen, and phosphorus make steel more brittle. These commonly found elements must be removed from the ore during processing.

When iron is smelted from its ore, it contains more carbon. To become steel, it must be melted and reprocessed to remove the correct amount of carbon. Once this liquid is cast into ingots, it usually must be "worked" at high temperature to remove any cracks or poorly mixed regions from the solidification process, and to produce shapes such as plate, sheet, wire, etc. It is then heat-treated to produce a desirable crystal structure, and often "cold worked" to produce the final shape. In modern steel making these processes are often combined, with ore going in one end of the assembly line and finished steel coming out the other. These can be streamlined by a deft control of the interaction between work hardening and tempering.

Active vocabulary

Cost-effective alloying – экономичное сплавление
Manganese – марганец
Tungsten – фольврам
Hardening agent – отверждающий реагент, дубиль
Preventing dislocation Ductility - ковкость
tensile strength – предельная прочность на растяжении
Brittle - хрупкий, легко раскалывающийся
Solubility - растворимость
Melting point – температура плавления
Slag – шлак
Weld – сковать, сваривать, соединять
Refinements усовершенствования
Earth's crust - земная кора, литосфера
Hematite – гематит, красный железняк (утяжелитель)
Smelting - выплавка
Manganese – марцанец, марганцевый
Austenite - аустенит
Metal fatigue - усталость метала
Quench rate – скорость охлаждения при закалки
Ingot - слиток
Cold worked – подвергнутый холодной деформации
Tempering - термообработка

Questions for discussion

1. What is stell?

2. What alloying materials are generally used?
3. What are the proporties of a natural iron?
4. How are the iron properties altered?

III. SUPPLEMENTARY READING

TWO STROKE CONFIGURATION

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 provides more efficiency than comparably sized four-stroke engines. Fuel injection is essential for a modern two-stroke engine for it to meet stringent emission standards. The problem of total loss oil consumption, however, remains a cause of high hydrocarbon emissions.

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 turbo charging) to scavenge the cylinders. An example of this type of motor is the Wärtsilä-Sulzer turbocharged two-stroke diesel, which is the most efficient and powerful internal combustion engine in the world. 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. Cylinder configurations include the straight or inline configuration.

The more compact V configuration, the wider but smoother flat or boxer configuration.

ACTIVE VOCABULARY

the two-stroke cycle – двух-тактный цикл двигателя

intake stroke – ход впуска

exhaust stroke – ход выпуска

scavenge the cylinder – продувать цилиндр

fresh charge in the crankcase – свежая рабочая смесь в картере двигателя

power output – мощность, снимаемая с двигателя;

less fuel-efficient – менее топливосберегающий

spark-ignition - искровое зажигание

air-assisted fuel injection – пневматический инжектор

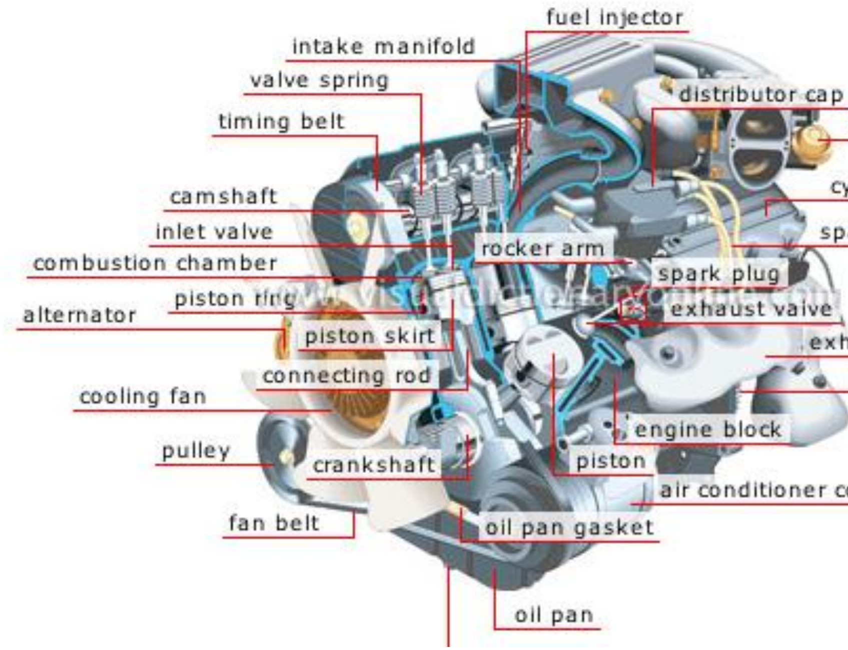
to meet stringent emission standards – соответствовать строгим нормам токсичности, загрязнения

uniflow scavenging – прямоточная продувка

thrust – осевое давление

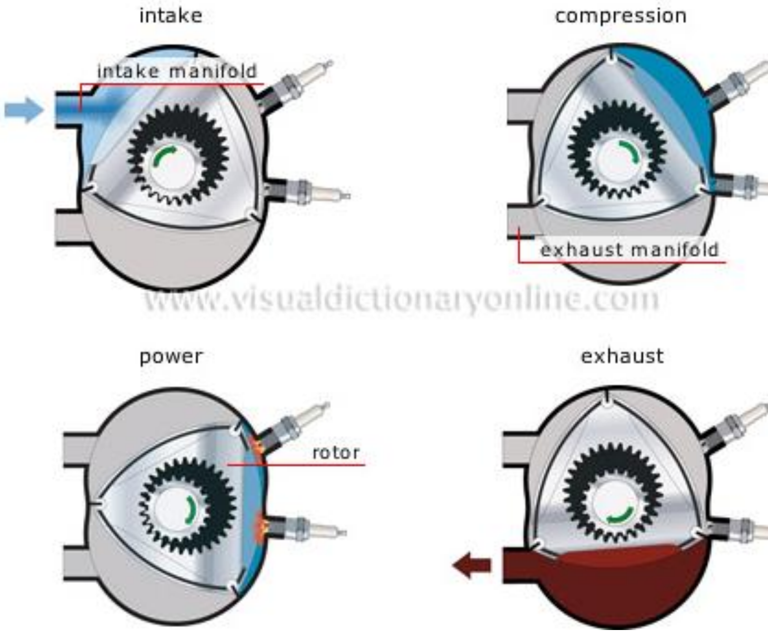
gasoline engine [2]

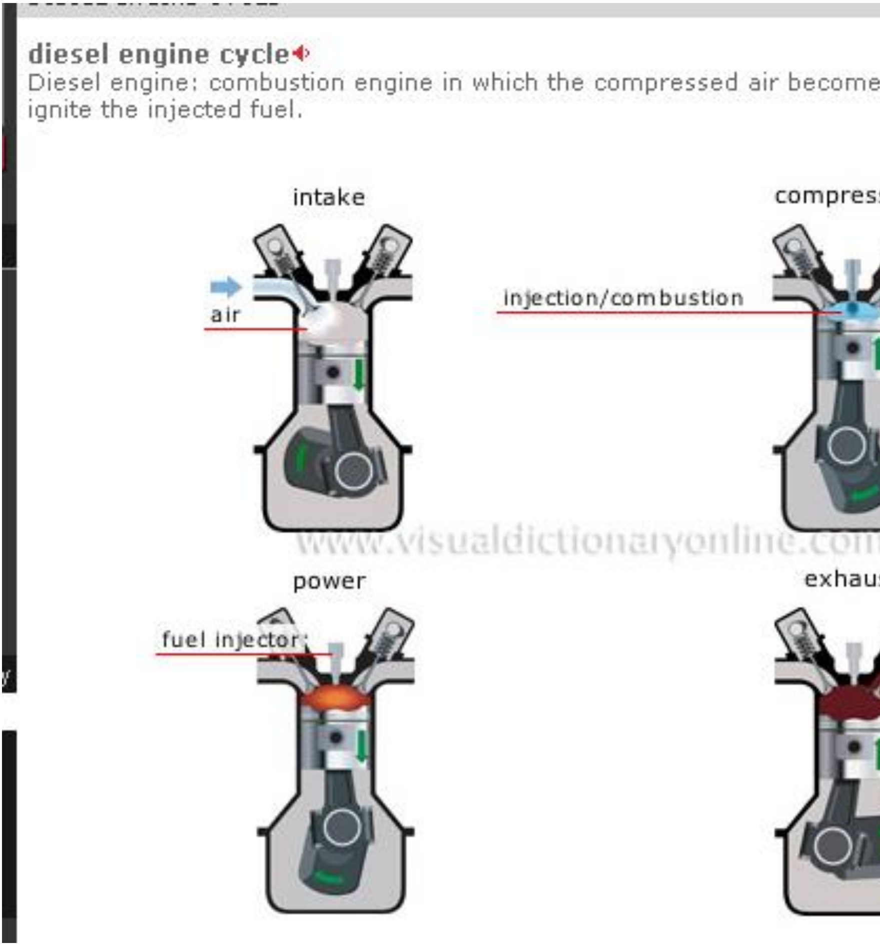
Engine in which a mixture of air and gasoline is compressed and ignited
explosion whose energy is converted into mechanical energy.



rotary engine cycle

Rotary engine: combustion engine in which the combustion chamber is divided by
three turning parts of unequal volume.





COMBUSTION

All internal combustion engines depend on combustion of a chemical fuel, typically with oxygen from the air (though it is possible to inject nitrous oxide 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 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 bio fuels, 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.

While gasoline internal combustion engines are much easier to start in cold weather than diesel engines, they can still have cold weather starting problems under extreme conditions. For years the solution was to park the car in heated areas. In some parts of the world the oil was actually drained and heated over night and returned to the engine for cold starts. In the early 1950s the gasoline Gasifier unit was developed, where part on cold weather starts raw gasoline was diverted to the unit where part of the gas was burned causing the other part to become a hot vapor sent directly to the intake valve manifold. This unit was quite popular till electric engine block heaters became standard on gasoline engines sold in cold climates.

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 take in air only, and shortly before peak compression, spray a small quantity of diesel fuel into the cylinder via a fuel injector that allows the fuel to instantly ignite. HCCI type engines 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 run just as well in cold weather once started. Light duty diesel engines with indirect injection in automobiles and light trucks employ glow plugs 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.

ACTIVE VOCABULARY:

internal combustion engine – двигатель внутреннего сгорания

inject nitrous oxide – взбрызгивать оксиды азота

gain a power boost – приобретать форсированный надув

oxidizer – окислитель;

yield triglycerides – производить триглицириды

charcoal gas – газ от древесного угля

an induction coil – катушка зажигания

lead–acid battery – свинцово-кислотная батарея

spark plug –запальная свеча

ignite the mixture – зажигать, воспламенять смесь

drain – спускать

cold start – запуск холодного двигателя

vapor – пар

intake valve manifold – канал впускного клапана

HCCI (Homogeneous charge compression ignition) – компрессионное воспламенение однородной смеси

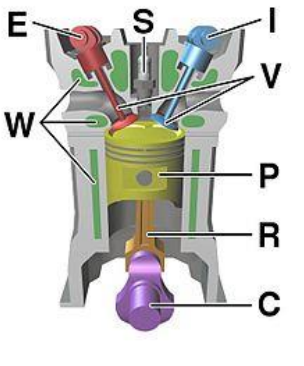
unaided auto-combustion process - автономный процесс самосгорания топлива

glow plug – запальная свеча

CRANKSHAFT

Components of a typical, four stroke cycle, DOHC piston engine. (E) exhaust camshaft, (I) intake camshaft, (S) spark plug, (V) valves, (P) piston, (R) connecting rod, (C) crankshaft, (W) water jacket for coolant flow.

Large engines are usually multicylinder to reduce pulsations from individual firing strokes, with more than one piston attached to a complex crankshaft. Many small engines, such as those found in mopeds or garden machinery, are single cylinder and use only a single piston, simplifying crankshaft design. This engine can also be built with no riveted seam.



Bearings

The crankshaft has a linear axis about which it rotates, typically with several bearing journals riding on replaceable bearings (the main bearings) held in the engine block. As the crankshaft undergoes a great deal of sideways load from each cylinder in a multicylinder engine, it must be supported by several such bearings, not just one at each end. This was a factor in the rise of V8 engines, with their shorter crankshafts, in preference to straight-8engines. The long crankshafts of the latter suffered from an unacceptable amount of flex when engine designers began using higher compression ratios and higher rotational speeds. High performance engines often have more main bearings than their lower performance cousins for this reason.

Piston stroke

The distance the axis of the crank throws from the axis of the crankshaft determines the piston stroke measurement, and thus engine displacement. A common way to increase the low-speed torque of an engine is to increase the stroke, sometimes known as "shaft-stroking." This also increases the reciprocating vibration, however, limiting the high speed capability of the engine. In compensation, it improves the low speed operation of the engine, as the longer intake stroke through smaller valve(s) results in greater turbulence and mixing of the intake charge. Most modern high speed production engines are classified as "over square" or short-stroke, wherein the stroke is less than the diameter of the cylinder bore. As such, finding the proper balance between shaft-stroking speed and length leads to better results.

Engine configuration

The configuration and number of pistons in relation to each other and the crank leads to straight, V or flat engines. The same basic engine block can be used with different crankshafts, however, to alter the firing order; for instance, the 90° V6 engine configuration, in older days sometimes derived by using six cylinders of a V8 engine with what is basically a shortened version of the V8 crankshaft, produces an engine with an inherent pulsation in the power flow due to the "missing" two cylinders. The same engine, however, can be made to provide evenly spaced power pulses by using a crankshaft with an individual crank throw for each cylinder, spaced so that the pistons are actually phased 120° apart, as in the GM 3800 engine. While production V8 engines use four crank throws spaced 90° apart, high-performance V8 engines often use a "flat" crankshaft with throws spaced 180° apart. The difference can be heard as the flat-plane crankshafts result in the engine having a smoother, higher-pitched sound than cross-plane (for example, IRL IndyCar Series compared toNASCAR Sprint Cup Series, or a Ferrari 355 compared to a Chevrolet Corvette).

Engine balance

For some engines it is necessary to provide counterweights for the reciprocating mass of each piston and connecting rod to improve engine balance. These are typically cast as part of the crankshaft but, occasionally, are bolt-on pieces. While counter weights add a considerable amount of weight to the crankshaft, it provides a smoother running engine and allows higher RPM levels to be reached.

Rotary engines

Many early aircraft engines (and a few in other applications) had the crankshaft fixed to the airframe and instead the cylinders rotated, known as a rotary engine design. Rotary engines such as the Wankel engine are referred to as pistonless rotary engines.

In the Wankel engine the rotors drive the eccentric shaft, which could be considered the equivalent of the crankshaft in a piston engine.

Radial engines

The radial engine is a reciprocating type internal combustion engine configuration in which the cylinders point outward from a central crankshaft like the spokes of a wheel. It resembles a stylized star when viewed from the front, and is called a "star engine" (German Sternmotor, French Moteur en étoile) in some languages. The radial configuration was very commonly used in aircraft engines before turbine engines became predominant.

Construction

Crankshafts can be monolithic (made in a single piece) or assembled from several pieces. Monolithic crankshafts are most common, but some smaller and larger engines use assembled crankshafts.

Forging and casting

Crankshafts can be forged from a steel bar usually through roll forging or cast in ductile steel. Today more and more manufacturers tend to favor the use of forged crankshafts due to their lighter weight, more compact dimensions and better inherent dampening. With forged crankshafts, vanadium micro alloyed steels are mostly used as these steels can be air cooled after reaching high strengths without additional heat treatment, with exception to the surface hardening of the bearing surfaces. The low alloy content also makes the material cheaper than high alloy steels. Carbon steels are also used, but these require additional heat treatment to reach the desired properties. Iron crankshafts are today mostly found in cheaper production engines (such as those found in the Ford Focus diesel engines) where the loads are lower. Some engines also use cast iron crankshafts for low output versions while the more expensive high output version use forged steel.

Machining

Crankshafts can also be machined out of a billet, often a bar of high quality vacuum remelted steel. Though the fiber flow (local inhomogeneities of the material's chemical composition generated during casting) doesn’t follow the shape of the crankshaft (which is undesirable), this is usually not a problem since higher quality steels, which normally are difficult to forge, can be used. These crankshafts tend to be very expensive due to the large amount of material that must be removed with lathes and milling machines, the high material cost, and the additional heat treatment required. However, since no expensive tooling is needed, this production method allows small production runs without high costs.

In an effort to reduce costs, used crankshafts may also be machined. A good core may often be easily reconditioned by a crankshaft grinding process. Severely damaged crankshafts may also be repaired with a welding operation, prior to grinding, that utilizes a submerged arc welding machine. To accommodate the smaller journal diameters a ground crankshaft has, and possibly an over-sized thrust dimension, undersize engine bearings are used to allow for precise clearances during operation.

Fatigue strength

The fatigue strength of crankshafts is usually increased by using a radius at the ends of each main and crankpin bearing. The radius itself reduces the stress in these critical areas, but since the radius in most cases is rolled, this also leaves some compressive residual stress in the surface, which prevents cracks from forming.

Hardening

Most production crankshafts use induction hardened bearing surfaces, since that method gives good results with low costs. It also allows the crankshaft to be reground without re-hardening. But high performance crankshafts, billet crankshafts in particular, tend to use nitridization instead. Nitridization is slower and thereby more costly, and in addition it puts certain demands on the alloying metals in the steel to be able to create stable nitrides. The advantage of nitridization is that it can be done at low temperatures, it produces a very hard surface, and the process leaves some compressive residual stress in the surface, which is good for fatigue properties. The low temperature during treatment is advantageous in that it doesn't have any negative effects on the steel, such as annealing. With crankshafts that operate on roller bearings, the use of carburization tends to be favored due to the high Hertzian contact stresses in such an application. Like nitriding, carburization also leaves some compressive residual stresses in the surface.

Counterweights

Some expensive, high performance crankshafts also use heavy-metal counterweights to make the crankshaft more compact. The heavy-metal used is most often a tungsten alloy but depleted uranium has also been used. A cheaper option is to use lead, but compared with tungsten its density is much lower.

Stress on crankshafts

The shaft is subjected to various forces but generally needs to be analysed in two positions. Firstly, failure may occur at the position of maximum bending; this may be at the centre of the crank or at either end. In such a condition the failure is due to bending and the pressure in the cylinder is maximal. Second, the crank may fail due to twisting, so the conrod needs to be checked for shear at the position of maximal twisting. The pressure at this position is the maximal pressure, but only a fraction of maximal pressure.

Active vocabulary

DOHC (double overhead camshaft) piston engine – поршневой двигатель с двойным верхним распределительным валом

exhaust camshaft – распределительный вал выпускных двигателей

intake camshaft - распределительный вал впускных двигателей

connecting rod (conrod) – шатун, карданный вал

water jacket – водяная рубашка (для двигателя)

coolant flow – поток охлаждающей жидкости

firing stroke – такт расширения; рабочий ход

riveted seam – заклепочное соединение

bearing journals – опорная шейка вала

be riding on – зависеть от

flex – деформация изгиб

torque – крутящий момент

reciprocating vibration возвратно-поступательные вибрации

"over square" or short-stroke – с небольшим ходом

cylinder bore – отверстие в блоке цилиндра

V engine - V-образный двигатель

flat engine – двигатель с горизонтально расположенными цилиндрами

bolt-on pieces – части, прикрепленные болтами

RPM (Revolutions Per Minute)- оборотов в минуту

cast – отливать

spokes of a wheel – спицы колеса

assembled – собранный

ductile steel – вязкая/ковкая сталь

forge – ковать

fiber flow

lathe – токарный станок

milling machine – фрезерный станок

welding operation - сварка

fatigue strength – предел выносливости

residual stress – остаточное напряжение

fatigue properties – усталостные характеристики

annealing – прокаливание

counterweight противовес

tungsten alloy – вольфрамовый сплав

depleted uranium – обедненный ураний

TIRE

A tire (U.S. English) or tyre (British English) is a ring-shaped covering that fits around a wheel's rim to protect it and enable better vehicle performance. Most tires, such as those for automobiles and bicycles, provide traction between the vehicle and the road while providing a flexible cushion that absorbs shock.

The materials of modern pneumatic tires are synthetic rubber, natural rubber, fabric and wire, along with carbon black and other chemical compounds. They consist of a tread and a body. The tread provides traction while the body provides containment for a quantity of compressed air. Before rubber was developed, the first versions of tires were simply bands of metal that fitted around wooden wheels to prevent wear and tear. Early rubber tires were solid (notpneumatic). Today, the majority of tires are pneumatic inflatable structures, comprising a doughnut-shaped body of cords and wires encased in rubber and generally filled with compressed air to form an inflatable cushion. Pneumatic tires are used on many types of vehicles, including cars, bicycles, motorcycles, trucks, earthmovers, and aircraft. Metal tires are still used on locomotives and railcars, and solid rubber (or other polymer) tires are still used in various non-automotive applications, such as some casters, carts, lawnmowers, andwheelbarrows.

Iron tires

The earliest tires were bands of iron (later steel), placed on wooden wheels, used on carts and wagons. The tire would be heated in aforge fire, placed over the wheel and quenched, causing the metal to contract and fit tightly on the wheel. A skilled worker, known as awheelwright, carried out this work. The outer ring served to "tie" the wheel segments together for use, providing also a wear-resistant surface to the perimeter of the wheel. The word "tire" thus emerged as a variant spelling to refer to the metal bands used to tie wheels.

Rubber tires

The first practical pneumatic tire was made by Scottish inventor John Boyd Dunlop while working as a veterinarian in May Street,Belfast in 1887 for his son's bicycle, in an effort to prevent the headaches his son had while riding on rough roads.

Dunlop's patent was later declared invalid because of prior art by fellow Scot Robert William Thomson, although Dunlop is credited with "realising rubber could withstand the wear and tear of being a tire while retaining its resilience".[5] The development of this technology hinged on myriad engineering advances. In terms of materials, the vulcanization of natural rubber is credited to Charles Goodyear and Robert William Thomson. Synthetic rubbers were invented in the laboratories of Bayer in the 1920s.[6] Today, over 1 billion tires are produced annually in over 400 tire factories

Manufacturing

Pneumatic tires are manufactured according to relatively standardized processes and machinery, in around 455 tire factories in the world. With over 1 billion tires manufactured worldwide annually, the tire industry is the major consumer of natural rubber. Tire factories start with bulk raw materials such as rubber, carbon black, and chemicals and produce numerous specialized components that are assembled and cured. This article describes the components assembled to make a tire, the various materials used, the manufacturing processes and machinery, and the overall business model. Pneumatic tires are manufactured according to relatively standardized processes and machinery, in around 455 tire factories in the world. With over 1 billion tires manufactured worldwide annually, the tire industry is the major consumer of natural rubber. Tire factories start with bulk raw materials such as rubber, carbon black, and chemicals and produce numerous specialized components that are assembled and cured. This article describes the components assembled to make a tire, the various materials used, the manufacturing processes and machinery, and the overall business model.

The top five tire manufacturing companies by revenue are Bridgestone,Michelin, Goodyear, Continental, and Pirelli

Tread

The tread is the part of the tire that comes in contact with the road surface. The portion that is in contact with the road at a given instant in time is the contact patch. The tread is a thick rubber, or rubber/composite compound formulated to provide an appropriate level of traction that does not wear away too quickly. The tread pattern is characterized by the geometrical shape of the grooves, lugs, voids and sipes. Grooves run circumferentially around the tire, and are needed to channel away water. Lugs are that portion of the tread design that contacts the road surface. Voids are spaces between lugs that allow the lugs to flex and evacuate water. Tread patterns feature non-symmetrical (or non-uniform) lug sizes circumferentially to minimize noise levels at discrete frequencies. Sipes are valleys cut across the tire, usually perpendicular to the grooves, which allow the water from the grooves to escape to the sides in an effort to prevent hydroplaning.

Treads are often designed to meet specific product marketing positions. High performance tires have small void ratios to provide more rubber in contact with the road for higher traction, but may be compounded with softer rubber that provides better traction, but wears quickly. Mud and snow (M&S) tires are designed with higher void ratios to channel away rain and mud, while providing better gripping performance. Specialized tires will always work better than general/all purpose/all weather tires when being used in the conditions the specialized tires are designed for.

Tread lug

Tread lugs provide the contact surface necessary to provide traction. As the tread lug enters the road contact area, or footprint, it is compressed. As it rotates through the footprint it is deformed circumferentially. As it exits the footprint, it recovers to its original shape. During the deformation and recovery cycle the tire exerts variable forces into the vehicle. These forces are described as Force Variation.

Tread void

Tread voids provide space for the lug to flex and deform as it enters and exits the footprint. Voids also provide channels for rainwater, mud, and snow to be channeled away from the footprint. The void ratio is the void area of the tire divided by the entire tread area. Low void areas have high contact area and therefore higher traction on clean, dry pavement.

Rain groove

The rain groove is a design element of the tread pattern specifically arranged to channel water away from the footprint. Rain grooves are circumferential in most truck tires. Many high performance passenger tires feature rain grooves that are angled from the center toward the sides of the tire. Some tire manufacturers claim that their tread pattern is designed to actively pump water out from under the tire by the action of the tread flexing. This results in a smoother ride in different types of weather.

Sipe

Tread lugs often feature small narrow voids, or sipes, that improve the flexibility of the lug to deform as it traverses the footprint area. This reduces shear stress in the lug and reduces heat build up. Testing of identical siped and unsiped tires showed measurable improvements in snow traction and ice braking performance, however diminishing and extending braking distances on wet and dry pavement by a few feet on siped tires. Off-road tire enthusiasts have been siping tires for years for greater traction, as many manufacturers now offer already siped off-road-tires.

Wear bar

Wear bars (or wear indicators) are raised features located at the bottom of the tread grooves that indicate the tire has reached its wear limit. When the tread lugs are worn to the point that the wear bars connect across the lugs, the tires are fully worn and should be taken out of service. Most wear bars indicate a remaining tread depth of 1.6 millimetres (0.063 in) and are deemed "worn out" at that point.

Bead

The bead is that part of the tire that contacts the rim on the wheel. The bead is typically reinforced with steel wire and compounded of high strength, low flexibility rubber. The bead seats tightly against the two rims on the wheel to ensure that a tubeless tire holds air without leakage. The bead fit is tight to ensure the tire does not shift circumferentially as the wheel rotates. The width of the rim in relationship to the tire is a factor in the handling characteristics of an automobile, because the rim supports the tire's profile.

Sidewall

Uneven sidewall wear, down to fabric plies, due to significant under-inflation

The sidewall is that part of the tire that bridges between the tread and bead. The sidewall is largely rubber but reinforced with fabric or steel cords that provide for tensile strength and flexibility. The sidewall contains air pressure and transmits the torque applied by the drive axle to the tread to create traction but supports little of the weight of the vehicle, as is clear from the total collapse of the tire when punctured. Sidewalls are molded with manufacturer-specific detail, government mandated warning labels, and other consumer information, and sometimes decorative ornamentation, like whitewalls.

Shoulder

The shoulder is that part of the tire at the edge of the tread as it makes transition to the sidewall.

Ply

Plies are layers of relatively inextensible cords embedded in the rubber to hold its shape by preventing the rubber from stretching in response to the internal pressure. The orientations of the plies play a large role in the performance of the tire and is one of the main ways that tires are categorized.

Associated components

Several additional components may be required in addition to just the tire to form a functional wheel.

Wheel

Main article: Wheel

Tires are mounted onto wheels that most often have integral rims on their outer edges to hold the tire. Automotive wheels are typically made from pressed and welded steel, or a composite of lightweight metal alloys, such as aluminum or magnesium. These alloy wheelsmay be either cast or forged. The mounted tire and wheel assembly is then bolted to the vehicle's hub. A decorative hubcap and trim ring may be placed over the wheel.

Rim

Main article: Rim (wheel)

The beads of the tire are held on the rim, or the "outer edge" of a wheel.[13] These outer edges are shaped to obtain a proper shape on each side, having a radially cylindrical inclined inner wall on which the tire can be mounted. The wheel's rim must be of the proper design and type to hold the bead of the appropriately sized tire. Tires are mounted on the wheel by forcing its beads into the channel formed by the wheel's inner and outer rims.

Inner tube

Most bicycle tires, many motorcycle tires, and many tires for large vehicles such as buses, heavy trucks, and tractors are designed for use with inner tubes. Inner tubes are torus-shaped balloons made from an impermeable material, such as soft, elastic synthetic rubber, to prevent air leakage. The inner tubes are inserted into the tire and inflated to retain air pressure.

Large inner tubes, which are large inflatable toruses, can be re-used for other purposes, such as swimming and rafting (see swim ring),tubing (recreation), sledding, and skitching. Purpose-built inflatable toruses are also manufactured for these uses, offering choice of colors, fabric covering, handles, decks, and other accessories, and eliminating the protruding valve stem.

Valve stem

Main article: Valve stem

The valve stem is a tube made of metal or rubber, through which the tire is inflated, with acheck valve, typically a Schrader valve on automobiles and most bicycle tires, or a Presta valve on high-performance bicycles. Valve stems usually protrude through the wheel for easy access. They mount directly to the rim, in the case of tubeless tires, or are an integral part of the inner tube. The rubber in valve stems eventually degrades, and, in the case of tubeless tires, replacement of the valve stem at regular intervals or with tire replacement reduces the chance of failure.

Construction types

Bias

Bias tire (or cross ply) construction utilizes body ply cords that extend diagonally from bead to bead, usually at angles in the range of 30 to 40 degrees, with successive plies laid at opposing angles forming a crisscross pattern to which the tread is applied. The design allows the entire tire body to flex easily, providing the main advantage of this construction, a smooth ride on rough surfaces. This cushioning characteristic also causes the major disadvantages of a bias tire: increased rolling resistance and less control and traction at higher speeds.

Belted bias

A **belted bias tire** starts with two or more bias-plies to which stabilizer belts are bonded directly beneath the tread. This construction provides smoother ride that is similar to the bias tire, while lessening rolling resistance because the belts increase tread stiffness. The design was introduced by Armstrong, while Goodyear made it popular with the "Polyglas" trademark tire featuring a polyester carcass with belts of fiberglass. The "belted" tire starts two main plies of polyester, rayon, or nylon aneled as in conventional tires, and then placed on top are circumferential belts at different angles that improve performance compared to non-belted bias tires. The belts may be fiberglass or steel.

Radial

Main article: Radial tire

Radial tire construction utilizes body ply cords extending from the beads and across the tread so that the cords are laid at approximately right angles to the centerline of the tread, and parallel to each other, as well as stabilizer belts directly beneath the tread. The belts may be cord or steel. The advantages of this construction include longer tread life, better steering control, and lower rolling resistance. Disadvantages of the radial tire include a harder ride at low speeds on rough roads and in the context of off-roading, decreased "self-cleaning" ability and lower grip ability at low speeds.

Solid

Many tires used in industrial and commercial applications are non-pneumatic, and are manufactured from solid rubber and plastic compounds via molding operations. **Solid tires** include those used for lawn mowers, skateboards, golf carts, scooters, and many types of light industrial vehicles, carts, and trailers. One of the most common applications for solid tires is for material handling equipment (forklifts). Such tires are installed by means of a hydraulic tire press.

Semi-pneumatic

Semi-pneumatic tires have a hollow center, but they are not pressurized. They are light-weight, low-cost, puncture proof, and provide cushioning.[18] These tires often come as a complete assembly with the wheel and even integral ball bearings. They are used on lawn mowers, wheelchairs, and wheelbarrows. They can also be rugged, typically used in industrial applications, and are designed to not pull off their rim under use.

Tires that are hollow but are not pressurized have also been designed for automotive use, such as the Tweel (a portmanteau of tire and wheel), which is an experimental tire design being developed at Michelin. The outer casing is rubber as in ordinary radial tires, but the interior has special compressible polyurethane springs to contribute to a comfortable ride. Besides the impossibility of going flat, the tires are intended to combine the comfort offered by higher-profile tires (with tall sidewalls) with the resistance to cornering forces offered by low profile tires. They have not yet been delivered for broad market use.

tire

Circular deformable unit made of rubber, mounted on the wheel and inflate
the connection between the car and the road, and absorbing the unevenne

disc brake [1]
Braking mechanism comprising a disc attached to the wheel, whose rotat
when the brake pads exert friction on it.

disc brake [1] image

drum brake [2]
Braking mechanism comprising a drum interlocked with the wheel; the b
the drum to slow down the wheel's rotation.

ACTIVE VOCABULARY

traction – трение

hinge on – зависеть от; основываться на

cure – варить; вулканизировать

Tread – протектор

contact – зацепление

groove – желобок, паз, канавка
lugs – шпора колеса
sipe – узкая прорезь на протекторе шины
circumferentially – по-окружности
Mud and snow (M&S) tires – зимняя шина
Pump out – выкачивать
shear stress – касательное напряжение
Wear bar – износная планка
Bead - борт
Puncture – протыкать
whitewall – шины с боковиной
shoulder – плечевая зона шины
ply – слой каркаса шины
hub – ступица
hubcap – покрышка
trim ring – окантовка
Inner tube – камера
impermeable - не пропускающий
valve stem – стержень клапана
Bias tire (cross ply) – шина с диагональным кордом
ply cords – слой корда
rolling resistance – сопротивление качению шины
Belted bias tire – диагонально-опоясывающим шина
Cushioning – амортизация
puncture proof- непрокалывающийся
forklifts – вильчатый подъемник

WIND POWER FOR PENNIES

Windmills may finally be ready to compete with fossil-fuel generators. The technology trick: turn them backwards and put hinges on their blades.

The newest wind turbine standing at Rocky Flats in Colorado, the U.S. Department of Energy's proving ground for wind power technologies, looks much like any other apparatus for capturing energy from wind: a boxy turbine sits atop a steel tower that sprouts two propeller blades stretching a combined 40 meters-almost half the length of a football field. Wind rushes by, blades rotate, and electricity flows. But there's a key difference. This prototype has flexible, hinged blades; in strong winds, they bend back slightly while spinning. The bending is barely perceptible to a casual observer, but it's a radical departure from how existing wind turbines work-and it just may change the fate of wind power.

Indeed, the success of the prototype at Rocky Flats comes at a crucial moment in the evolution of wind power. Wind-driven generators are still a niche technology-producing less than one percent of U.S. electricity. But last year, 1,700 megawatts' worth of new wind capacity was installed in the United States-enough to power 500,000 houses-nearly doubling the nation's wind power capacity. And more is on the way. Manufacturers have reduced the cost of heavy-duty wind turbines fourfold since 1980, and these gargantuan machines are now reliable and efficient enough to be built offshore. An 80-turbine, $245 million wind farm under construction off the Danish coast will be the world's largest, and developers are beginning to colonize German, Dutch and British waters, too. In North America, speculators envision massive offshore wind farms near British Columbia and Nantucket, MA.

But there is still a black cloud hovering over this seemingly sunny scenario. Wind turbines remain expensive to build-often prohibitively so. On average, it costs about $1 million per megawatt to construct a wind turbine farm, compared to about $600,000 per megawatt for a conventional gas-fired power plant; in the economic calculations of power companies, the fact that wind is free doesn't close this gap. In short, the price of building wind power must come down if it's ever to be more than a niche technology.

And that's where the prototype at Rocky Flats comes in. The flexibility in its blades will enable the turbine to be 40 percent lighter than today's industry standard but just as capable of surviving destructive storms. And that lighter weight could mean machines that are 20 to 25 percent cheaper than today's large turbines.

Earlier efforts at lighter designs were universal failures-disabled or destroyed, some within weeks, by the wind itself. Given these failures, wind experts are understandably cautious about the latest shot at a lightweight design. But most agree that lightweight wind turbines, if they work, will change the economic equation. "The question would become, How do you get the transmission capacity built fast enough to keep up with growth,'" says Ward Marshall, a wind power developer at Columbus, OH-based American Electric Power who is on the board of directors of the American Wind Energy Association, a trade group. "You'd have plenty of folks willing to sign up."

And, say experts, the Rocky Flats prototype-designed by Wind Turbine of Bellevue, WA-is the best hope in years for a lightweight design that will finally succeed. “I can say pretty unequivocally that this is a dramatic step in lightweight [wind turbine] technology,” says Bob Thresher, director of the National Wind Technology Center at Rocky Flats. “Nobody else has built a machine that flexible and made it work.”

Steady as She Blows

Wind turbines are like giant fans run in reverse. Instead of motor-driven blades that push the air, they use airfoils that catch the wind and crank a generator that pumps out electricity. Many of today’s turbines are mammoth machines with three-bladed rotors that span 80 meters-20 meters longer than the wingspan of a Boeing 747. And therein lies the technology challenge. The enormous size is needed if commercial wind turbines are to compete economically because power production rises exponentially with blade length. But these vast structures must be rugged enough to endure gales and extreme turbulence.

In the 1970s and ’80s, U.S. wind energy pioneers made the first serious efforts at fighting these forces with lightweight, flexible machines. Several startups installed thousands of such wind turbines; most were literally torn apart or disabled by gusts. Taking lightweight experimentation to the extreme, General Electric and Boeing built much larger prototypes-behemoths with 80-, 90- and even 100-meter-long blades. These also proved prone to breakdown; in some cases their blades bent back and actually struck the towers.

All told, U.S. companies and the Department of Energy spent hundreds of millions of dollars on these failed experiments in the 1980s and early 1990s. “The American model has always gravitated toward the light and the sophisticated and things that didn't work," says James Manwell, a mechanical engineer who leads the University of Massachusetts's renewable-energy research laboratory in Amherst, MA.

Into these technology doldrums sailed researchers from Denmark's Ris National Laboratory and Danish companies like Vestas Wind Systems. During the past two decades they perfected a heavy-duty version of the wind turbine-and it has become the Microsoft Windows of the wind power industry. Today, this Danish design accounts for virtually all of the electricity generated by wind worldwide. Perhaps reflecting national inclinations, these sturdy Danish designs had little of the aerodynamic flash of the earlier U.S. wind turbines; they were simply braced against the wind with heavier, thicker steel and composite materials. They were tough, rugged-and they worked.

What's more, in recent years, power electronics-digital silicon switches that massage the flow of electricity from the machine-further improved the basic design. Previously, the turbine's rotor was held to a constant rate of rotation so its alternating-current output would be in sync with the power grid; the new devices maintain the synchronization while allowing the rotor to freely speed up and slow down with the wind. "If you get a gust, the rotor can accelerate instead of just sitting there and receiving the brute force of the wind," says Manwell.

Mastering such strains enabled the Danish design to grow larger and larger. Whereas in the early 1980s a typical commercial machine had a blade span of 12.5 meters and could produce 50 kilowatts-enough for about a dozen homes-today's biggest blades stretch 80 meters and crank out two megawatts; a single machine can power more than 500 homes.

The newest challenge facing the Danish design is finding ways for it to weather the corrosive and punishing offshore environment, where months can pass before a mechanic can safely board and fix a turbine. Vestas, for one, is equipping its turbines with sensors on each of their components to detect wear and tear, and backup systems to take over in the case of, say, a failure in the power electronics.

Vestas's approach goes to the test this summer, as Denmark's power supplier begins installing 80 Vestas machines in shallow water 14 to 20 kilometers off the Danish coastline. It will be the world's biggest offshore wind farm, powering as many as 150,000 Danish households.

Wind Shadows

These upgrades will make big, heavy turbines more reliable, but they don't add up to a fundamental shift in the economics of wind power. Nations like Denmark and Germany are prepared to pay for wind power partly because fossil fuels are so much more costly in Europe, where higher taxes cover environmental and health costs associated with burning them. (About 20 percent of Denmark's power comes from wind.) But for wind power to be truly cost competitive with fossil fuels in the United States, the technology must change.

What makes Wind Turbine's Rocky Flats design such a departure is not only its hinged blades, but also their downwind orientation. The Danish design faces the blades into the wind and makes the blades heavy so they won't bend back and slam into the tower. The Wind Turbine design can't face the wind-the hinged blades would hit the tower-so the rotor is positioned downwind.

Finally, it uses two blades, rather than the three in the traditional design, to further reduce weight.

Advances in the computer modeling of such dangerous forces as vibration helped the design's development. Flexible blades add an extra dimension to the machine's motion; so does the fact that the whole machine can freely swivel with the wind. (Traditional designs are driven to face the wind, then locked in place.) Predicting, detecting and preventing disasters-like rapidly shifting winds that swing a rotor upwind and send its flexible blades into the tower-are control challenges even with the best design. "If you don't get that right, the machine can literally beat itself to death," says Ken Deering, Wind Turbine's vice president of engineering.

Two years ago, when Wind Turbine's prototype was erected at Rocky Flats, there were worries that this machine, too, would beat itself to death. Thresher says some of his staff feared that the machine, like its 1980s predecessors, would not long escape the scrap heap. Today, despite some minor setbacks, those doubts are fading.

Emboldened by its early success, Wind Turbine has installed, near Lancaster, CA, a second prototype, with a larger, 48-meter blade span. By the end of this year, the company expects to boost blade length on this machine to 60 meters-full commercial size. What's more, this new prototype has a thinner tower, aimed at reducing the noisy thump-known as a "wind shadow"-that can occur each time a blade whips through the area of turbulent air behind the tower. And with its lighter weight, the turbine could be mounted atop higher towers, reaching up to faster winds.

Becalmed

Whatever the advances in technology, however, the wind power industry still faces significant hurdles, starting with uncertain political support in the United States. In Europe, wind power is already a relatively easy sell. But in the United States, wind developers rely on federal tax credits to make a profit. These vital credits face chronic opposition from powerful oil and coal lobbies and often lapse. The wind power industry raced to plug in its turbines before these credits expired at the end of last year, then went dormant for the three months it took the U.S. Congress to renew them. Congress extended the credits through the end of next year, initiating what is likely to be yet another start-and-stop development cycle.

A second obstacle to broad adoption is the wind itself. It may be free and widely accessible, but it is also frustratingly inconsistent. Just ask any sailor. And this fickleness translates into intermittent power production. The more turbines get built, the more their intermittency will complicate the planning and management of large flows of power across regional and national power grids. Indeed, in west Texas, a recent boom in wind turbine construction is straining the region's transmission lines-and also producing power out of sync with local needs: wind blows during cool nights and stalls on hot days when people most need electricity.

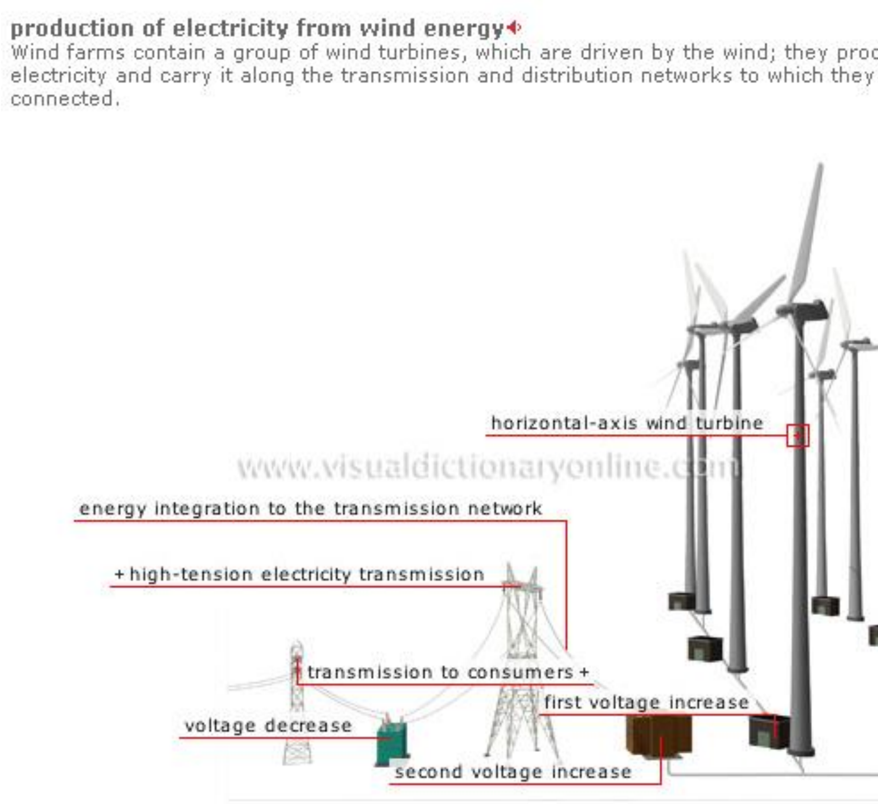
Texas utilities are patching the problem by expanding transmission lines. But to really capture the value of wind power on a large scale, new approaches are needed to storing wind power when it's produced and releasing it when needed. The Electric Power Research Institute, a utility-funded R&D consortium in Palo Alto, CA, is conducting research on how to make better one-day-ahead wind predictions. More important, it is exploring ways to store energy when the wind is blowing. “We need to think about operating an electrical system rather than just focusing on the wind turbines,” says Chuck McGowin, manager for wind power technology at the institute. Storage facilities “would allow us to use what we have more efficiently, improve the value of it.”

In the northwest United States, one storage option being developed by the Portland, OR-based Bonneville Power Administration balances wind power with hydroelectric power. The idea is simple: when the wind is blowing, don’t let the water pass through the hydroelectric turbines; on calm days, open up the gates. And the Tennessee Valley Authority is even experimenting with storing energy in giant fuel cells; a pilot plant is under construction in Mississippi.

Wind power faces plenty of obstacles, but there’s more reason than ever to believe these obstacles will be overcome. Worries over the environmental effects of burning fossil fuels and political concerns about an overdependence on petroleum are spurring a boom in wind turbine construction. But it is advances in the technology itself, created by continued strong research efforts, that could provide the most critical impetus for increased use of wind power.

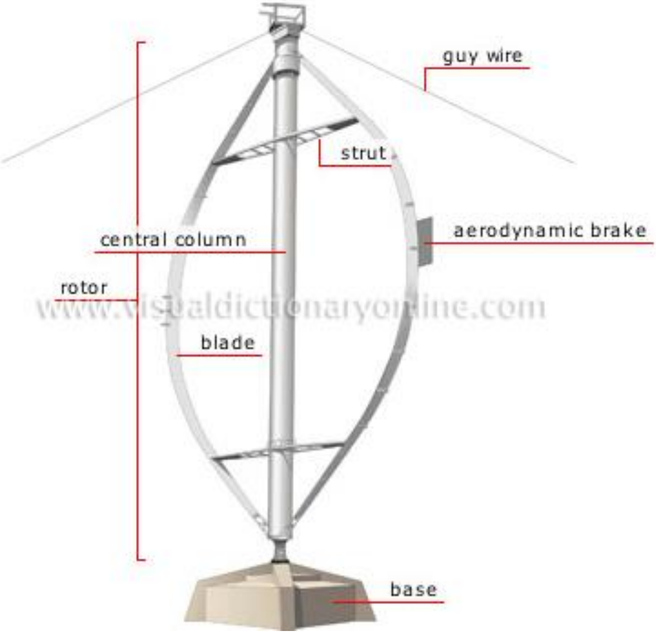
At Rocky Flats, four rows of research turbines-a total of a dozen machines ranging from 400-watt battery chargers to grid-ready 600-kilowatt machines-share a boulder-strewn 115-hectare plain. With the Rocky Mountains as a backdrop, their blades whup against the breezes blowing in from El Dorado Canyon to the west. At least, they do much of the time. “We have a lot of calm days, in the summer in particular, and for a testing site it's good to have a mix," Thresher says.

Calm days may be good for wind turbine research, but they're still among the biggest concerns haunting wind turbine commercialization. While no technology can make the wind blow, lower-cost, reliable technologies appear ready to take on its fickleness. And that could mean a wind turbine will soon sprout atop a breezy hill near you.



vertical-axis wind turbine

Wind turbine whose axis is perpendicular to the wind.



ACTIVE VOCABULARY

wind shadow – поток ветра, ветровая тень
downwind orientation – направление по ветру
alternating-current –переменный ток
be in sync with – соответсвовать
brute force – грубая сила
technology doldrums – технологический спад (депрессия)
economic equation –экономический баланс

GETTING A GRIP: HOW GECKO TOES STICK

Geckos are the envy of rock climbers. Without glue, suction, or claws, these lizards scamper up walls and hang from ceilings.

Scientists finally have pinned down the molecular basis of this seeming magic. Gecko feet are covered by billions of tiny hair tips, or spatulae, that hug surfaces. Temporary shifting of the electrons in the molecules of the spatulae and of opposing rocks, walls, or ceilings creates adhesive van der Waals forces, according to a study in the Aug. 27 Proceedings of the National Academy of Sciences. The collective action of these subtle intermolecular interactions contributes to countless properties, including a liquid's boiling point and a polymer's strength.

Previous research had shown that gecko adhesion relies on intermolecular forces (SN: 7/15/00, p. 47), but scientists weren't sure whether van der Waals bonding or water adsorption was at work. In water adsorption, a thin layer of the liquid acts like glue, but only on surfaces that readily bond water. The new study, however, shows that geckos cling equally well to water-attracting and water-repelling surfaces. Using mathematical models, the authors report that the width of each spatula is just what would be expected if van der Waals forces were operating.

The small size and high density of the spatulae, rather than their chemical composition, enable geckos to stick to the world so well, report Kellar Autumn of Lewis and Clark College in Portland, Ore., and his colleagues.

Gecko spatulae are made of keratin, the protein in human hair. However, when the scientists made spatulae mock-ups out of either silicon rubber or polyester, each material adhered to many surfaces as well as the real spatulae did.

"Just by splitting a surface into multiple small tips, we can get dry adhesion," Autumn says. Such structures might serve as a new type of adhesive that doesn't require messy, smelly liquids.

The work shows that strong adhesion can arise from what are thought to be relatively weak forces, comments Matthew Tirrell of the University of California, Santa Barbara. The highly divided gecko foot is also minutely adaptable to bumpy surfaces and is easy to reposition, he says.

A good adhesive has to both stick and release easily, adds Anthony Russell of the University of Calgary in Alberta. "Getting something to stick is not that hard," he notes. "Getting it off and being able to use it again, that is one of the neat things that geckos have been able to do."

ACTIVE VOCABULARY

suction – присасывание
scamper up – мчаться вверх
pin down – связывать
spatula – лопаточка
adhesive – клейки
water adsorption – адсорбция воды

CAUGHT ON TAPE: GECKO-INSPIRED ADHESIVE IS SUPERSTRONG

As it scurries along the ceiling, a gecko has the sticking power to support not just its own body weight, but about 400 times as much. Besides that sticking power, the natural adhesive on this animal's feet is clean and reusable, and it works on all surfaces, wet or dry.

Scientists at the University of Manchester in England and the Institute for Microelectronics Technology in Russia have emulated the animal's adhesive mechanism by creating "gecko tape." It comes closer to the lizard's sticking power than any other gecko-styled adhesive so far.

The 1-square-centimeter prototype patch can bear about 3 kilograms, almost one-third the weight that the same area of gecko sole can support.

In the July *Nature Materials*, Andre Geim of the University of Manchester and his colleagues claim that the tape is scalable to human dimensions: Wearing a "gecko glove," a person could dangle from the ceiling. In theory, the tape could hold tissues together after surgery or support stunt doubles climbing around movie sets.

The gecko tape is modeled on the gecko sole, an intricate fingernail-size surface covered with a half-million microscopic, hair-like structures known as setae. Each seta's tip branches into even finer hairs that nestle so closely with every surface the gecko touches that intermolecular attractions called van der Waals bonds and capillary forces kick in. These bond the gecko's foot to the surface.

Geim and his team made their synthetic gecko adhesive by fabricating a tidy array of microscale hairs out of polyimide, a flexible and wear-resistant plastic. When mounted on a flexible base, the arrangement and density of the hairs maximize the number of hairs contacting a surface.

"The smaller the hairs are, and the more of them you have, the greater the adhesion," notes Ron Fearing, an engineer at the University of California, Berkeley.

Unlike a gecko's feet, however, the tape begins to lose its adhesive power after about five applications. Geim blames this shortcoming on polyimide's hydrophilicity, that is, its tendency to attract water. With repeated applications, some of the gecko tape's hairs get soggy, bunch together, and then clump onto the tape's base. This happens even when the tape is attached to surfaces that are dry to the touch, because they carry a layer of water two or three atoms thick.

By using hydrophilic material, Geim departed from the gecko's design—its setae are made of keratin, a so-called hydrophobic protein that repels water. Geim says hydrophobic materials, which include silicone and polyester, are more difficult to mold into setae-like structures than is polyimide. Even so, both he and Fearing agree, it will take water-repellant substances to produce a long-lasting gecko tape.

ACTIVE VOCABULARY

scurry – бегать
scalable – эластичный
human dimensions
kick in – действовать

hydrophilicity – гидрофильность
get soggy – намокнуть

NATIONAL ACADEMY OF ENGINEERING REVEALS TOP ENGINEERING IMPACTS OF THE 20TH CENTURY: ELECTRIFICATION CITED AS MOST IMPORTANT

One hundred years ago, life was a constant struggle against disease, pollution, deforestation, treacherous working conditions, and enormous cultural divides unreachable with current communications technologies. By the end of the 20th century, the world had become a healthier, safer, and more productive place, primarily because of engineering achievements.

Speaking on behalf of the National Academy of Engineering (NAE), astronaut/engineer Neil Armstrong today announced the 20 engineering achievements that have had the greatest impact on quality of life in the 20th century. The announcement was made during National Engineers Week 2000 at a National Press Club luncheon.

The achievements – nominated by 29 professional engineering societies – were selected and ranked by a distinguished panel of the nation's top engineers. Convened by the NAE, this committee – chaired by H. Guyford Stever, former director of the National Science Foundation (1972-76) and Science Advisor to the President (1973-76) – worked in anonymity to ensure the unbiased nature of its deliberations.

"As we look at engineering breakthroughs selected by the National Academy of Engineering, we can see that if any one of them were removed, our world would be a very different – and much less hospitable place," said Armstrong. Armstrong's announcement of the top 20 list, which includes space exploration as the 12th most important achievement, covers an incredibly broad spectrum of human endeavor – from the vast networks of electrification in the world (No. 1), to the development of high performance materials (No. 20) such as steel alloys, polymers, synthetic fibers, composites and ceramics. In between are advancements that have revolutionized the way people live (safe water supply and treatment, No. 4, and health technologies, No. 16); work (computers, No. 8, and telephones, No. 9); play (radio and television, No. 6); and travel (automobile, No.2, airplane, No.3, and interstate highways, No.11) In his statement delivered to the National Press Club, Armstrong said that he was delighted to announce the list of the greatest achievements to underscore his commitment to advancing the understanding of the critical importance of engineering. "Almost every part of our lives underwent profound changes during the past 100 years thanks to the efforts of engineers, changes impossible to imagine a century ago. People living in the early 1900s would be amazed at the advancements wrought by engineers," he said, adding, "as someone who has experienced firsthand one of engineering's most incredible advancements - space exploration - I have no doubt that the next 100 years will be even more amazing."

The NAE notes that the top achievement, electrification, powers almost every pursuit and enterprise in modern society. It has literally lighted the world and impacted countless areas of daily life, including food production and processing, air conditioning and heating, refrigeration, entertainment, transportation, communication, health care, and computers. Many of the top 20 achievements, given the immediacy of their impact on the public, seem obvious choices, such as automobiles, at No. 2, and the airplane, at No. 3. These achievements, along with space exploration, the nation's interstate highway system at No. 11, and petroleum and gas technologies at No. 17, made travel and mobility-related achievements the single largest segment of engineering to be recognized. Other achievements are less obvious, but nonetheless introduced changes of staggering proportions. The No. 4 achievement, for example, the availability of safe and abundant water, literally changed the way Americans lived and died during the last century. In the early 1900s, waterborne diseases like typhoid fever and cholera killed tens-of-thousands of people annually, and dysentery and diarrhea, the most common waterborne diseases, were the third largest cause of death. By the 1940s, however, water treatment and distribution systems devised by engineers had almost totally eliminated these diseases in America and other developed nations. They also brought water to vast tracts of land that would otherwise have been uninhabitable. Number 10, air conditioning and refrigeration technologies, underscores how seemingly commonplace technologies can have a staggering impact on the economy of cities and worker productivity. Air conditioning and refrigeration allowed people to live and work effectively in sweltering climates, had a profound impact on the distribution and preservation of our food supply, and provided stable environments for the sensitive components that underlie today's information-technology economy. Referring to achievements that may escape notice by most of the general public, Wm. A. Wulf, president of the National Academy of Engineering, said, "Engineering is all around us, so people often take it for granted, like air and water. Ask yourself, what do I touch that is not engineered? Engineering develops and delivers consumer goods, builds the networks of highways, air and rail travel, and the Internet, mass produces antibiotics, creates artificial heart valves, builds lasers, and offers such wonders as imaging technology and conveniences like microwave ovens and compact discs. In short, engineers make our quality of life possible."

SELECTION PROCESS

The process for choosing the greatest achievements began in the fall of 1999, when the National Academy of Engineering, an autonomous non-profit organization of outstanding engineers founded under the congressional charter that established the National Academy of Sciences, invited discipline-specific professional engineering societies to nominate up to ten achievements. A list of 105 selections was given to a committee of academy members representing the various disciplines. The panel convened on December 9 and 10, 1999, and selected and ranked the top 20 achievements. The overarching criterion used was that those advancements had made the greatest contribution to the quality of life in the past 100 years. Even though some of the achievements, such as the telephone and the automobile, were invented in the 1800s, they were included because their impact on society was felt on the 20th century.

Editors Notes:

Greatest Engineering Achievements of the 20th Century is a collaborative project led by the National

Academy of Engineering, with the American Association of Engineering Societies, National Engineers Week, and 29 engineering societies. The National Academy of Engineering was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers.

Since its founding in 1951 by the National Society of Professional Engineers, National Engineers Week, a consortium of more than 100 engineering, scientific, education societies, and major corporations, has helped increase public awareness and appreciation of technology and the engineering profession. National Engineers Week 2000 co-chairs are the American Consulting Engineers Council (ACEC), a national organization of private engineering firms, and CH2M HILL, a global engineering company specializing in water and wastewater, environmental management, transportation, telecommunications, industrial facilities, and related infrastructure. American Association of Engineering Societies is a federation of engineering societies dedicated to advancing the knowledge, understanding, and practice of engineering whose membership represents more than one million engineers in the United States.

ACTIVE VOCABULARY

treacherous working conditions – опасные условия труда

typhoid - брюшной тиф
overarching criterion – всеохватывающий критерий

RUNNING LATE? RESEARCHERS BLAME AGING BRAIN

Can March be almost over? Didn't they play the Super Bowl just last week? It sometimes seems that with each passing year, the days and weeks zip by more quickly.

If you have ever had this feeling, you are not imagining it. Studies of human time perception show that age-related changes in the nervous system alter one's sense of time; it really does seem to move more quickly with age. At a meeting of the Society for Neuroscience in New Orleans in November, a psychologist, Dr. Peter A. Mangan, reported on a study in which he asked people in different age groups to estimate when three minutes had passed by silently counting one-one-thousand, two-one-thousand, three-one-thousand and so on. People in their early 20's were accurate within three seconds, and some got it exactly right. People in their 60's estimated that three minutes were up after 3 minutes and 40 seconds had passed. Middle-aged subjects fell in between but, like the older people, all underestimated the passage of time.

This phenomenon has led some researchers to suspect that the brain contains a special clock that tracks time intervals in the range of seconds to minutes. A Duke University neuroscientist, Dr. Warren Meck, and a graduate student, Matthew Matell, have now proposed a model of this clock based on studies of human brain anatomy.

According to their theory, a cluster of neurons in the midbrain collects time signals from all over the brain and coordinates those that occur at the same time and involve singular events or perceptions. The neurons also establish the start and finish of various time intervals that the brain is interested in measuring, such as how long it should take before a red traffic light turns green. Moreover, a brain chemical called dopamine regulates this clock. Add dopamine and the clock runs faster; take it away, and the clock slows down.

Defects in this clock could help explain human ailments like dyslexia, hyperactivity, Parkinson's disease and schizophrenia. It could explain why, in an automobile accident, three seconds can feel like three minutes, why old people in nursing homes are often confused about time, and even how some drugs like cocaine and amphetamine give the sense of "speed" while others, including marijuana, subjectively slow down the passage of time.

An American psychologist, Dr. Hudson Hoagland, first suspected the existence of an interval clock in the 1930's, when his wife ran a high fever. Mrs. Hoagland complained that her husband had been out of the room for a very long time when he had actually been gone for only a few moments. Curious, Dr. Hoagland asked his wife to estimate when a minute had passed. After 37 seconds, she said the time was up. And as her temperature rose, she counted faster.

In further experiments, Dr. Hoagland found that he could retard an individual's sense of time by 20 percent by applying heat to the person's brain. Other researchers later found that lowering a person's body temperature by two or three degrees could speed up the subjective sense of time.

The idea that there is a clock measuring intervals in the range of second to minutes (in addition to the circuits that measure tenths and hundredths of seconds and the circadian clock that tracks the length of the day) makes a lot of sense. The ability to estimate short durations of time is critical for learning and survival, said Dr. John Gibbon of the New York State Psychiatric Institute and Columbia University.

People unconsciously monitor the timing of external events and respond to them. For example, Dr. Meck said, "suppose you are sitting at a red light, waiting for it to turn green," adding: "At a certain point, based on past experience, you will begin to put your foot on the gas in anticipation that the light is about to turn. Unconsciously, you are counting the seconds, without looking at your watch. But if the light fails to turn green in the expected amount of time, you start fretting, wondering if it is working properly. If enough time passes, you may decide to run the red light."

People use interval clocks when engaged in music or sports. Basketball players, Dr. Meck points out, keep track of time in their brains, knowing that they will be penalized under certain circumstances if they hold the ball for longer than several seconds without dribbling or passing. Musicians simultaneously measure not just the beat but the phrase, the crescendos and innuendoes. When jazz players shade the time in violation of strict beats, it makes the music interesting, Dr. Gibbon said.

In the case of the basketball player, different parts of the brain are working on different tasks. Cells in the visual system are looking for places to run or pass the ball. Cells in the motor system are controlling movements. Cells in the auditory system are listening for information from teammates on what to do next. Each of these specialized cell circuits carrying out different jobs tend to oscillate or fire at different rates. Some might be firing 5 times a second, others up to 40 times a second. It is as if they are operating independently on different time scales, yet the basketball player's brain must integrate them so that he or she can decide what to do with the ball.

For this task of coordination, Dr. Meck and his assistant have nominated a structure in the midbrain called the striatum, which is loaded with spiny neurons, so called because their projections are thick with spines. Such neurons are well connected in that each one -- and there are thousands of them -- is linked to tens of thousands of other cells via dendrites coming from other parts of the brain. The dendrites are the slender spines that help brain cells communicate. They detect oscillations or cell firing rates that occur all over the brain, Dr. Meck said, "and the question has been what the heck do they do with them?"

"We think spiny neurons integrate these signals," Dr. Meck said, and, based on previous experience of what is important, select those that are beating at the same frequency and synchronize them. This collective timing signal is sent to higher cortical areas where, in a grand loop from the brain's basal ganglia to its frontal lobes, perceptions and actions are coordinated and acted upon. When a person is performing several tasks at once and needs to measure time, spiny neurons parcel out the tasks, Dr. Meck said.

The key to how this clock works -- or fails to work -- is dopamine. When the brain notices something new or rewarding, dopamine made in a nearby region called the substantia nigra is released into the spiny neurons, which become excited and begin to integrate time signals. In this way, the brain learns to anticipate events seconds or minutes into the future.

Animal and human experiments support the existence of the short-interval circuit, Dr. Meck said. For example, rats trained to press a lever at regular intervals to get food lose the ability when their dopamine-producing cells are removed. When the rats are given a synthetic form of dopamine, the ability is restored. In brain imaging experiments by Dr. Sean Hinton at Duke, people were asked to estimate when 11 seconds were up and to squeeze a ball just before and after this interval. The loop from the midbrain, where the source of dopamine and spiny neurons reside, to the higher cortex was activated each time they estimated 11 seconds had gone by.

The interval clock has drawn the interest of medical researchers. Dr. Guinevere Eden of Georgetown University Medical Center in Washington said that dyslexia was basically a timing problem throughout the brain and that for dyslexics difficulty in learning to read was just one manifestation of a more widespread defect. Some dyslexics have a problem with time, she said. They come late to appointments and have trouble keeping rapidly moving events in proper chronological order.

A study in the Feb. 7 issue of the British medical journal The Lancet found that people with attention deficit hyperactivity disorder tend to have smaller than normal frontal lobes and basal ganglia, the loop that Dr. Meck and his colleagues think is the interval time keeper.

People with Parkinson's disease lose cells that make dopamine and their interval clocks are thrown off, Dr. Meck said. They have tremors, difficulty in starting movements, rigid muscles and problems perceiving time accurately, all of which can be reversed with drugs that supply dopamine to the brain.

Researchers agree that drugs affect the brain's sense of time. Cocaine and methamphetamine both increase the amount of dopamine and speed up the interval clock or its equivalent elsewhere in the brain. A similar chemical cascade may happen during an accident, when dopamine and other neurotransmitters flood the brain, Dr. Mangan said. Time seems to stand still or move incredibly slowly. Conversely, drugs that reduce the amount of dopamine in the brain, like Haloperidol and Clozapine, used to treat schizophrenia, and marijuana, slow the interval clock, Dr. Meck said.

It is in growing older that most people will experience the vagaries of the interval clock. Studies show that dopamine levels gradually begin to fall when people are in their 20's and decline through old age, said Dr. Mangan, a psychologist at Clinch Valley College of the University of Virginia in Wise, Va. As shown by the experiments reported by Dr. Mangan in New Orleans, the older you get the more you are going to feel that time is passing by quickly. The good news is that spring will come sooner and sooner.

ACTIVE VOCABULARY

zip by – промелькнуть, пронестись;
time perception - восприятие времени;
be up – заканчиваться;
a cluster of neurons – группа нейронов;
ailment – заболевание;
retard- - замедлять;
circadian clock – околосуточные часы (о биоритмах);

fret – раздражать;
be penalized – быть наказанным;
oscillate – колебаться;
fire – раздражать;
spiny neurons – шипиковые нейроны;
dendrite дендрит (отросток нервной клетки);
act upon – согласовано действовать;
parcel out – делить, дробить;
basal ganglia – базальное ядро, подкоркоые узлы
throw off - нарушаться
vagary – каприз, выходка, причуда

NUTRITIONAL SUPPLEMENTS MAY COMBAT MUSCLE LOSS

Early indications show that nutritional supplements may lessen muscle atrophy brought on by space travel, prolonged bed confinement or immobility.

To study space travel's effect on muscles, Dr. Robert Wolfe of the University of Texas Medical Branch at Galveston enlisted healthy subjects to stay in bed 28 days during a National Space Biomedical Research Institute study.

"One cause of muscle atrophy in space is lack of muscular activity. That's why bed rest is a good model because it minimizes activity, and like astronauts, you lose muscle mass primarily in the legs," said co-investigator Dr. Arny Ferrando, a professor of surgery at UTMB and Shriners Hospital for Children in Galveston. "When muscles are inactive, as they are in space, they don't make new proteins. If muscle breakdown rates are the same, that means you lose muscle."

Researchers are attempting to increase protein synthesis rates with supplements of amino acids, which are the raw materials of protein. Participants received the supplements three times a day, and researchers compared the protein synthesis/breakdown rates and muscle mass before and after the bed-rest study. This data was compared to results from a control group that received a placebo drink instead of the supplements.

"Early results suggest that the amino acid supplement is able to maintain synthesis rates and body mass," Ferrando said. During the study, subjects must remain in bed and can get up only briefly to use a bedside commode. They eat and bathe from their beds, and daily activities encompass watching television, reading books and using a bedside computer.

Midway through the study, researchers determine muscle mass and function by testing the subjects' strength and body composition. They gather the most vital data, the protein synthesis and breakdown rates, by using stable isotope analysis. With the stable isotope technique, researchers attach a harmless tracer to specific amino acids that travel through the bloodstream. Then, they take blood samples to determine the amount of amino acids that enter and exit the leg.

"If 80 amino acids are coming into the artery and 60 are going out of the vein, we know that 20 were probably made into proteins in the muscle," said Dr. Douglas Paddon-Jones, also of UTMB and a co-investigator performing these studies. "We complete the muscle analysis by removing a small piece of muscle and determining how many amino acids have been incorporated into proteins. Over time, we can calculate the rate at which the synthesis and breakdown occurs."

Space conditions also elevate the body's level of the stress hormone cortisol, which increases the breakdown rate of proteins. "Under stress, the body breaks down proteins to make energy for survival," said Ferrando, a member of NSBRI's nutrition and fitness research team. "However, this process also causes muscle atrophy."

To study the supplement's effects on muscle loss due to elevated levels of cortisol, researchers infused the stress hormone into the participants' blood during the stable isotope tests. The researchers mimic the cortisol concentrations found during space flight, then determine protein synthesis and breakdown rates of the subjects taking the supplement and compare this to the rates of the control group.

Ferrando and Wolfe are also collaborating with other NSBRI researchers who use the subjects' body fluids to study changes in bone, immune function and cell damage induced by bed rest.

Findings from this research on nutritional supplements could benefit patients on Earth.

"Muscle atrophy is common in many populations: the elderly, kids with burns, patients in intensive care or people who have had major operations. We're looking at this phenomenon in terms of space flight, but the study has many other implications," Ferrando said.

ACTIVE VOCABULARY

nutritional supplements – биологически активные добавки

muscle atrophy – артофия мышц

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Учебное издание

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Гатауллина Камила Наилевна

TECHNICAL TRANSLATION IN USE

Учебное пособие

Корректура авторская

Подписано в печать _________
Бумага офсетная. Формат 60х84 1/16.
Печать ризографическая. Гарнитура Times New Roman Cyr.
Усл. печ. л. Уч.- изд. л.
Тираж _________экз. Заказ №.________

Отпечатано с готового оригинал-макета в лаборатории оперативной полиграфии Набережночелнинского института Казанского (Приволжского) федерального университета

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г. Набережные Челны, пр. Сююмбике, 10 А (11/29)
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