

**МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ УКРАИНЫ
ДОНБАССКАЯ ГОСУДАРСТВЕННАЯ
МАШИНОСТРОИТЕЛЬНАЯ АКАДЕМИЯ**

**В.И.МИШИНА
Л.А.ШТАБА**

УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ

**УЧИТЕСЬ ЧИТАТЬ
ЛИТЕРАТУРУ ПО СПЕЦИАЛЬНОСТИ
НА АНГЛИЙСКОМ ЯЗЫКЕ**

**КРАМАТОРСК
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Рекомендовано Министерством
образования Украины в качестве
учебного пособия для студентов
высших учебных заведений

Второе стереотипное издание

**КРАМАТОРСК
2005**

ББК 81.2
УДК 42
У-92

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Гриф присвоен Министерством образования и науки Украины
Письмо № 14/182-1934 от 24.12.01

Учитесь читать литературу по специальности на английском языке: Учебно-методическое пособие / В.И.Мишина, Л.А. Штаба.– Краматорск: ДГМА, 2002. - 80с.

У-92
ISBN 5-7763-1237-X

Пособие содержит 18 уроков, каждый из которых включает основные тексты (А), предтекстовые и послетекстовые упражнения для работы над лексикой, а также тексты (В,С) для чтения без словаря на базе изученной лексики.

Тексты пособия связаны с металлургическими процессами и оборудованием.

Цель пособия – сформировать навыки и умения самостоятельного чтения оригинальной литературы по специальности, умение извлекать необходимую информацию и вести беседу в пределах пройденной тематики.

ББК 81.2

ISBN 5-7763-1237-X

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LESSON 1

1 Прослушайте слова и словосочетания для повторения и запоминания:

definition	определение
a solid	твердое вещество
to forge	ковать
Luster	блеск
a feature	черта, призрак
a property	свойство
ability	способность
elasticity	упругость
ductility	пластичность
malleability	ковкость
toughness	вязкость
brittleness	хрупкость
Wear resistance	износостойкость
corrosion resistance	коррозийная устойчивость
electric conductivity	электропроводимость
Pure	чистый
an alloy	сплав
to melt	плавить
strength	прочность
durability	стойкость, долговечность
ferrous metals	черные металлы
non-ferrous metals	цветные металлы
pig iron	Доменный (чушковый) чугун
cast iron	литейный чугун
wrought iron	ковкая сталь, кованное железо
mild steel	мягкая сталь
carbon steel	углеродистая сталь
Alloy steel	легированная сталь
high-speed steel	быстрорежущая сталь
tool-steel	инструментальная сталь
copper	медь
magnesium	магний
Lead	свинец
Tin	олово
tungsten	вольфрам
melting point	точка плавления
low (lower, lowest)	низкий
a light weight	легкий вес
aircraft building industry	авиационная промышленность, самолетостроение
due to	благодаря, вследствие
Need	нужда, потребность

enormously-extremely	чрезвычайно, очень, весьма
germanium	германий
plutonium	плутоний
thorium	торий
to develop	развивать, разрабатывать, создавать
development	развитие
to meet	встречать, удовлетворять
dominant element	доминирующий, преобладающий элемент
zink-base alloys	сплавы на основе цинка
to be intended	предназначаться
under severe stresses	в условиях большой нагрузок

Metals and alloys

There are different metals in nature.

The first definition of the word “metal” was formulated by Lomonosov in the following way: “ A metal is a bright solid that can be forged”. This definition is still true. In fact, the characteristic features of metallic materials are their metallic luster and the ability for plastic deformation. However, we know that metals possess the following properties: elasticity, ductility, malleability, toughness, brittleness, wear resistance, corrosion resistance, etc. The most important feature of metals is their high electric conductivity.

All metallic materials can be classified as pure metals and alloys. Pure or simple metals consist of only one chemical element. An alloy may be formed by melting two or more elements together. Alloys possess increased strength, durability and other valuable properties.

Both pure metals and alloys are divided into two groups: ferrous and non-ferrous metals. Metals consisting of iron and some other elements are called ferrous metals. All the other metals are called non-ferrous metals.

The principal ferrous materials used are: pig iron, cast iron, wrought iron and steel. There are various kinds of steel, such as mild steel, carbon steel, alloy steel, high-speed steel, tool-steel, etc. Pig iron is the starting point in the production of all ferrous materials. It contains from 92 to 97 per cent of iron. The remainder consists of carbon and other elements.

The most widely used non-ferrous metals are: zink, copper, aluminium, magnesium, lead, tin, silver, gold, nickel, cobalt, tungsten and others. The non-ferrous metals are of great importance for our industry. Except nickel, these metals have a lower melting point than the iron alloys. Most of them have good corrosion resistance, high electric conductivity. Some non-ferrous metals have a light weight. This property is very important in aircraft building industry.

During the last years, due to the fast development of industry, the need for the new metallic materials has enormously increased. Metals practically unknown before, such as germanium, plutonium and thorium have come to light. They are used in the electronic and atomic industries.

The non-ferrous alloys have been developed to meet the specialized needs of industry. They have been grouped according to their dominant element. For example, there are copper-base alloys, aluminium-base, lead-base, tin-base, zinc-base and nickel-base alloys.

There have also been developed high temperature alloys, new ferromagnetic materials, constructional steels. They are intended for operating under severe stresses or at extremely high or low temperatures.

Post-Text Exercises

1 Ответьте на следующие вопросы:

1. In what way did Lomonosov formulate the definition of the word “metal”?
2. What are the characteristic features of metals?
3. What properties do metals possess?
4. What is a pure metal, an alloy?
5. Why are some metals so valuable?
6. What ferrous metals do you know?
7. What are the most widely used non-ferrous metals?
8. Do you know any special properties of non-ferrous metals?
9. What metals are used in electronic and atomic industries?

2 Translate into English:

1. В природе существуют различные металлы.
2. Первое определение слова «металл» сформулировал Ломоносов.
3. Чистые металлы состоят из одного химического элемента.
4. Сплавы обладают улучшенной прочностью, долговечностью и другими ценными свойствами.
5. Как чистые металлы, так и сплавы делятся на две группы: черные и цветные.
6. Основные черные металлы – это доменный чугун, литейный чугун и кованное железо.
7. Доменный чугун является исходным материалом для производства всех черных металлов.
8. За последние годы, вследствие быстрого развития промышленности, резко возросла потребность в новых металлах.
9. Появились металлы, практически неизвестные раньше.

3 Finish the following sentences:

1. However, we know that metals possess, in some degree, the following properties:
..... .
2. An alloy may be formed
3. Metals consisting of iron and
4. There are various kinds of steel:
5. is the starting point in the production of all ferrous materials.
6. The most widely used non-ferrous metals are

7. The non-ferrous metals have been developed to
 8. There have also been developed high temperature alloys,

LESSON 2

Grammar: Tenses / Active /

1 Вспомните правила образования времен в действительном залоге.

Система времен глагола

АКТИВ / Active /

	Indefinite	Continuous	Perfect	Perfect Continuous
	V	to be + V + ing	to have + V + + ed / 3 ф /	Perfect to be + V + + ing
Past	V + ed / 2 ф /	was } were } + V + ing	had + V + ed / 3 ф /	had been + V + ing
Present	V V + s / 3 л.ед.ч /	am } is } + V + ing are }	had } has } + V + ed / 3 ф /	have been } has been } + V + ing
Future	shall } will } + V	shall be } will be } + V + ing	shall have } will have } + V + ed / 3 ф /	shall have been } will have been } + V + ing
	Обычное действие	Действие в процессе, в момент времени	Действие, законченное к моменту времени	Действие в процессе, целый период времени

2 Еще раз обратите внимание на образование времен в действительном залоге и на перевод глагольных форм на русский язык.

Tense	Active
Present Indefinite	This example <u>illustrates</u> / иллюстрирует/ the latest achievement in metallurgy.
Past Indefinite	This example <u>illustrated</u> / иллюстрировал / the latest achievement in metallurgy.
Future Indefinite	This example <u>will illustrate</u> / будет иллюстрировать, проиллюстрирует / the latest achievement in metallurgy.
Present Continuous	This lecturer <u>is illustrating</u> / иллюстрирует сейчас / the latest achievement in metallurgy.
Past Continuous	This lecturer <u>was illustrating</u> / иллюстрировал / the latest achievement in metallurgy for an hour.
Future Continuous	This lecturer <u>will be illustrating</u> / будет иллюстрировать, проиллюстрирует / the latest achievement in metallurgy for an hour.

Present Perfect	This lecturer <u>has just illustrated</u> / только что проиллюстрировал / the latest achievement in metallurgy.
Past Perfect	This lecturer <u>had already illustrated</u> / уже проиллюстрировал / the latest achievement in metallurgy when he came.
Future Perfect	This lecturer <u>will have illustrated</u> / проиллюстрирует / the latest achievement in metallurgy by 7 o'clock.

3 Прочтите предложения, обращая внимание на формы глаголов-сказуемых и на способ их перевода, а также на то, как их действие протекает во времени:

- | | |
|---|---|
| 1. The students <u>listen</u> to the lecture on the strength of materials every week.
<i>/ обычное, повторяющееся действие /</i> | 1. Студенты слушают лекцию о сопротивлении материалов каждую неделю. |
| 2. The teacher <u>stood up, came up</u> to the blackboard and showed us the iron-carbon diagram.
<i>/ последовательные действия /</i> | 2. Преподаватель встал, подошел к доске и показал нам диаграмму железо-углерод. |
| 3. The students <u>are working</u> at the laboratory.
<i>/ длительное действие в процессе его совершения /</i> | 3. Студенты /сейчас/ работают в лаборатории. |
| 4. The students <u>will be working</u> at the laboratory the whole day tomorrow.
<i>/ длительное действие, совершаемое в определенный отрезок времени в будущем /</i> | 4. Студенты будут работать в лаборатории целый день завтра. |
| 5. I <u>have visited</u> this machine-building plant.
<i>/ завершенное действие без указания времени, обращается внимание на результат /</i> | 5. Я посетил этот машиностроительный завод. |
| 6. He <u>had already written</u> his article about the properties of steel when I came to see him.
<i>/ действие, завершенное до начала другого действия в прошлом /</i> | 6. Он уже написал статью о свойствах стали, когда я зашел навестить его. |
| 7. They <u>will have translated</u> the article about nickel alloys by the end of the week.
<i>/ действие, завершенное к указанному моменту в будущем /</i> | 7. Они переведут статью о никелевых сплавах к концу недели. |
| 8. The students of our group <u>have been making</u> experiments with nickel alloys for ten days. | 8. Студенты нашей группы проводят эксперименты с никелевыми сплавами уже десять |

*/длительное действие, начавшееся в
прошлом и еще совершающееся в
настоящее время/*

4 Для грамматического анализа:

1. At 5 o'clock we were still looking through the results of our experiments.
2. Steel possesses such properties as physical, mechanical and technological.
3. We have never seen such equipment.
4. By the end of the month we shall have studied the properties of ferrous and non-ferrous metals.
5. We were answering the professor's questions when our dean came in.
6. Tomorrow I shall listen to the lecture about properties of metals.

Pre-Text Exercises

1 Обратите внимание на ударение в следующих словах:

1. /metal – me'tallurgy – metal'lurgical
2. /product – pro'duction – pro'ductive
3. /industry – in'dustrial
4. e'conomy – eco'nomie

2 Обратите внимание на перевод следующих словосочетаний:

- | | |
|-------------------------------|-------------------------------|
| 1. heat treatment | -термообработка |
| 2. applied mechanics | - теоретическая механика |
| 3. physical metallurgy | - металловедение |
| 4. extractive metallurgy | - металлургическое извлечение |
| 5. processes of working metal | - процессы обработки металлов |
| 6. to deal with | - иметь дело с |
| 7. constitution of alloys | - состав сплавов |

3 Переведите на русский язык:

1. extraction of metal from ores;
2. processing of metals into useful forms;
3. other phases of the science of metals;
4. to include;
5. to fall into;
6. chemical changes;
7. methods of production;
8. to refine

4 Прслушайте слова и словосочетания для повторения и запоминания:

- | | |
|---------------|------------|
| 1. to include | включать |
| 2. extraction | извлечение |
| 3. property | свойство |
| 4. behaviour | поведение |

5. heat treatment	термообработка
6. to broaden	расширять
7. Applied mechanics	теоретическая механика
8. to fall into	распадаться на
9. to refine	очищать
10. to deal with	иметь дело с
11. metal working	обработка металлов
12. to call	называть
13. change	изменение
14. to involve	вовлекать

Text A Some Words about Metallurgy

Metallurgy is the science of the technology of metals including extraction of metal from ores, processing of metals into useful form, and the study of their properties and behaviour.

With the development of physics of metals, metallography, theory of heat treatment, and other phases of the science of metals, the field of metallurgy has broadened.

Metallurgy includes areas of physics, chemistry, and applied mechanics, and also the development of new metal and alloy systems. So, metallurgy falls into three divisions; chemical or extractive, physical and mechanical.

Chemical metallurgy includes the metallurgical processes involving chemical change and the methods of production and refining.

Physical metallurgy deals with the nature, structure, and physical properties of metals and alloys.

Mechanical metallurgy includes the processes of working and shaping metals – processes which do not involve chemical changes.

The branch of metallurgy called metallography, or theoretical metallurgy, deals with the microscopic structure and constitution of metals and alloys.

Post-Text Exercises

1 Дайте синонимы следующих слов:

1. to extract; 2. phase; 3. to apply; 4. to fall into; 5. to involve; 6. to call; 7. to deal with.

2 Переведите с русского языка на английский:

1. металлы и сплавы, 2. обработка металлов, 3. изучение свойств, 4. с развитием различных отраслей науки, 5. методы очистки, 6. включить различные процессы обработки металлов, 7. состав металлов и сплавов.

Text B

3 Прочтите и перескажите ЭТОТ ТЕКСТ на АНГЛИЙСКОМ ЯЗЫКЕ.

I have entered a metallurgical department because I take interest in metallurgy. I shall study ferrous metals and their alloys, their chemical composition /состав/ and mechanical properties, and the methods of their production. I shall learn the construction of metallurgical furnaces and how they operate. I shall also learn the processes which occur in them. I shall become an engineer by profession. I understand that ferrous metallurgy is a core /основа/ of national economy/ It provides for the development of other industries and, in that way, favours the creation of the material and technical foundation of our society.

Text C

4 Прочтите, переведите и кратко перескажите ЭТОТ ТЕКСТ на АНГЛИЙСКОМ ЯЗЫКЕ.

Dmitry Ivanovich Mendeleev

Dmitry Ivanovich Mendeleev is a famous Russian chemist. He is best known for his development of the periodic table of the properties of the chemical elements. This table displays that elements' properties are changed periodically when they are arranged according to atomic weight.

Mendeleev was born in 1834 in Tobolsk, Siberia. He studied chemistry at the University of St. Petersburg, and in 1859 he was sent to study at the University of Heidelberg. Mendeleev returned to St. Petersburg and became Professor of Chemistry at the Technical Institute in 1863. He became Professor of General Chemistry at the University of St. Petersburg in 1866. Mendeleev was a well-known teacher, and, because there was no good textbook in chemistry at that time, he wrote the two-volume "Principles of Chemistry" which became a classic textbook in chemistry.

In this book Mendeleev tried to classify the elements according to their chemical properties. In 1869 he published his first version of his periodic table of elements. In 1871 he published an improved version of the periodic table, in which he left gaps for elements that were not known at that time. His table and theories were proved later when three predicted elements: gallium, germanium, and scandium were discovered.

Mendeleev investigated the chemical theory of solution. He found that the best proportion of alcohol and water in vodka is 40%. He also investigated the thermal expansion of liquids and the nature of petroleum.

In 1893 he became director of the Bureau of Weights and Measures in St. Petersburg and held this position until his death in 1907.

LESSON 3

Grammar: Tenses / Passive /

1 Вспомните правила образования времен в пассивном залоге.

/ Passive / to be + V + ed			
	Indefinite	Continuous	Perfect
Present	am } is } + V + ed /3ф/ are }	am } + being + V + is } + ed /3ф/ are }	have } + been + V + ed has } /3ф/
Past	was } were } + V + ed /3ф/	was } + being + V + were } + ed /3ф/	had been + V + ed /3ф/
Future	shall be } will be } + V + ed /3ф/	-----	shall have } + been + V + ed will have } /3ф/

2 Еще раз обратите внимание на образование времен в пассивном залоге и на перевод глагольных форм на русский язык.

Tense	Passive Voice
Present Indefinite	The latest achievements in metallurgy <u>are illustrated</u> / иллюстрируются / by this example.
Past Indefinite	The latest achievements in metallurgy <u>were illustrated</u> / были проиллюстрированы / by this example.
Future Indefinite	The latest achievements in metallurgy <u>will be illustrated</u> / будут иллюстрироваться, проиллюстрируются / by this example.
Present Continuous	The latest achievements in metallurgy <u>are being illustrated</u> / иллюстрируются сейчас / by the lecturer for an hour.
Past Continuous	The latest achievements in metallurgy <u>were being illustrated</u> / иллюстрировались / by the lecturer.
Present Perfect	The latest achievements in metallurgy <u>have just been illustrated</u> / были только что проиллюстрированы / by the lecturer.
Past Perfect	The latest achievements in metallurgy <u>had already been illustrated</u> / были проиллюстрированы / by the lecturer when he came.
Future Perfect	The latest achievements in metallurgy <u>will have been illustrated</u> / будут проиллюстрированы / by the lecturer by 7 o'clock.

3 Прочтите предложения, обращая внимание на формы глаголов-сказуемых и на способ их перевода, а также на то, как их действие протекает во времени:

- | | |
|--|---|
| 1. We were invited to the lecture about ferrous metals and alloys yesterday.
<i>/ действие, имевшее место в прошлом и соотнесенное с обстоятельством словом, точно обозначающим прошедшее время /</i> | 1. Нас пригласили вчера на лекцию о черных металлах и сплавах. |
| 2. The students were being asked questions about the properties of white and grey iron when I came/
<i>/ длительное действие, которое продолжалось совершаться в период времени, определяемый указанием на другое действие, одновременно с которым оно происходило /.</i> | 2. Студентам задавали вопросы о свойствах белого и серого чугуна, когда я пришел. |
| 3. The experiment has just been completed.
<i>/ завершенное действие с указанием неопределенного времени /.</i> | 3. Эксперимент только что закончен. |
| 4. Mechanical properties of metals had been discussed by the 1st of February.
<i>/ завершенное действие к указанному моменту/.</i> | 4. Механические свойства металлов были обсуждены к первому февраля. |

4 Для грамматического анализа:

1. Physics has been called the science of measurement. 2. A compound is made by the union of two or more elements. 3. It was known long ago that matter consisted of atoms. 4. By the middle of the 19th century about 60 different metals had been discovered. 5. The delegates will be met at the station. 6. He will be offered this job.

Pre-Text Exercises

1 Обратите внимание на ударения в следующих словах:

1. ^{/'}science – scien^{/'}tific - ^{/'}scientist
2. pro^{/'}duce – pro^{/'}duction
3. ^{/'}magnet – mag^{/'}netic
4. ^{/'}chemistry - ^{/'}chemical - ^{/'}chemist
5. in^{/'}crease - ^{/'}increase
6. an ^{/'}alloy – to al^{/'}loy
7. a ^{/'}process – to pro^{/'}cess
8. a ^{/'}subject – to sub^{/'}ject

2 Убедитесь в том, что вы знаете эти слова:

so-called	- так называемый
to some extent	- в определенной степени
per year	- в год
as a result of	- в результате
such as	- такие как
Therefore	- следовательно, поэтому
in order to	- для того, чтобы
that is	- то есть
by means of	- с помощью
in particular	- в частности

3 Обратите внимание на чтение « ch » в следующих словах:

[k] chemistry; [k] mechanical; [t] change; [] machine.

4 Переведите на русский язык:

1. to have a great influence on one's life; 2. for a long time to come; 3. to take place; 4. stainless steels, 5. creep-resisting steels; 6. slag control; 7. a governing factor; 8. a fairly new development.

5 Прослушайте слова и словосочетания для повторения и запоминания:

1. light metals	- легкие металлы
2. to depend on	- зависеть от
3. harvester	- уборочная машина
4. huge	- огромный
5. output	- продукция, продукт
6. an alloy, to alloy	- сплав, легировать /сталь/
7. crankshaft	- коленчатый вал
8. propeller shaft	- вал винта
9. to reach	- достигать
10. amount	- количество
11. stainless steel	- нержавеющая сталь
12. strong steels	- прочные стали
13. jet engine	- реактивный двигатель
14. rapid	- быстрый
15. to ensure	- обеспечивать
16. cheap	- дешевый
17. improvement	- улучшение, усовершенствование
18. cost	- стоимость
19. to apply	- применять

Text A The Present and the Future of Metallurgy

In this age of sensational discoveries, newspapers and periodicals often contain articles on light metals and plastics. These new developments have a great influence on our life. But the so-called basic instruments, in particular, the coal and iron industry are still in an early stage of development and will change considerably as a result of scientific researches. Even agriculture is now dependent on tractors and harvesters to produce the huge outputs needed to feed the world.

It is true that some things that were once made of steel may soon be made of light alloys or of plastics, but highly stressed parts such as the crankshaft in aero-engine or the propeller shaft in a big liner will be made of steel for a long time to come. Industry today has become a network of many different processes, each depending to some extent on the others.

Iron and steel have been made for many centuries, but it is only during the last hundred years that production has reached gigantic amounts. For example, two hundred years ago Great Britain produced about twenty tons per year. They can now produce this amount in half a day.

Yet, this is only a beginning. The application of science to the iron and steel industry is a fairly new development. Most of the special steels, for example, stainless steel, the extraordinary strong magnetic steels, and the creep-resisting steels used for jet engines have all been developed during the last twenty years.

As a result of all scientific development that has taken place during this century, iron and steel making is rapidly changing from an art to a science.

Chemical analysis, magnetic testing and many other rapid methods are now being used to ensure that finished metal has the desired properties.

All changes are, however, subject to one governing factor, namely, the relative cheapness of iron and steel. The processes may be modified in many ways but any substantial increase in manufacturing costs without any corresponding increase in quality cannot be tolerated.

Commentary

art - зд. ремесло

still in an early stage – все еще на ранней стадии

for a long time to come - в будущем

to some extent - в некоторой степени

it is only during the last hundred years that - именно только в течение последних ста лет

subject to one governing factor - подчинен одному главному фактору

Post-Text Exercises

1 Дайте синонимы следующих слов:

1. age; 2. to contain; 3. development; 4. influence; 5. considerably; 6. huge; 7. different; 8. to reach; 9. amount; 10. application; 11. to take place; 12. rapid.

2 Дайте антонимы следующих слов:

1. often; 2. early; 3. huge; 4. to begin; 5. rapidly; 6. cheap; 7. to increase; 8. advantage.

Text B

3 Прочтите и перескажите этот текст на английском языке.

So happened that once I came across a popular scientific book about metals, read it and got interested in metallurgy. I learned from the book that the ancient peoples in China, India, Egypt and Mesopotamia had used iron 4000-5000 years ago, at first for ornaments, even for drugs / лекарство /, and then for weapons and tools / оружие и орудие труда /. I also learned that the most famous of all ancient /древний/ furnaces / печи / for iron making were those used in Spain, they were called “Catalan” after the country where they were invented. The furnaces were low, crude and primitive and yet they were used for many centuries.

Text C

4 Прочтите, переведите и кратко перескажите этот текст на английском языке.

Mikhail Vasilyevich Lomonosov

Mikhail Vasilyevich Lomonosov was a famous Russian writer, chemist, and astronomer who made a lot in literature and science.

Lomonosov was born on November 19, 1711, in Denisovka (now Lomonosov), near Archangelsk, and studied at the University of the Imperial Academy of Sciences in St.Petersburg. After studying in Germany at the Universities of Marburg and Freiberg, Lomonosov returned to St.Petersburg in 1745 to teach chemistry and built a teaching and research laboratory there four years later.

Lomonosov is often called the founder of Russian science. He was an innovator in many fields. As a scientist he rejected the phlogiston theory of matter commonly accepted at the time and he anticipated the kinetic theory of gases. He regarded heat as a form of motion, suggested the wave theory of light, and stated the idea of conservation of matter. Lomonosov was the first person to record the freezing of mercury and to observe the atmosphere of Venus during a solar transit.

Interested in the development of Russian education, Lomonosov helped to found Moscow State University in 1755, and in the same year wrote a grammar that reformed the Russian literary language by combining Old Church Slavonic with modern language. In 1760 he published the first history of Russia. He also revived the art of Russian mosaic and built a mosaic and coloured-glass factory. Most of his achievements, however, were unknown outside Russia. He died in St. Petersburg on April 15, 1765.

LESSON 4

Grammar: Tenses / Review /

1 Сгруппируйте следующие предложения по временным группам: Indefinite, Continuous, Perfect. Переведите их.

1. Ferrous metals are widely used in metallurgy. 2. Steel possesses such definite properties as physical, mechanical and technological. 3. We have never seen such equipment. 4. By the end of the week the students of our group will have studied the properties of ferrous and non-ferrous metals. 5. The future of metallurgy was discussed at our last lesson. 6. Tomorrow we shall read the text "Metals". 7. They were discussing the lecture about properties of metals for three hours. 8. He had already written his article about stainless steel by Monday. 9. The students were being asked questions about the present and the future of metallurgy.

2 Выберите из текста предложения, глаголы-сказуемые которых стоят в Present Indefinite Active, Past Indefinite Passive, Future Indefinite Active and Passive, Present Perfect Active and Passive, Present Continuous Passive. Переведите их.

Pre-Text Exercises

1 Ознакомьтесь с произношением некоторых слов из текста

arrangement
regularly
malleable
ductile
metallurgy
lead
extrusion
quenching

2 Работа над словообразованием. Переведите производные наречия согласно модели.

Модель: основа прилагательного + ly → наречие

true – правильный;

truly – правильно

Exact	- точный	exactly	-
Wide	- широкий	widely	-
Constant	- постоянный	constantly	-
Rapid	- быстрый	rapidly	-
technological	- технологический	technologically	-
High	- высокий	highly	-

3 Переведите с английского языка на русский:

1. crystalline structure

2. irregular crystals
3. coarse grains
4. that is why
5. metals vary greatly
6. machine-tools
7. nature of the grains
8. less than 1 per cent
9. most widely used
10. at red heat

4 Прослушайте слова и словосочетания для запоминания.

1. separation	разделение
2. dense	плотный
3. arrangement	расположение
4. to slide	скользить
5. to bend (p.p.bent)	сгибать
6. fracture	разрушение
7. to draw (p.p.drawn)	тянуть, вытягивать
8. wire	проволока
9. grain	зерно
10. to depend	зависеть
11. size	размер
12. shape	форма
13. composition	состав
14. coarse	крупный
15. treatment	обработка
16. quenching	закалка
17. tempering	отпуск после закалки
18. annealing	отжиг
19. rolling	прокатка
20. hammering	ковка на молоте
21. extrusion	выдавливание
22. lathe	токарный станок
23. milling machine	фрезерный станок
24. shaper	строгальный станок
25. grinder	шлифовальный станок
26. to cast	отливать
27. mould	форма (для отливки)

Text A

Metals

Metals are materials most widely used in industry because of their properties. The study of the production and properties of metals is known as metallurgy.

The separation between the atoms in metals is small, so most metals are dense. The atoms are arranged regularly and can slide over each other. That is why metals are malleable (can be deformed and bent without fracture) and ductile (can be drawn into wire). Metals vary greatly in their properties. For example, lead is soft and can be bent by hand, while iron can only be worked by hammering at red heat.

The regular arrangement of atoms in metals gives them a crystalline structure. Irregular crystals are called grains. The properties of the metals depend on the size, shape, orientation, and composition of these grains. In general, a metal with small grains will be harder and stronger than one with coarse grains.

Heat treatment such as quenching, tempering, or annealing controls the nature of the grains and their size in the metal. Small amounts of other metals (less than 1 per cent) are often added to a pure metals. This is called alloying (легирование) and it changes the grain structure and properties of metals.

All metals can be formed by drawing, rolling, hammering and extrusion, but some require hot-working. Metals can be worked using machine-tools such as lathe, milling machine, shaper and grinder.

The ways of working a metal depend on its properties. Many metals can be melted and cast in moulds, but special conditions are required for metals that react with air.

Post-Text Exercises

1 Выясните друг у друга, какие факты из текста, касающиеся металлов, вы запомнили.

2 Перескажите текст на русском языке.

Text B

3 Прочтите и перескажите этот текст на английском языке.

The use of metals marked one of the great stages in the evolution of man. Scientists use the terms “bronze age” and “iron age” because the discovery and shaping of these metals was the most significant event of the period. Year by year the amount of metal used steadily increased.

Today we know about 66 metals. With the increase in the number of metals has come an increase in the number of their alloys. From about one hundred the number of alloys has grown to many thousands.

The word metal is used in two ways. In the narrow and more precise meaning a metal is a chemical element having metallic properties. In the broader, more colloquial usage, it signifies any material, either element or alloy, which has metallic properties.

The occurrence of metals in the earth’s crust is unequal, some of them being not plentiful, the others existing only in small quantities. The only metal that can be found in almost every part of the world, although usually in the form of ore, is iron.

Text C

4 Прочтите, переведите и кратко перескажите этот текст на английском языке.

George Stephenson

George Stephenson was a British inventor and engineer. He is famous for building the first practical railway locomotive.

Stephenson was born in 1781 in Wylam, near Newcastle upon Tyne, Northumberland. During his youth he worked as a fireman and later as an engineer in the coal mines of Newcastle. He invented one of the first miner's safety lamps independently of the British inventor Humphry Davy. Stephenson's early locomotives were used to carry loads in coal mines, and in 1823 he established a factory at Newcastle for their manufacture. In 1829 he designed a locomotive known as the Rocket, which could carry both loads and passengers at a greater speed than any locomotive constructed at that time. The success of the Rocket was the beginning of the construction of locomotives and the laying of railway lines.

Robert Stephenson, the son of George Stephenson was a British civil engineer. He is mostly well-known for the construction of several notable bridges.

He was born in 1803 in Willington Quay, near Newcastle upon Tyne, and educated in Newcastle and at the University of Edinburgh. In 1829 he assisted his father in constructing a locomotive known as the Rocket, and four years later he was appointed construction engineer of the Birmingham and London Railway, completed in 1838. Stephenson built several famous bridges, including the Victoria Bridge in Northumberland, the Britannia Bridge in Wales, two bridges across the Nile in Damietta in Egypt and the Victoria Bridge in Montreal, Canada. Stephenson was a Member of Parliament from 1847 until his death in 1859.

LESSON 5

Grammar: Modal Verbs.

1 Вспомните, что вы знаете о модальных глаголах, обратите внимание на их эквиваленты:

Present	Past	Future	Эквиваленты
Must- выражает необходимость, обязательность или вероятность, переводится – <i>должен, надо, нужно, вероятно</i>	-----	-----	to have to- <i>должен, вынужден, придется / в силу каких-то обстоятельств/</i> to be to ... <i>должен, нужно / в силу предварительной договоренности, заранее намеченного плана,</i>

расписания/

can – возможность или способность /умственная или физическая/ совершения действия – <i>могу, умею</i>	could -----	to be able to / am, is, are, was, were, shall, will, be able to / - <i>могу, умею, в состоянии, способен</i>
may – разрешение, предположение – - можно, возможно	might -----	to be allowed to ... <i>позволено, разрешено, можно</i>

2 Прочтите предложения, обращая внимание на перевод модальных глаголов в сочетании с Perfect Infinitive, Infinitive Passive.

1. Our age might be called the age of atom. 2. The machine can't be stopped at any moment. 3. Water might be used for shielding, but concrete is more convenient. 4. He may have got the article he needed. 5. Something must have happened to our TV set. 6. He could not have seen this machine.

3 Для грамматического анализа:

1. You should improve you knowledge of English. 2. He has to pay attention to his reading. 3. We are to translate technical texts in the second year. 4. They should be sent all the necessary instructions. 5. You ought to look through the latest magazines before you begin working.

Pre-Text Exercises

1 Постарайтесь запомнить следующие слова и словосочетания из текста.

a rather large period	довольно длительный период
everyday life	Повседневная жизнь
as soon as	как только
mainly	главным образом
mercury	Ртуть

2 Работа над словосочетаниями. Определите части речи, к которым относятся слова, данные ниже:

important, importance, harder, development, mainly, precious, winner, unknown, transformation.

3 Поставьте вопросы к предложению:

People could not use many metals until the 19th century.

4 Прслушайте слова и словосочетания, которые необходимо запомнить.

1. tin	олово
2. silver	серебро
3. copper	медь

Post-Text Exercises

1 Переведите с русского языка на английский:

драгоценный металл, получить металл, древние греки, победитель, главным образом, как только, расширять, получить название, дешевый метод

2 Перескажите текст на русском языке, а затем на английском.

3 Письменно переведите первый абзац текста. Обсудите все вместе качество перевода и выберите лучший вариант.

Text B

4 Ответьте на вопросы по тексту для ознакомительного чтения / вопросы даются после текста /.

It is supposed that gold was the first of all the metals ever used by man. And probably, this was the case everywhere in the ancient world. We may certainly believe this, for beautiful gold rings, ornaments, etc. have been found in ancient tombs /могила/ and buried towns of Egypt, Peru and other places.

Gold is a wonderful metal in many ways. It does not rust like iron. It is easily worked and you can flatten a piece of gold into very thin sheets. You can, also, draw a single grain of gold into a wire over five hundred feet in length.

As you know, gold is a yellow metal, bright and shining when it is polished – the colour of the sun. And that, in fact, is the answer why gold seemed to these ancient folk to be a piece of the sun found on earth. Search for gold / gold hunting / became in later years more important to us than even gold itself has ever been, because it led to the use of the other metals. And that path, which was first made around the earth by the gold seekers, was followed later on by the makers of copper, bronze, iron and steel tools. Copper came after gold.

Questions:

1. What was the first metal used by man?
2. How can we prove that gold was used in ancient times?
3. What can you say about gold?
4. Is gold easily worked?
5. What metal came after gold?

Text C

5 Прочтите, переведите и кратко перескажите этот текст на английском языке.

Perhaps it will not surprise you to learn that copper is a beauty. But few people have really seen it. If you want to see the metal as it really is you must take off its covering. You can do it if you heat it to redness in a glass tube. Then copper will show its beauty. You will see a shining silvery metal delicately tinted with pink, like the petals of a rose.

“Not worth a copper” goes the well-known saying. Yet copper is worth much to the world in this age of Electricity and Light. It is almost as good as silver and much better than iron. When was copper first used? There are many traces of the early use of copper in Europe, Asia, America and Africa. Probably, it was in Egypt, after all, that man first found copper. Perhaps this was 4300 B.C. or so. In early days copper was too sacred, too beautiful and too hard to get from the earth, to use it in poor houses.

LESSON 6

Grammar: Verbals / Participle /.

1 Вспомните формы и функции причастия

Формы причастия

Participle	Active	Passive
Present Participle / participle I /	changing writing	being changed being written
Perfect Participle	having changed having written	having been changed having been written
Past Participle / participle II /	-----	changed written

Функции причастия

		Определение	Обстоятельство
Participle I	Active	A conductor <u>carrying</u> an electric current is surrounded by a magnetic field. <i>Проводник, несущий электрический ток, окружен магнитным полем.</i>	Charged particles moved in curved paths when passing through a strong magnetic field. <i>Заряженные частицы двигались по кривым при прохождении через сильное магнитное поле.</i>
	Passive	The protons of the nucleus <u>being</u> positively <u>charged</u> repel one another. <i>Протоны ядра, которые положительно заряжены, отталкивают друг друга.</i>	<u>Being well insulated</u> the wire may be used as a conductor. <i>Так как провод хорошо изолирован, его можно использовать как проводник.</i>

Participle Perfect	Active		<p><u>Having devised</u> the ultrasonic generator P.Langevin, a French scientist, developed the method for detecting submarines.</p> <p><i>Изобретя ультрозвуковой генератор, П.Лангевин, французский ученый, разработал метод для обнаружения подводных лодок.</i></p>
	Passive		<p>Having been designed in 1931 an electron microscope is by no means a recent invention.</p> <p><i>Электронный микроскоп ни в коем случае не является новым изобретением, так как он был сконструирован в 1931 году.</i></p>
Participle II	Passive	<p>The purpose of electrical source is to produce the necessary electromotive force <u>required</u> for the flow of current through the circuit.</p> <p><i>Цель электрического источника – создать необходимую э.д.с., требуемую для прохождения тока через цепь.</i></p>	<p>Some materials when <u>heated</u>, will generate a continuous flow of electricity.</p> <p><i>Некоторые материалы, когда их нагревают, создают непрерывный поток электричества.</i></p>

2 Изучите таблицу, обратите внимание на функции причастий и на способ их перевода.

Функция	Пример	Перевод
<p>Определение / перед определяемым словом /</p>	<p>1. The <u>improved</u> methods of melting were used at this laboratory.</p> <p>2. There are different types of <u>melting</u> furnaces.</p>	<p>1. В этой лаборатории использовались улучшенные методы плавки.</p> <p>2. Существуют различные типы плавильных печей</p>
<p>Определение / после определяемого слова /</p>	<p>1. A piece of steel <u>heated</u> to a bright cherry red and suddenly <u>chilled</u> becomes very hard.</p> <p>2. The school <u>being built</u> in our street is a large building.</p>	<p>1. Кусок стали, нагретый до ярко-вишневого цвета и внезапно охлажденный, становится очень твердым.</p> <p>2. Школа, которая строится на нашей улице, - большое здание.</p>

Обстоятельство	1. <u>Having read</u> the book I took it to the library. 2. <u>Reading</u> the book he made some notes in it. 3. / <u>While</u> / <u>Going</u> home he met a friend of mine.	1. Прочитав книгу, я отнес ее в библиотеку. 2. Читая книгу, он делал некоторые заметки в ней. 3. Идя домой, он встретил моего друга.
----------------	--	--

3 Изучите таблицу, обратите внимание на независимый причастный оборот, на его место и способы его перевода в предложении.

1. Подлежащее + причастие	Подлежащее + сказуемое
The question being difficult, no one could answer it. Так как вопрос был очень трудным, никто не мог на него ответить.	
2. Подлежащее + сказуемое	Подлежащее + причастие
Pure iron ranks ninth among the metals in degree of malleability, gold being the most malleable metal known. Чистое железо занимает девятое место по степени ковкости среди металлов, причем золото является самым ковким из всех известных металлов.	

4 Для грамматического анализа:

1. Being stronger per unit weight than copper, aluminium is used in most long distance electric power lines .
2. The book having been read was taken to the library.
3. Manganese, phosphorus, sulphur and silicon are the elements separately and distinctly acting on physical properties of the steel.
4. Ecasilicon is the element predicted by Mendelejev and discovered by Winkler, now known under the name of germanium.
5. Oxygen being a very active element, it is difficult to prevent metals from oxidation.
6. Carbon occurs in several allotropic forms, diamonds being crystalline forms of pure carbon.
7. The gas being compressed, the number of molecules in each cubic centimeter is increased.

Pre-Text Exercises

1 Прочтите следующие интернациональные слова, определите их значение:

form, deform, problem, typical, carbon, final, production, control, class, industry, corrosion, deformation.

2 Словообразование: Переведите производные существительные согласно модели:

Модель: основа глагола + ment —————> существительное

to move – двигаться;

movement – движение.

to require – требовать

requirement –

to develop – развивать

development –

to achieve – достигать

achievement –

3 Переведите прилагательные, от которых произошли следующие наречия, выбранные из текста.

widely, increasingly, readily, comparatively.

4 Переведите на русский язык:

1. quantity of carbon

2. pig

cast

white

grey

malleable

} iron

3. to resist shock = to stand shock

4. to cast into desired shape and size

5. in comparison with

6. grades of castings

5 Прослушайте слова и словосочетания для повторения и запоминания:

1. non-ferrous metals

цветные металлы

2. both ... and

как..... так и

3. to possess

обладать / свойствами /

4. elasticity

упругость

5. ductility

пластичность

6. malleability

ковкость, тягучесть

7. toughness

вязкость

8. brittleness

хрупкость

9. hardness

твердость, жесткость

10. wear resistance

износостойкость

11. corrosion resistance

коррозийная устойчивость

12. silicon

кремний

13. ferrous metals

черные металлы

14. to derive

происходить

15. strength

прочность

16. to machine

обрабатывать

17. to resist

оказывать сопротивление

18. to cast

лить / металл /, отливать

19. tool steel

инструментальная сталь

20. manganese

марганец

Text A Ferrous Metals and Alloys

There are two groups of metals: ferrous metals and non-ferrous metals. Both ferrous and non-ferrous metals are known to possess, in some degree, the following properties: elasticity, ductility, malleability, toughness, brittleness, hardness, wear resistance, and corrosion resistance.

Ferrous metals consist of iron combined with carbon, silicon, phosphorous and other elements. Carbon is the most important of all elements present in ferrous alloys. Ferrous metals are now being used in industry in two general forms: steel and cast iron, which differ in the quantity of carbon. These two ferrous alloys are derived from pig iron which is produced in a blast-furnace in the form of pigs.

Steel is iron with a very little carbon content / to 1,7 – 2 per cent / which makes it much stronger than iron and is therefore widely used in machine-building. But very much carbon makes steel brittle, which reduces its strength.

Cast iron contains a higher percentage of carbon / more than 2 per cent /. It is cheapest of all the engineering metals. Cast iron is divided into two classes: white iron and grey iron. When all the carbon in cast iron is in the combined form, the metal has a white metallic appearance. It is therefore called white iron. It is difficult to machine it because most of the carbon present is in the chemical combination with the iron. Almost the only commercial use for white iron is making malleable iron.

Malleable iron castings are being increasingly used in the manufacture of machinery. Many castings that were made of grey iron are now being made of malleable iron. One of the reasons is that malleable iron is much stronger, particularly in the matter of resisting shock. Malleable iron castings are used in agriculture machinery, railroad equipment, automobile parts, and many other products.

Grey iron can be cast into almost any shape and size. The nature of the metal used for grey iron castings is such that castings can be made so hard that ordinary tool steel will not cut them or so soft that they can be readily machined. However, in comparison with other casting metals grey iron is weak and will not stand great shock. The alloy of grey castings is composed of iron, carbon, silicon, phosphorous, manganese and sulphur. These elements are used in different proportions depending on the grade of castings.

Notes and commentary

most of the carbon present	–	большая часть присутствующего углерода
in the matter of resisting shock	–	что касается сопротивления удару
will not stand great shock	-	не выдерживает большого удара

Post-Text Exercises

- 1 Найдите в тексте предложения с причастием. Проанализируйте причастие.**
- 2 Поставьте к тексту 5 вопросов и задайте их друг другу.**

Text B

3 Переведите этот текст письменно со словарем.

Production of castings made from different metals requires different types of melting furnaces. The cupola furnace is usually used for melting grey iron. The air cupola and electric furnaces are used to melt the metal for making malleable iron castings. For melting steel, the open-hearth, crucible or electric furnaces are used. The fuels mostly used for melting metals are coke, coal, oil and gas. Besides the different types of furnaces, different kinds of moulding sand are also required for making the moulds for different metals. In many cases, it is necessary as well to treat either the metals or the castings in some special way before the castings can be used.

Text C

4 Прочтите, переведите и кратко перескажите этот текст на английском языке.

James Watt

James Watt was a Scottish inventor and mechanical engineer, known for his improvements of the steam engine.

Watt was born on January, 19, 1736, in Greenock, Scotland. He worked as a mathematical-instrument maker from the age of 19 and soon became interested in improving the steam engine which was used at that time to pump out water from mines.

Watt determined the properties of steam, especially the relation of its density to its temperature and pressure, and designed a separate condensing chamber for the steam engine that prevented large losses of steam in the cylinder. Watt's first patent, in 1769, covered this device and other improvements on steam engine.

At that time, Watt was the partner of the inventor John Roebuck, who had financed his researches. In 1775, however, Roebuck's interest was taken over by the manufacturer Matthew Boulton, owner of the Soho Engineering Works at Birmingham, and he and Watt began the manufacture of steam engines. Watt continued his research and patented several other important inventions, including the rotary engine for driving various types of machinery; the double-action engine, in which steam is admitted alternately into both ends of the cylinder; and the steam indicator, which records the steam pressure in the engine. He retired from the firm in 1800 and thereafter devoted himself entirely to research work.

The misconception that Watt was the actual inventor of the steam engine arose from the fundamental nature of his contributions to its development. The centrifugal or flyball governor, which he invented in 1788, and which automatically regulated the speed of an engine, is of particular interest today. It embodies the feedback principle of a servomechanism, linking output to input, which is the basic concept of automation. The watt, the unit of power, was named in his honour. Watt was also a well-known civil engineer. He invented, in 1767, an attachment that

adapted telescopes for use in the measurement of distances. Watt died in Heathfield, near Birmingham, in August 1819.

LESSON 7

Grammar: Verbals / Gerund /

1 Вспомните формы герундия

	Active	Passive
Indefinite	solving	being solved
Perfect	having solved	having been solved

2 Обратите внимание на функции герундия и на способы его перевода

Функция	Пример	Перевод
Подлежащее	Reading is his hobby.	Чтение – его любимое занятие
Часть глагольного сказуемого	She started asking him different questions.	Она стала задавать ему разные вопросы
Часть именного сказуемого	His hobby is swimming.	Его любимое занятие – плавание
Дополнение	This machine needs repairing.	Эта машина нуждается в ремонте
Определение	The best way of remembering new words is repeating them from time to time.	Лучшим способом запоминания новых слов является повторение их время от времени
Обстоятельство	You will never be able to translate correctly without knowing grammar well.	Вы никогда не сможете правильно переводить, не зная хорошо грамматики

3 Обратите внимание на герундиальный оборот, на способы его перевода в предложении

1 I did not know of his having been sent to Moscow.

Я не знал о том, что он был послан в Москву.

2 Her having left for Moscow was unexpected.

То, что она уехала в Москву, было неожиданно.

4 Для грамматического анализа:

1. We know of the ancient Greeks having used mercury / ртуть / in medicine.

2. Without knowing chemistry it is not always easy to make clear the distinction between chemical continuation and physical changes.

3. By doing this over and over again, they learned that different substances have different boiling points and that liquids mixed together can be separated by controlling the temperature of the boiling mixture.
4. You should carry on this experiment without interrupting it.

Pre-Text Exercises

1 Прочтите интернациональные слова, определите их значение:

operation, part, material, process, metal, industry, per cent, steel, product, method, minimum, physical, energy, fact.

2 Словообразование. Определите прилагательные, от которых произошли следующие наречия:

ultimately	в конечном счете
extensively	широко
gradually	постоянно
roughly	грубо
comparatively	сравнительно

3 Работа со словарем. Расположите следующие слова в алфавитном порядке и установите с помощью словаря, к каким частям речи они относятся.

effort, to free, way, modern, satisfactory, standpoint, scale, basic, severe, further, top.

4 Дайте словарную форму следующих слов и переведите их / существительные дайте в единственном числе, глагол – в неопределенной форме, прилагательные – в положительной степени /.

used, know, dates back, became, is, divided, discovered, more, stronger, making, possesses, classified, called, tools, making, better.

5 Прослушайте слова и словосочетания для повторения и запоминания:

1. article	предмет, изделие
2.to occur	происходить, случаться
3.age	век
4.plentiful	обильный
5.expensive	дорогой
6.to displace	вытеснять, вымещать
7.content	содержание
8.to contain	содержать в себе, вмещать
9.alloy steel	легированная сталь
10.carbon steel	углеродистая сталь
11.alloying element	легирующая добавка

12.sufficient	достаточный
13.to impart	давать, придавать
14.self-hardening steel	самозакаливающаяся сталь
15.raw material	сырье

Text A

Steel

The most useful metal known to people today is steel. It is part of anything we make. Our buildings, machines, roads, transport are all depend on steel. It is our shoes, our watches and thousands of everyday articles.

Metal does not occur freely in nature. Instead, we must manufacture it by a number of complex operations.

While the use of iron dates back to ancient times, the story of steel is the story of this industrial age. Only a century ago people discovered a method of mass producing steel. Thereafter steel became plentiful and expensive, displacing iron as the most useful metal at man's disposal.

As a nation grows, so its industries and its people need more and more steel. Steel is the basic raw material of modern industry. The ability to make steel is a sure measure of national development.

Steel is a ferrous material with some carbon content. There are two kinds of steel: carbon and alloy steel.

Carbon steel should contain only iron and carbon without any other alloying elements and is divided into: machine steel with a low carbon content from 0.05 to 0.60 per cent, it is very soft and can be used for making machine parts that do not need strength; medium carbon steel with a carbon content from 0.15 to 0.60 per cent; it is of better grade and stronger than machine steel; tool steel with a high carbon content from 0.6 to 1.15 per cent, it is used for manufacturing tools and working parts of machines because of the high strength and hardness. Carbon steel is the most common steel used in industry.

Alloy steels are those in which in addition to carbon one or more alloying elements are present in sufficient quantity to impart certain properties. Alloy steels are divided into special alloy steels and high-speed steels, which are called self-hardening steels. Alloying elements of these steels are: nickel, chromium, manganese, etc. These alloying elements have a definite effect on the characteristic of steel.

Steel possesses definite properties which can be classified as physical, mechanical and technological.

Notes and commentaries

dates back to	- берет начало
at man's disposal	- в распоряжении человека
a sure measure	- верный критерий

Post-Text Exercises

1 Найдите в тексте предложения с герундием, переведите их письменно, проанализируйте герундий.

2. Ответьте на следующие вопросы:

1. What is steel?
2. What are the two kinds of steel mentioned in the text?
3. What kind of steel is the most common steel used in industry?
4. What properties does steel possess?

Text B

3 Ознакомьтесь с текстом и перескажите его на родном языке

Atomic Steel

Japan's Atomic Energy Research Institute is looking into the possibility of using nuclear power to produce steel. The process under consideration would employ a high-temperature gas-cooled experimental reactor / HTGR /, capable of providing operating temperatures of 750 to 900 degrees centigrade – near the range required for making steel. Heat from the HTGR would be used to bring reducing gas to a high enough temperature to cause it to react with iron ore in a reduction furnace – the first step in converting ore to steel. The sponge iron from that process would then be treated in an electric furnace possibly with electric power also supplied by the HTGR, and then transformed into steel. If it works, the HTGR process could prove a major boon in the steel industry's efforts to overcome the twin problems of energy supply and pollution. It could also substantially reduce production costs for molten steel.

Commentary

to cause it to react - чтобы заставить его вступать в химическую реакцию
could prove a major boon – мог бы оказаться огромным достижением
if it works - если это осуществится

Text C

4 Прочтите, переведите и кратко перескажите этот текст на английском языке.

Steel

The most important metal in industry is iron and its alloy – steel. Steel is an alloy of iron and carbon. It is strong and stiff, but corrodes easily through rusting,

although stainless and other special steels resist corrosion. The amount of carbon in a steel influences its properties considerably. Steels of low carbon content are quite ductile and are used in the manufacture of sheet iron, wire, and pipes. Medium-carbon steels containing from 0.2 to 0.4 per cent carbon are tougher and stronger and are used as structural steels. Both mild and medium-carbon steels are suitable for forging and welding. High-carbon steels contain from 0.4 to 1.5 per cent carbon, are hard and brittle and are used in cutting tools, surgical instruments, razor blades and springs. Tool steel, also called silver steel, contains about 1 per cent carbon and is strengthened and toughened by quenching and tempering.

The inclusion of other elements affects the properties of the steel. Manganese gives extra strength and toughness. Steel containing 4 per cent silicon is used for transformer cores or electromagnets because it has large grains acting like small magnets. The addition of chromium gives extra strength and corrosion resistance, so we can get rust-proof steels. Heating in the presence of carbon or nitrogen-rich materials is used to form a hard surface on steel (case-hardening). High-speed steels, which are extremely important in machine-tools, contain chromium and tungsten plus smaller amounts of vanadium, molybdenum and other metals.

LESSON 8

Grammar: Verbals. Participle. Gerund. / Review /.

1 Сводное упражнение на “-ing”-forms. Определите неличную форму глагола в следующих предложениях. Переведите на русский язык.

1. Because of its being expensive silver is not widely used in industry. 2. After conducting many experiments to find a solution of the problem, the scientists made the first successful device. 3. The substance being heated, the motion of the molecules increases. 4. The semiconductor diode being a very important device of modern science is common knowledge. 5. Problem solving is not only a means of testing knowledge; it is also a means of acquiring knowledge in useful forms.

Pre-Text Exercises

1 Переведите следующие словосочетания из текста с помощью словаря.

Middle Ages, in the second half, high grade steel, cheap steel, that's why, mechanical qualities, in one's honour, regular studies.

2 Переведите на русский язык:

to alloy, to add, to lead (led, led), to do much, to be engaged in, to cope with, to work hard, to become interested in, to examine, to appear, to look like.

3 Словообразование. Переведите производные слова согласно модели.

Модель: основа глагола + ing

to melt – плавить;

melting – плавка

to work – working; to chill – chilling; to examine – examining.

4 Прослушайте слова и словосочетания для повторения и запоминания:

1. to appear	появляться
2. grade	качество, сорт
3. sword	меч
4. to present /to/	представлять /кому-то/
5. to examine	осматривать
6. to alloy	легировать /сталь/
7. to look very much like	быть очень похожим
8. to cope with a problem	справиться с проблемой
9. addition	добавка
10.unsuccessful	неуспешный
11.various	различный
12.contribution	вклад
13.to be engaged in	быть занятым в
14.to turn to	обратиться к
15.acid	кислота

Text A

From the History of Steel

Everybody knows that the oldest and best steel is the bulat steel. It is strong and plastic. There is information that even before 1300 B.C. people could make this kind of steel in India, Persia, Syria and Egypt. In the Middle Ages they made steel in Damascus and Japan. So, the other name for the bulat steel is Damascus steel.

In the second half of the 18th century with the Industrial Revolution there appeared the production of big machines. People needed much high grade and cheap steel for machine-building. That's why they began to study different steels, their properties. Scientific research led to the appearance of a special science about metals.

In 1820 Robert Scott traveled about India. He got interested in Indian steel and bought in Bombay an Indian sword. He brought the thing to England and presented it to the London Royal Society. Michael Faraday, the well-known English scientist, who was an expert in experimental research, began to examine the Indian steel. Chemical analysis showed that there was aluminium in the steel. The new alloy looked very much like the bulat steel but the great English scientist could not cope with the difficult problem.

In 1828 Russian metallurgist P.P.Anosov learnt about Faraday's experiment. He also started his research with "magic" additions. He added to steel silver, gold, platinum, and even diamond, but – no good results. These unsuccessful

experiments led to the systematic regular studies of various alloys. Anosov's contribution to metallurgy was great.

Anosov did much for the development of metallurgy as a science. He was engaged in experimental work for many years and then turned to the theoretical study of steel production.

Anosov was the first to use microscope for examining the structure of metals and alloys. He used an acid to see the complex structure of bulat steel. He coped with the problem and understood how the structure of a metal is connected with its mechanical qualities. He worked hard for 5 years and rediscovered the real bulat steel in 1833. The secret was not only in the components of the steel but in the specific technological process. The results of his ten year studies P.P. Anosov published in 1841 in his first book "On Damascus steel". The book was immediately translated into French and German. Many foreign scientists became interested in Anosov's work.

Post-Text Exercises

1 Найдите в тексте слова с –ing формами. Определите вид неличной формы / причастие или герундий /.

2 Ответьте на вопросы по тексту:

1. What do you know about the bulat steel?
2. When and why did people begin to study different steels?
3. Who made different experiments with steel?
4. What contribution did Anosov make to metallurgy?
5. What book did Anosov publish in 1841?

Text B

3 Переведите текст письменно с помощью словаря. Напишите аннотацию на русском языке.

Production of Steel

Converter steel is made from molten pig iron by forcing a blast of cold air under great pressure through the metal. The converter represents a large tank made of steel and covered with refractory bricks with an open top through which the molten metal is poured into the converter and out of it. When forcing the blast of cold air through the melted metal, the oxygen contained in the air combines with the carbon of the pig iron, and almost all the carbon in the metal is burnt out. Steel made by this method is very cheap, but it is low grade steel because this method of producing steel cannot be well controlled.

Steel made in this way is called "Bessemer steel". One ton of such steel can be made in one minute.

Text C

4 Прочтите, переведите и кратко перескажите этот текст на английском языке.

P.P. Anosov continued making numerous experiments aimed at investigating the effects of various alloying elements on the properties of steel. Thorough investigations having been completed, P.P. Anosov developed a method for the production of special steel which combined the properties of great toughness and ductility with extreme hardness, thus initiating the production of high-quality steel. We also know of Anosov's having devoted great attention to the physical structure and chemical composition of steel and also of his having used the microscope for the investigation of the structure of metal, this method being then quite novel.

Microscopic examination of metals being a success, investigators have made it the basis of modern metallurgy.

LESSON 9

Grammar: Verbals / Infinitive /

1 Вспомните формы инфинитива

	Active	Passive
Indefinite	to help	to be helped
Continuous	to be helping	-----
Perfect	to have helped	to have been helped
Perfect Continuous	to have been helping	-----

2 Обратите внимание на функции инфинитива и на способы его перевода

Функция	Пример	Перевод
Подлежащее	<u>To read</u> English texts is my great desire.	Читать английские тексты – мое большое желание
Часть составного сказуемого	His task was <u>to learn</u> a new process.	Его задача состояла в том, чтобы изучить новый процесс
Дополнение	I like <u>to read</u> English books.	Мне нравится читать английские книги
Определение	There are different methods <u>to obtain</u> castings.	Существуют различные методы получения отливок
Обстоятельство	<u>To make</u> this report he read many articles.	Чтобы сделать этот доклад, он прочел много статей.

3 Обратите внимание на инфинитивные обороты и на способы их перевода в предложении / Сложное дополнение. Сложное подлежащее /

1. I want you to read an article about metals.

Дополнение + инфинитив = объектный инфинитивный оборот

Я хочу, чтобы вы прочитали статью о металлах.

2. He is said to read much about metals.

Подлежащее + инфинитив = субъектный инфинитивный оборот

Говорят, что он много читает о металлах.

4 Для грамматического анализа:

1. This method of casting metals is said to be the best one. 2. I want him to tell me about an electric furnace. 3. The students wanted to be given the necessary information about metals and alloys. 4. Gold and silver are believed to have been used by the ancients prior to any other metal. 5. We can expect any compound to contain no less than two different elements. 6. We see substances possess different properties. 7. Many devices to measure different properties of substances are used in our laboratories. 8. To measure pressure is often very important.

Pre-Text Exercises

1 Установите словарную форму следующих слов из текста

oldest, known, cheapest, does, desired, made, shapes, heated, cooled, changes, called.

2 Дайте значение следующих выражений

grey cast iron, white cast iron, to cast into molds, intricate shapes, alloying elements, to improve hardness, wear resistance, malleable cast iron, to remove castings.

3 Прослушайте слова и словосочетания для повторения и запоминания

1. cast iron	чугун
2. to cast	отливать
3. solid	твердое тело
4. grey cast iron	серый чугун
5. white cast iron	белый чугун
6. pig iron	чугун в чушках, чушковый чугун
7. malleable cast iron	ковкий чугун
8. to improve	улучшать
9. fast	быстро
10. mold = mould	литейная форма
11. wear resistance	износостойкость
12. casting	отливка
13. to anneal	обжигать, отпускать
14. furnace	печь
15. ductile	пластичный, ковкий

Text A

Cast Iron

Cast iron is one of the oldest ferrous alloys known to man. It is the cheapest of the ferrous metals and must be cast into shape as it does not possess the necessary plasticity to form it into desired shapes by plastic methods when in the solid state.

There are many variations in the structure and physical properties available in so-called "cast iron". However, we may classify all cast irons into three groups: grey cast iron, white cast iron and malleable cast iron.

Grey cast iron constitutes one of the most valued cast metals. It may be made by melting pig iron and scrap in the cheapest of melting processes, the cupola, and then cast into molds forming intricate shapes that may vary from a few grams to many tons on weight. Many grey cast irons are now cast with the addition of some alloying elements, such as nickel, copper, molybdenum, chromium. The alloys are used to improve the strength and hardness of the castings.

White cast iron has practically all of its carbon in the combined state as cementite. If white cast iron were slowly cooled in the molds it would have a structure of ferrite and free carbon in the form of graphite. If cast iron were cooled relatively fast in the molds it would have a structure of martensite and cementite. This improves hardness and wear resistance of the castings.

Malleable cast iron is made by a process of annealing a hard, brittle white cast iron. A white iron casting is placed in a furnace and slowly heated to 1550-1600⁰ F, which usually requires two days. Then the cast metal is cooled slowly until the heat reaches 1200⁰F. At this temperature the door of the furnace may be opened and castings removed to cool in air. This treatment changes the hard brittle white cast iron into soft, ductile product called malleable cast iron. This form of cast iron finds many applications.

Notes and commentaries:

cast	лить металл
cast iron	чугун
intricate shape	сложная форма
cementite	цементит
ferrite	феррит
martensite	мартенсит

Post-Text Exercises

1 Найдите в тексте инфинитивы. Укажите их формы и функции.

2 Ответьте на вопросы по тексту:

1. What are the three groups of cast irons?
2. What is important to know about grey cast iron?
3. What is cementite? What is martensite?
4. By what process is malleable cast iron made?

3 Расскажите на английском языке о классификации чугунов.

Text B

4 После ознакомительного чтения текста ответьте на вопросы, данные ниже. Письменно переведите описание печи.

Pig iron is mainly used in the production of steel in the Bessemer furnace, Martin furnace, and electric furnaces. Pig iron contains impurities which may be harmful in steel, so a process of steelmaking consists in the removal of the impurities by oxidation. The oxidation is accomplished either by the oxygen of the air or by adding some oxidizing agent. The carbon present in the pig iron is oxidized to CO₂ which escapes in the furnace gases, whereas the other impurities are oxidized to compounds which will unite with the slag. Wrought iron produced by the puddling process, is used for the production of steel by the crucible process, but both processes are rarely used today. The Bessemer furnace, in which the refining action is accomplished, is a large, pear-shaped steel shell lined with fire brick. This shell or converter is tilted on its side during the charging of pig iron, after which a blast of air is turned on through holes in the bottom /"tuyeres"/, and the converter is returned to an upright position. When the impurities have been oxidized, the blast is immediately turned off, and the heat is ready. Then the heat is recarburized by the addition of some alloys, as during the blast some of the iron was inevitably oxidized, and the recarburized serves to remove the oxygen.

1. What kinds of impurities does pig iron contain?
2. How does the removal of the impurities take place?
3. What kind of furnace is the Bessemer furnace?

Text C

5 Прочтите диалог и перескажите его по-английски:

- Could you explain me the difference between pig iron and cast iron?
- Certainly. First of all, keep it in mind that those notions do not correspond to the Russian «перелитый чугун» and «литейный чугун» respectively, since pig iron may be produced for both steelmaking and casting. Just when the pig iron has been remelted it is known as cast iron.

- And what is the difference between grey iron and white iron?

- You see, it depends on the form of carbon which the iron contains.

You must know that the irons have above 2,0% carbon which can exist in them in two forms; /1/ as free carbon or graphite which is soft weak and bulky and produces a grey fracture; or /2/ as combined carbon or cementite / Fe₃C/ which is hard and brittle, and produces a white fracture.

As a rule, the pig iron smelted for casting is grey. It readily fills moulds and easily yields to working by cutting tools. You must also remember that silicon is a strong graphite stabilizer in pig iron, whereas phosphorus makes it fluid – both qualities are valued in the foundry.

As to the pig iron smelted for steelmaking, it is usually white.

- No more questions. Thank you for your information.

Commentary

grey /white/ iron

- серый /белый/ чугун

fracture

- излом

to yield to working by cutting tools

- поддаваться обработке режущим инструментами

strong graphite stabilizer

- сильный графитообразующий

fluid

- текучий

foundry

- литейный цех

LESSON 10

Grammar: Adverbial Clauses of Condition

1 Вспомните 3 типа условных предложений. Обратите внимание на перевод глагольной формы в главных и придаточных предложениях трех типов.

I тип	II тип	III тип
Реальные условия, относящиеся к настоящему и будущему времени	Малореальные условия, относящиеся к настоящему и будущему времени	Нереальные условия, относящиеся к прошедшему времени
If he <u>knows</u> about the production of castings, he <u>will tell</u> me about it.	If he <u>knew</u> about the production of castings, he <u>would tell</u> me about it now.	If he <u>had known</u> about the production of castings, he <u>would have told</u> me about it yesterday.
Если он знает о производстве отливок, он расскажет мне о нем.	Если бы он знал о производстве отливок, он рассказал бы мне о нем сейчас.	Если бы он знал о производстве отливок, он рассказал бы мне о нем вчера.

2 Для грамматического анализа:

1. If you have time, you will tell me about powder metallurgy and its role in the automobile industry. 2. He would have answered your questions if he had been present at the lecture on non-ferrous metals and their properties. 3. If you came tomorrow I should give you a book about different castings. 4. Had you given me the book about castings yesterday, my report would have been much better. 5. If I were here I should tell you more about non-ferrous alloys. 6. If you had read the article, you would have known much interesting about the steels used in industry. 7. I shall make the report on non-ferrous alloys on condition that you help me.

Pre-Text Exercises

1 Прочтите следующие интернациональные слова и словосочетания и определите их значения:

metallurgical methods, traditional, structural, critical, cycle, powder metallurgy, type, porous, dynamic, operation, component.

2 Словообразование. Дайте перевод следующих слов как существительных и как глаголов. Обратите внимание на чтение слов.

work – to work

cast – to cast

use – to use

light – to light

part – to part

alloy – to alloy

3 Прочтите текст А из урока 10 и постарайтесь правильно выбрать один из ответов на поставленные вопросы

1. What metals are more expensive?

- a) non-ferrous metals;
- b) ferrous metals.

2. What do you know about copper?

- a) it is a reddish-brown metal;
- b) it has low electrical conductivity;
- c) it has not very high corrosion-resistant qualities;
- d) it is used for making electrical contacts and wires.

3. What properties does aluminium possess?

- a) it is a hard metal;
- b) it is light in weight;
- c) it is used for automobile and airplane parts;
- d) it has low corrosion-resistant qualities.

4. What do you know about nickel?

- a) it is a soft metal;
- b) it has high corrosion-resistant qualities;
- c) it is a silvery metal.

4 Прослушайте слова и словосочетания для повторения и запоминания.

1. to contain

содержать

2. tin

олово

3. expensive

дорогой, дорогостоящий

4. to require

требовать

5. to cast

лить /металл/

6. thermal conductivity

теплопроводность

7. frequently

часто

8. lead

свинец

9. reddish	красноватый
10. quality	качество
11. wire	проволока, провод
12. brittle	хрупкий
13. to employ	использовать
14. pure	чистый
15. sheet	лист
16. soft	мягкий
17. low	низкий
18. lining	прокладка

Text A

Non-Ferrous Metals

Some non-ferrous metals do not contain iron, such as copper, nickel and tin. Other metals and alloys in which iron may be present but not in the principal proportion are also classed as non-ferrous.

Non-ferrous metals are more expensive than ferrous ones. They are used, therefore, only where special properties are required. Most non-ferrous metals have better resistance to corrosion than steel; they are usually more easy to cast and to work, some of them have especially high thermal and electrical conductivity or light weight, etc.

The metals most frequently used to make non-ferrous metal casting are copper, tin, zinc, lead, nickel, gold and aluminium.

Copper is a reddish-brown metal. It has very high electrical conductivity and high corrosion-resistant qualities. Its electrical conductivity is higher than that of any other metal except the much more expensive silver. Copper is used for making electrical contacts and wires, pipes, telephone cables, etc.

Zinc is a hard, brittle, bluish-white metal that is employed in the pure form as sheet zinc.

Lead is a very heavy bluish-grey metal which is very soft. This metal is highly resistant to corrosion, but its strength is so low that it must be supported by a core of some other metal. Lead is used for lining pipes, acid tanks, etc.

Aluminium is a soft silvery white metal. It is light in weight, has high corrosion-resistant qualities and is used for automobile and airplane parts as well as for making different light-weight objects-frames, chairs, etc.

Tin is a silvery, corrosion-resistant metal. It is hardly used in pure form, but is employed as an alloying element.

Nickel is a hard silvery metal. It has high corrosion-resistant qualities and is used for plating iron, steel, brass, and other base metals. The thickness of nickel is often 0.0003 in. for plating on brass and 0.001 in for plating on steel.

The above-mentioned non-ferrous metals may be mixed in various proportions to form many alloys.

Post-Text Exercises

1 Ответьте на следующие вопросы:

1. Do non-ferrous metals contain iron?
2. Are non-ferrous metals more expensive than ferrous ones?
3. What metals are most frequently used to make non-ferrous metal castings?
4. What properties does copper possess?
5. What is lead used for?
6. What is aluminium used for?
7. Is tin used in pure form?
8. What is nickel used for?

Text B

4 Переведите текст письменно с помощью словаря. Напишите аннотацию на русском языке.

Non-Ferrous Alloys

Non-ferrous alloys are nearly all alloys which have been developed to meet the specialized needs of industry. They have been grouped according to their dominant element.

Copper-base alloys are used where high thermal or electrical conductivity is the chief requirement.

Aluminium-base alloys are used where light weight is primary requirement. They are also used because of their resistance to corrosion. Besides, aluminium-base alloys have desirable combinations of mechanical properties with thermal and electrical conductivity.

Castings made of magnesium-base alloys are used where light weight is needed.

Brasses are yellowish or reddish alloys of copper and zinc in different proportions. An addition of tin makes brasses stronger. Brasses are very ductile and may be treated without heating them. They are used for making musical instruments, etc. The usual brasses contain about 67% copper and 33% zinc. These alloys have good resistance to corrosion as well as good finish, good casting qualities, and machinability. About 3% lead may be added to make brass more machinable.

Bronze is an alloy containing primarily copper and tin. The most common bronzes are known as straight bronze, phosphor bronze and manganese bronze.

There are also lead-base alloys, tin-base alloys, zinc-base alloys and nickel-base alloys.

All non-ferrous castings will take a high polish and will not rust so easily as the ferrous metals, a characteristic that makes them especially useful in wet or damp places.

Text C

5 Прочтите текст и постарайтесь понять его основное содержание. Ответьте на ключевые вопросы по его содержанию.

Nickel, a hard, silvery-white metal, was known in Greece and India, but it was probably quite rare. It really did not come into general use until the 16th century in Germany where it got its name of nickel which means “old Nick” or “demon”. It was so called because it was difficult to work.

Zinc, a white metal, which we use today in a hundred ways was not known in the ancient world. It was almost in modern times that pure zinc was first made in Germany. We use zinc for making brass today. But, perhaps, the use of zinc to protect steel and iron is more important nowadays. There are several ways in which this is done. For example, it can be applied to metal as lead, that is in the form of paint.

Then there is a rather crude method of applying zinc to iron. It consists in spaying the iron with molten zinc.

All the metals seemed mysterious /тайнственный/ to the ancients. They were terribly afraid of them.

It seems that the alchemists were the first to take up the study of metals in the mediaeval /средневековый/ times. During the 12th and 13th centuries many alchemists lived and worked in England, France and Germany. They usually worked alone. They had two aims: to change base metal into gold, and to find an elixir of life, a drink that would keep people young. The alchemists, to a great extent, were the forefathers of the modern science.

Scientists today say that the world is made up of one hundred simple elements. Now we know a great deal about them; not only what they are but how to combine them with hundreds of other metals to make alloys.

Questions:

1. When did nickel come into general use?
2. Where was pure zinc first made?
3. What was the attitude of the ancients towards all the metals?
4. Do you know a crude method of applying zinc to iron?
5. What do you know about the alchemists of the 12th and the 13th centuries?

LESSON 11

1 Прочтите интернациональные слова и переведите их:

metal, production, product, industry, method, complex, machine, mechanical, ceramic material, temperature, assembly, to classify, group, hydraulic.

2 Запомните следующие слова и словосочетания:

metal casting	металлическая отливка
sand casting	литье в землю
foundry	литейное производство

furnace mold /mould/ sand mold /mould/ to solidify owing to in most cases specified manufacturing tolerances refractory heat-resisting material surface finish smooth rough coarse sand fine sand to pour die casting	печь, литейная форма, изложница песочная форма затвердевать благодаря /чему-то/ во многих случаях установленные производственные допуски огнеупорный материал теплоустойчивый материал отделка, окончательная обработка поверхности гладкий, ровный неровный, шероховатый крупный /крупнозернистый/ песок мелкий /мелкозернистый/ песок разливать литье под давлением
--	---

Text A

Metal Casting

Metal Casting - A Basic Manufacturing Process

One of the basic processes of the metal-working industry is the production of metal castings. Numerous methods have been developed through the ages for producing metal castings, but the oldest method is that of making sand castings in the foundry. Primarily, work consists of melting metal in a furnace and pouring it into suitable sand molds, where it solidifies and assumes the shape of the mold. However, the operation of making sand castings is not as simple as it seems.

The foundry industry has developed slowly but steadily through the centuries. At present, however, the industry is going through a process of rapid transformation, owing to modern development of new technological methods, new machines, and new materials.

There are few metal-working industries that do not use castings of one or more kinds. Most castings serve merely as details or component parts of complex machines and products. In most cases, they are found usable only when they are machined and finished to specified manufacturing tolerances, providing easy and proper assembly of the product.

Development of Metal-Casting Methods

Metal-casting methods may be classified into three groups, depending upon the type of mold used and the manner in which the molten metal introduced into the mold.

The mold may be made from a refractory or heat-resisting material, such as sand, some suitable ceramic material, or plaster. Such molds are used only once. The kind of material, chosen to make the mold, is determined primarily by the melting temperature of the cast metal. Other factors involved are the porosity of the

molding material, i.e., the ability to transmit air and gases, and the type of surface finish desired for the product. For example, to obtain a product with smoother finish a finer molding sand is needed; for rougher finish a coarser molding sand is needed.

Molten metals may be poured into the mold by gravity or by pressure. The latter method is known as die casting. Die-casting may be furnished by air, hydraulic means, mechanical means or centrifugally.

Post-Text Exercises

1 Дайте русские эквиваленты:

numerous methods; the oldest method; to assume the shape of the mold; through the centuries; owing to modern development; in most cases; specified manufacturing tolerances; easy and proper assembly; the porosity of the molding material; the ability to transmit; smoother finish; rougher finish; hydraulic means; mechanical means.

2 Дайте английские эквиваленты:

принимать форму изложницы, операция получения песочной формы, благодаря современному развитию, во многих случаях, обеспечивая легкую и правильную сборку изделия, в зависимости от типа литейной формы, способность передавать, формовочный песок, литье под давлением.

3 Ответьте на следующие вопросы:

1. What is the oldest method of producing metal castings? 2. What is the use of castings? 3. How can metal casting methods be classified? 4. Will you describe the operation of making sand castings? 5. What material is used for making the mold? 6. What can you say about die casting?

4 Закончите предложения фразами из текста А.

- 1 One of the oldest methods of metal casting is that of
- 2 Work consists of
- 3 Castings serve as
- 4 Metal-casting methods may be classified depending upon ...
- 5 The mold may be of ...
- 6 Die casting is characterized by

5 Прочтите текст В и переведите его без словаря. Передайте краткое его содержание на английском языке, используя разговорные клише:

it is well-known that
it is possible to say ...
in my opinion
as far as I know
it is important to say

Text B

Casting

Casting is the process of forming metal objects by melting metal and pouring it into molds. Wrought metal products differ from cast metal products. Practically all metal is initially cast. Castings obtain their shape principally when molten metal solidifies in the desired form. Wrought objects, however, are cast as ingots and then plastically worked to the desired shape.

Metal-casting processes have certain advantages in comparison with some other shaping processes. Metal casting is highly adaptable to the requirements of mass production. Large number of castings may be produced very rapidly. The use of castings in the automotive industry provides ample illustration of this point. Extremely large heavy metal objects may be cast when it is difficult or economically impossible to produce them otherwise.

6 Передайте содержание текста С на русском языке

Text C

Continuous Casting of Steel

Continuous casting of steel is a process in which liquid metal is poured into the mould from the lower end of which a partially solidified ingot is continuously withdrawn. The cast ingot is, when completely solidified, cut into lengths. Continuous casting simplifies conventional steel making process by eliminating several operations and much costly equipment.

The quality of continuous cast material is superior to that produced by normal method. The surface of an ingot is better and surface conditioning is not normally required, even on highly alloyed steels. In most cases the reduction of operating costs is about 10 per cent of the present cost of semi-finished billets and slabs. Such savings have a profound effect on the economics of production.

Notes:

wrought metal objects	изделия, обработанные давлением
desired form /shape/	нужная форма
ingot	слиток
shaping process	формовочный процесс

LESSON 12

1 Прочтите интернациональные слова и переведите их:

proportion, model, modern, to form, type, process, permanent, practical, gravity, graphite, structure, technique, ingredient.

2 Запомните следующие слова и словосочетания:

sand molding	почвенная формовка, формовка в почве
mold material	формовочный материал
grade	сорт
cohesion	сцепление, связность
to pack	уплотнять

depression } cavity } }	углубление, полость
permanent mold	постоянная форма
modern technique	современная техника /технология/
to make it possible	делать возможным
low-melting temperature metals	легкоплавкие металлы
higher-melting temperature metals	тугоплавкие металлы
with the aid	с помощью
to withstand	выдерживать
screw	винт
core	стержень
hollow space	пустое пространство
dimensional accuracy	точность по размеру
pressure	давление

Text A

Molding

Sand Molding

Among the mold materials sand is used more often since it can be packed to any required shape with small effort. Of course, the proper grade of molding sand must be selected, and the ingredients with which the sand is mixed must be used in prescribed proportion in order to obtain necessary cohesion. The pattern or model of the object to be cast is placed into a box. The sand is molded by packing it around the pattern of the object. When the pattern is withdrawn from the sand a depression or cavity is formed.

Most castings are produced in sand molds, since this method of production is relatively simple, inexpensive, and is not limited to any particular type of metal or to certain sizes and shapes of castings. Of courses molds are used only once, and each casting requires a new mold.

Metal Molding

The use of the permanent type of mold made from steel, iron, or any other suitable metal is greatly desired.

However, in processes which use permanent molds, some difficulties are presented which are not easily to overcome. Because of these difficulties, use of molds of this type is limited. Large castings are difficult to produce in permanent molds. Permanent metal molds are practical for large production of small – and medium-size castings more or less of simple shape, made from low-melting-temperature nonferrous metals and their alloys. Modern technique makes it also possible to cast higher-melting temperature metals with the aid of permanent molds.

Metals used to make permanent molds must be carefully selected to withstand high temperatures. Steel molds, coated with refractory material such as graphite, may also be successfully used for production of iron and steel castings.

The metal molds are usually made in two parts which are either clamped together or closed by a screw or other suitable device. If necessary, cores made of

metal or sand are employed to form hollow spaces in the casting. If metal cores are used, they should be removed as soon as the casting begins to solidify. The molten metal may be introduced into the mold by gravity or pressure.

Castings made in metal molds have greater dimensional accuracy than sand castings. They are also strong and have good structure. They can be re-used.

Post-Text Exercises

1 Переведите следующие словосочетания, выбранные из текста :

the proper grade; in order to obtain; required shape; because of these difficulties; permanent molds; small- and medium-size castings; low- melting- temperature metals; higher-melting temperature metals; with the aid of permanent mold; to withstand high temperatures; in most cases; as soon as; dimensional accuracy.

2 Найдите английские эквиваленты:

- | | |
|------------------------------------|----------------------------------|
| 1. почвенная формовка | 1. to mold |
| 2. постоянная форма | 2. core |
| 3. формовать | 3. grade |
| 4. стержень | 4. cavity |
| 5. необходимое сцепление | 5. permanent mold |
| 6. точность по размеру | 6. to withstand high temperature |
| 7. огнеупорный материал | 7. sand molding |
| 8. полость | 8. refractory |
| 9. выдерживать высокую температуру | 9. dimensional accuracy |
| 10. сорт | 10. necessary cohesion |

3 Переведите производные существительные от глаголов:

- | | |
|----------------------------------|-------------|
| to mold - формировать | molding - |
| to pack - уплотнять | packing - |
| to cast - отливать | casting - |
| to finish - обрабатывать начисто | finishing - |
| to use - использовать | using - |
| to make - производить | making - |

4 Просмотрите текст и выберите из следующих утверждений те, которые соответствуют его содержанию:

1 Most castings are produced in

- a) loan molds;
- b) sand molds;
- c) permanent molds.

2 Permanent metal molds are practical for large production of ...

- a) large-size castings;
- b) complex shape castings;
- c) small-and-medium size castings.

3 Sand molds are used ...

- a) only once;
- b) twice;
- c) many times.

4 Large castings are difficult to produce in

- a) sand molds;
- b) permanent molds;
- c) steel molds.

5 Metals used for permanent molds must withstand ...

- a) low temperatures;
- b) severe stresses;
- c) high temperatures.

5 Сделайте краткое сообщение на русском или английском языках по основному содержанию текста В.

Text B

Moulding processes

Many metallic articles may be produced in the foundry in the form of casting. This method involves melting the metal and then pouring it into a previously made mould where it solidifies.

Castings are made of grey and malleable irons, steel, and copper, aluminium and magnesium - base alloys. Castings are used for manufacturing cylinder blocks of automobile and airliner engines, pistons, machine tool beds and frames, mill rolls, wheels, pipes, etc. Therefore, castings have found the widest application in the engineering, metallurgical, building, chemical and other industries.

The most common method of making castings is in sand moulds which are made in metallic flasks using wooden or metal patterns.

Metallic patterns are most often made of aluminium-base alloys which are light in weight and can easily be machined.

The purpose of the flask is to impart the rigidity and strength to the sand in moulding. Flasks are made of steel, cast iron or aluminium alloys.

Moulds may also be made of metal /permanent mould/ or of fireclay /loan moulds/.

Notes:

malleable iron	- ковкий чугун
flask	- опока
pattern	- модель
to impart the rigidity	- придавать жесткость
fireclay	- огнеупорная глина
loan mould	- полупостоянная форма

6 Прочтите и перескажите текст С на русском языке.

Text C

Iron and Steel Castings

In the foundry iron and steel castings of any desired form and size are made by casting the molten metal in sand molds.

The molds are made by ramming sand around the pattern in a flask. The flask is simply a box-type container of two or more sections, allowing for removal of the pattern. The pattern is removed and the space is filled with molten metal. Patterns are made of wood or metal.

Steel castings are almost exclusively cast in sand molds, although some steel is being cast centrifugally in metal molds. Steel castings range in size from light 1/4-inch sections to sections up to 4 feet, weighing more than 200 tons.

A mold used for castings of steel must possess special properties. Due to the high pouring temperatures, difficulties are encountered in trying to manufacture the perfect molding material and mold. The sands used must possess high silica content, bonding agents to insure proper cohesion of the sand grains. Porosity and the formation of holes are defects which occur in steel castings because of internal shrinkage or entrapped gases, oxides, slag, etc. Some of the defects found in sand castings may be eliminated through the use of centrifugal castings.

LESSON 13

1 Запомните следующие слова и словосочетания:

green-sand mold	- сырая литейная форма
low cost	- низкая стоимость
to ram } to pack }	- утрамбовывать, набивать
pattern	- модель
flask	- опока
to withdraw	- убирать
dry-sand mold	- высушенная литейная форма
clay-bonding material	- глиняный связывающий материал
to bake } to dry }	- сушить
skin-dried mold	- поверхностно высушенная форма
mixture	- смесь
bonding substance } bond }	- связывающее вещество
internal surface	- внутренняя поверхность
external surface	- наружная поверхность

to apply } to employ }	- применять, использовать
partial mold	- неполная / частичная / форма
core-oven	- сушильная печь для стержней
core molding machine	- стержневая машина
core roll-over machine	- поворотная стержневая машина
core blowing machine	- песконабивная стержневая машина
core extrusion machine	машина для выбивки стержней

Text A

Sand Molds

There are three principal methods of making sand molds. Green-sand molds are formed by mixing silica, 8 per cent or 15 per cent clay, and a small amount of water. They are used principally because of their low cost and simplicity of operation. The green sand is rammed around the pattern in flasks. When the pattern is withdrawn, the mold is finished. The mold may be poured as soon as made or it may be held over a day or more, depending upon its size. Green-sand molds are recommended for cast iron.

Dry-sand molds are formed by mixing sand of coarse grain with a clay-bonding material and water, and then baking the mixture dry. These molds are used where heavy work is to be cast. Dry-sand molds are usually made up one day, baked overnight, and assembled and cast the next day. Dry-sand molds require the use of metal flasks because heat is used to dry them. Dry-sand molds are recommended for steel castings.

Skin-dried molds can be constructed economically by one of two methods. By the first method, silica sand /silicon dioxide / is mixed with a dry-sand bond. The mixture is packed around the pattern to a thickness of $\frac{1}{2}$, thus forming a partial mold, which is dried out. When the partial mold is dry the remaining portion of the mold is completed with green sand. By the second method, the entire mold is constructed of green sand, after which a bonding substance is applied to its surface.

Cores

Internal surfaces of castings are molded with the aid of sand cores. Cores are made chiefly from dry-sand mixtures in core boxes of proper shape, and then are baked and inserted in the mold after the pattern has been removed. In some cases, metal shapes are used for cores. To simplify molding operations for intricate castings, baked sand-cores are successfully employed for molding the external surfaces.

Cores may be made by hand for limited production. This work consists of ramming up sand in the core box, removing the core from the box, and then baking it. For large production, cores are rapidly constructed by special core-making equipment. The core-ovens for drying the machine-made cores are usually arranged close to the core-making equipment.

Among the various types of machines developed for core-making are the following: the core molding machine, the core-roll-over machine, the core blowing machine and the core extrusion machine.

Exercises

I. Найдите русские эквиваленты:

1 green-sand mold	1 неполная форма
2 low cost	2 высушенная литейная форма
3 dry-sand mold	3 металлическая опока
4 partial mold	4 сырая литейная форма
5 skin-dried mold	5 смесь
6 bonding substance	6 высушивать
7 metal flask	7 связывать вещество
8 pattern	8 низкая стоимость
9 to dry out	9 металлическая опока
10 mixture	10 модель

2 Напишите английские эквиваленты следующих русских словосочетаний:

основные методы, низкая стоимость, простота операции, в зависимости от размера, крупное зерно, связывающий материал, сырая литейная форма, поверхностно высушенная форма, металлическая опока, внутренняя и наружная поверхность, специальное оборудование для производства стержней.

3 Опишите три основных метода производства песочных литейных форм:

- 1 Green-sand molds.
- 2 Dry-sand molds.
- 3 Skin-dried molds.

4 Ответьте на вопросы:

1. How are internal surfaces of castings molded? 2. What are cores made from and how? 3. Is there any difference between cores used for limited production and for large production? 4. Why are the core-ovens arranged close to the core-making equipment? 5. What types of machines have been developed for core-making?

5 Прочтите и переведите содержание текста В на английском языке.

Text B

Cores and core-ovens

After the cores are formed in the core boxes, they are placed on metal plates and put in low temperature ovens operating within a range of 350⁰ to 450⁰F.

Core ovens have been developed for cores of various types and sizes, and for both limited and mass production. Drying ovens may be portable, stationary or

continuous. Portable ovens are small and are usually used when production is limited. Stationary ovens are simple in construction and are recommended for small and medium-size cores produced in large quantities.

Cores may be made by hand for limited production and by special core-making machines for large production. There are different types of machines developed for core-making. For example, in the core blowing machine the sand is blown at high velocity and pressure into a core box. This process is rapid and produces large quantity of cores of uniform structure and composition. Cores of various lengths and shapes / round, square, oval etc./ are extruded in specially developed machines.

Notes:

portable ovens	- переносные печи
stationary ovens	- неподвижные печи
velocity	- скорость
uniform	- одинаковый

6 Прочитайте и передайте содержание текста С на русском языке:

Text C Principles of green-sand molding

Certain principles which provide the procedure of iron and steel molding are suitable for all classes of foundry work. A practical understanding of these principles is essential for producing casting of good quality.

The ultimate purpose of the operations in a foundry is the production of castings of good quality at the lowest possible cost. This over-all purpose is subdivided into four specific aims with respect to green-sand molding. These are: production of sound castings which are free from internal defects, such as blowholes, porous spots and cracks; production of smooth castings having a uniform surface free from scabs, buckles and swells; successful use of sand molds which take the least possible time to prepare before molten metal is poured into them.

LESSON 14

1 Запомните следующие слова и словосочетания:

cupola	вагранка
air furnace	отражательная печь
crucible furnace	тигельная печь
open-flame furnace	пламенная печь
open-hearth process	мартеновский процесс
flux	флюс
charge	загрузка, шихта
molten state	расплавленное состояние
ladle	ковш
capacity	производительность

adjustment	настройка, регулировка
to line	футеровать
firebrick	огнеупорный кирпич
leg	опора, стойка
layer	слой
bottom of the furnace	днище, под/печи/
opening	отверстие
tuyere	фурма
coke bed	коксовый пласт
wind box	воздушная коробка
crucible zone	тигельная зона
combustion zone	зона сгорания
preheating zone	зона предварительного нагрева
stack zone	шахта
waste gases	отработанные газы
shell	корпус, кожух

Text A Metal-Melting Equipment

The metal used in various kinds of castings is melted in several types of furnaces. Cast iron is usually melted in a cupola or an air furnace; when high-grade castings are required the electric furnace is employed. Pig iron, scrap iron, flux, and other materials compose the charge placed in the selected furnace. This charge is reduced to a molten state and then transferred by ladle to the molds, where it is cast. Steel may be melted and refined by the open-hearth process, the electric furnace process, the converter process. Non-ferrous metals and alloys are melted in crucible furnaces; open-flame furnaces; electric furnaces, and in rare cases, in cupolas.

The Cupola Furnace

The cupola is the oldest type of furnace and the most economical. It may be of different sizes. Cupola capacities vary from 1 to 15 tons of metal per heat /the amount of metal melted at one time/. It is difficult to produce metal of precisely uniform quality in the cupola as compared to furnaces in which uniformity of the molten material can be controlled by frequent and periodic tests and adjustment.

The cupola is a cylindrical shell lined with firebrick. The main furnace structure is usually supported on cast-iron legs. The opening at the bottom of the furnace may be closed by cast-iron doors. Refractory sand protects these doors during the melting of the charge, which is placed over the layer of sand. At the end of the melting operation the doors open and materials remaining from the charge drop down through the opening.

A row of openings or tuyeres is arranged around the shell at its base to introduce air to the coke bed. A wind box placed at the level of the tuyeres supplies the air.

The cupola is generally divided into a number of zones: the crucible zone, tuyere zone, combustion zone, melting zone, preheating zone, and the stack zone.

The crucible zone is located at the bottom of the cupola. Molten iron and slag accumulate in this space.

The combustion zone extends from the bottom of the tuyeres to the top of the coke bed.

The melting and preheating zones extend the top of the combustion zone to the charging door. The location of the charging door depends upon the size of the cupola.

The purpose of the stack, which is another zone of the cupola, is to carry off the waste gases. It is located above the charging door.

Post-Text Exercises

1 Выпишите из текста А английские эквиваленты следующих русских словосочетаний:

различные виды отливок, в редких случаях, по сравнению с, цилиндрический корпус, чугунная опора, чугунное окно, слой песка, через отверстие, воздушная коробка, зона предварительного нагрева, зона сгорания, тигельная зона, завалочное окно, отработанные газы, коксовый пласт.

2 Напишите список терминов, касающихся конструкции вагранки.

3 Найдите в тексте существительные от следующих глаголов:

to melt, to locate, to charge, to adjust, to cast, to operate, to open.

4 Перескажите текст А на английском языке по следующему плану:

- a) Different types of furnaces;
- b) Technical characteristics of cupola;
- c) The cupola zones.

5 Прочтите и переведите текст В без словаря.

Text В

Production of Castings

Production of castings made from different metals requires different types of melting furnaces. The cupola furnace is usually used for melting grey iron. The air cupola, and electric furnaces are used to melt the metal for making iron castings. For melting steel, the open-hearth crucible or electric furnaces are used. Non-ferrous metals are generally melted in crucible or electric furnaces. The fuels mostly used for melting metals are coke, coal, oil and gas.

Besides the different types of furnaces, different kinds of moulding sand are also required for making the moulds for different metals. In many cases, it is necessary to treat /обрабатывать/ either the metals or the castings in some special way before the castings can be used.

6 Переведите текст С в письменной форме.

Text C

Cupola Melting

Most of the grey cast iron produced in our country is melted in the cupola furnace. The cupola is a vertical cylindrical type of furnace, consisting of a steel shell lined with firebrick. Usually the charging door is located 15 to 25 ft above the bottom. At the lower end of the furnace is a wind box or air box. Air enters the cupola through tuyeres. Some cupolas are equipped with a single row of tuyeres. Others have two or three rows of tuyeres.

The cupola is a simple and economical melting unit, because the fuel and the metal are in intimate contact with each other. Fuel, metal and flux enter the cupola through the charging door.

Generally a flux is charged on the coke bed. This bed usually extends from 36 to 60 in above the lower tuyeres. The preparation of the charge and charging are most important in obtaining uniform results in melting.

LESSON 15

1 Запомните следующие слова и словосочетания:

blast furnace	доменная печь
raw material	сырье
to reinforce	усиливать, укреплять
to reduce	восстанавливать
to charge	загружать
impurities	примеси
to be fluxed	превращаться в флюс
to be slagged	отшлаковываться, превращаться в шлак
stove	воздухонагреватель
to blow	продувать
hopper	бункер, загрузочная воронка
upper bell	верхний конус
lower bell	нижний конус
to lower	опускать
hearth	под /печи/
to tap	выпускать /металл из печи/
to transfer	транспортировать
ladle	ковш
tuyere	фурма

2 Переведите производные глаголы от существительных:

slag	- шлак	to slag	-
flux	- флюс	to flux	-
heat	- тепло	to heat	-
tap	- выпуск	to tap	-

pump	- насос	to pump	-
charge	- загрузка	to charge	-
blow	- дутье	to blow	-
drop	- падение	to drop	-
transfer	- перемещение	to transfer	-

Text A

Blast Furnace

The modern blast furnace is a tall circular structure about 100 ft. high built of firebrick and reinforced by steel shell on the outside. It is the largest and most complicated metallurgical apparatus in the world. It is capable of producing more than one thousand tons of pig iron every twenty four hours and consumes enormous quantities of raw materials.

Iron is reduced from the ore in the furnace by means of coke charged with ore. The impurities are fluxed or slogged by means of limestone also charged with the ore. The air blown through the furnace is heated by means of stoves that constitute an important part of the apparatus of the blast furnace. These stoves are cylindrical towers lined with firebrick. Gas burnt in the bottom of the stoves heats the brickwork in them to about 1150⁰C. Thus, air pumped through the stoves is heated to about 900⁰C before it is blown into the furnace.

The ore, coke, and limestone are conveyed from the ground to the top of the furnace by means of two cars running on an inclined hoist. The cars dump the charge into a hopper from which it is then dropped into the furnace by lowering the upper bell then lowering the lower bell. The use of these two bells prevents gases and flame from being blown into the air from the top of the furnace every time it is charged. Hot air is blown into the furnace through the tuyeres in the hearth of the furnace.

As the iron and slag are formed, they drop to the hearth at the bottom of the furnace. Since the iron is heavier than the slag, it settles to the bottom while the slag floats on the top of the molten iron. There are two holes in the hearth of the blast furnace. The iron is tapped from the lower hole; the slag is tapped from the upper hole.

The molten iron is transferred by a ladle to the molds where it is cast into pigs or to the steel making furnaces.

Post-Text Exercises

1 Переведите на русский язык следующие словосочетания:

circular structure; steel shell; enormous quantities; by means of; inclined hoist; hot air; through the tuyeres; the heart of the furnace; the bottom of the furnace; the lower hole; the upper hole; the molten iron; steel making furnace.

2 Заполните пропуски в предложениях глаголами, данными ниже. Используйте их в страдательном залоге.

to heat; to slag; to tap; to reduce; to blow; to convey; to transfer; to cast

1 Iron from the ore in the furnace by means of coke. 2 The impurities by means of limestone charged with the ore. 3 The air pumped through the stoves to about 900⁰C. 4 The ore, coke and limestone ... from the ground to the top of the furnace by means of two cars. 5 Hot air into the furnace through the tuyeres. 6 The iron ... from the lower hole; the slag from the upper hole. 7 The molten iron ... by a ladle to the molds where it ... into pigs.

3 Проверьте друг у друга, усвоили ли вы английские эквиваленты следующих слов и словосочетаний:

самый крупный и сложный металлургический аппарат в мире, потреблять огромное количество сырья, посредством, верхний и нижний конусы, через фурмы, под печи, горячий воздух, расплавленный чугун, воздухонагреватель, бункер, примеси, ковш, вагонетка, днище печи.

4 Дайте три степени сравнения прилагательных:

large, heavy, complicated, difficult, important, low, high, many, little, slow, easy.

5 Установите словарную форму следующих слов из текста А:

reduced, heated, blown, built, burnt, stoves, are, running, dropped, heavier, largest, transferred, tapped, lowering, molten, heats.

6 Передайте содержание текста В на русском языке

Text B

Iron and its Production

Ferrous metals are used in industry in two general forms: cast iron and steel. These two ferrous alloys are usually produced from pig iron and they have different carbon content. Steel is iron which contains from 0.05 to 1.7 per cent carbon, while pig iron is an alloy of iron and carbon with the carbon content more than 2.0 per cent.

The furnace that is used for separating iron from the other elements combined with it in the iron ore is called a blast furnace.

The modern blast furnace consisting of metallic shell, refractory and the furnace top, rests on a very heavy and powerful reinforced concrete foundation.

A mixture of ore, fuel, and flux in proper proportions is charged through a specially constructed opening in the top of the furnace. At the same time heated air from stoves is blown into the furnace through the tuyeres.

The process is a continuous one except for the periodic removal of the impurities, in the form of slag, and of the metal through large openings in the crucible of the furnace.

7 Прочтите и переведите текст С без словаря. Перескажите его на английском языке.

Text C

Blast Furnace

The modern blast furnace constitutes the largest and most complicated type of metallurgical plant. Such a plant is capable of producing more than one thousand tons of pig iron, a day. It consumes large quantities of raw materials. The material entering the blast-furnace derived its name from the fact that the air to support combustion must be forced into it under pressure. The air is usually blown in the bottom through the tuyeres.

The blast-furnace is a circular shaft of different dimensions made of firebrick. The furnace has a cylindrical crucible at its base for the molten products.

Chemical reactions between carbon, oxygen, and iron and its oxides occur within the blast-furnace. As a result of these reactions pig iron and slag are produced.

LESSON 16

1 Запомните следующие слова и словосочетания:

to generate heat	вырабатывать тепло
to free	освободить
to convert	превращать
to oxidize	окислять
tilting vessel	качающийся /опрокидывающийся/ сосуд
heat-resisting brick	жаропрочный кирпич
flame	пламя
to burn	гореть
to turn down	поворачивать вниз
low cost	низкая стоимость
pure oxygen	чистый кислород
blast	дутье
clay	глина
mouth of the converter	горловина конвертера
trunnion	цапфа
to carry on the process	продолжать процесс
to cut off	срезать

2 Переведите и запомните производные существительные от глаголов:

to operate	- работать	operation	-
to convert	- превращать	conversion	-
to generate	- вырабатывать	generation	-
to oxidize	- окислять	oxidation	-
to replace	- заменять	replacement	-
to combine	- сочетать	combination	-

to charge	- загружать	charge	-
to cut	- резать	cut	-
to till	- наклонять	tilt	-
to heat	- нагревать	heat	-

Text A

The Bessemer Converter

In the Bessemer process of making steel air is blown through the molten pig iron, and the oxygen of the air combines with the carbon, manganese, and silicon of the pig iron. This action generates heat and frees the iron from the major part of its impurities thus converting the iron into steel.

The Bessemer converter, in which the process takes place, is a pear shaped tilting vessel made of steel and lined with heat-resisting bricks and clay. It is mounted on trunnion. The top of the converter is cut off to form a mouth through which molten metal is charged and discharged. In the bottom of the vessel are number of holes, called tuyeres, through which air is blown. The air is blown through the charge and oxidizes the silicon, manganese and carbon. The combustion of these materials generates the heat to carry on the process. The progress of the operation is shown by the flame issuing from the mouth of the converter. At first this flame is short and dry with very little visibility; then a reddish-brown flame occurs during the period when silicon and manganese are oxidized. As the carbon burns, the flame changes in character and increases in size, becoming yellowish-white.

Suddenly the flame drops, and the operator must stop the blast of air. The vessel is turned down on its side and metal is removed from the converter.

The whole operation of "blow" usually takes from 12 to 18 minutes.

Bessemer steel is used because of the low cost of the process. Today we have a new, more perfect technology of converting pig iron into steel in which the blast of air is replaced by a jet of nearly pure oxygen.

Post-Text Exercises

1 Найдите в разделе /в/ эквиваленты для английских словосочетаний из раздела /а/:

а/ molten pig iron; generate heat; major part; heat-resisting bricks; the air is blown through the charge; the mouth of the converter; very little visibility; the flame changes in character and increases in size; metal is removed from the converter; low cost of the process; pure oxygen.

в/ вырабатывать тепло; воздух продувается через шихту; металл удаляется из конвертера; основная часть; расплавленный чугун; очень маленькая /незначительная/ видимость; низкая стоимость процесса; чистый кислород; характер пламени изменяется и размер его увеличивается; горловина конвертера; жаропрочный кирпич.

2 Закончите предложения:

- 1 The Bessemer converter is a pear-shaped tilting vessel made of
- 2 The top of the converter is cut off to
- 3 The air is blown through
- 4 The progress of the operation is shown by
- 5 The whole operation of "blow" usually
- 6 Bessemer steel is used because of

3 1. Опишите конструкцию конвертера.

2. Опишите процесс, который происходит в конвертере.

4 Прочтите текст В и перескажите его на английском языке

Text B

Henry Bessemer

Henry Bessemer, English inventor and engineer, was born at Charlton on January 19, 1813. He discovered the first process for making inexpensive steel. The so-called Bessemer process of steel-making was a great event in the world's economic history.

In 1830 he came to London. There he worked out a process for the manufacture of "gold" powder.

At the time of the Crimean War Bessemer designed a rotating artillery shell. He discovered a process in which air was blown through pig iron. Heat was generated by the reactions to keep the charge hot and liquid. He used phosphorous as the raw material.

In 1859 he established steel works at Sheffield producing guns and steel rails.

The application of this process to pig iron high in phosphorous was developed by Sidney Thomas /1878/ who discovered the proper basic refractories. His method, the basic Bessemer, or Thomas process, is of great importance in Europe.

The Bessemer process, both acid and basic, produced enormous quantities of steel used in bridges, railway construction and shipbuilding.

Bessemer was one of the founders, and president of Iron and Steel Institute. He was a fellow of the Royal Society and received many other honours. He died in London, on March, 15, 1898.

5 Составьте устно краткое сообщение по содержанию текста С, используя в качестве плана следующие вопросы:

- 1 What does the charge for the Bessemer process consist of?
- 2 When do the iron, silicon and manganese burn to their oxides?
- 3 What temperature is reached in this process?
- 4 How long does the slag-forming period continue?
- 5 When does the second period of the Bessemer process begin?
- 6 What occurs in the third period?

Text C

The Bessemer process

Pig iron in the Bessemer process must have a high amount of silicon and manganese /up to 2% Si and up to 1.5%Mn/, and the minimum possible amounts of sulphur and phosphorus. When the air is blown through the molten metal the iron, silicon, and manganese burn to their oxides. In this process the temperature of the metal bath is raised from 1250⁰ to 1650⁰C.

The slag-forming period /blow/ in converter continues for 4 or 5 minutes.

The second period of the Bessemer process – carbon blow – begins after almost all of the silicon and manganese are burnt out of the pig iron and the metal reaches a sufficiently high temperature. This creates favourable conditions for intensive burning of carbon from the molten metal.

In the third period the impurities of the metal are burnt out and only iron is oxidized. This period continues one or two minutes. Bessemer steel made by this process contains very little carbon since it was burnt out in the second period.

LESSON 17

1 Запомните следующие слова и словосочетания:

grade	сорт
acid refractory	кислый огнеупор
basic refractory	основной огнеупор
rocker	балансир, рычаг
to pour off	выливать
roof	свод /печи/
arc	дуга
current	электрический ток
to warrant	оправдывать
lining	футеровка
door	загрузочное окно

2 Переведите производные существительные от глаголов:

to line	- футеровать	lining	-
to melt	- плавить	melting	-
to increase	- увеличивать	increasing	-
to cast	- отливать	casting	-
to remove	- удалять	removing	-

Text A

The Electric Furnace

The finest grades of steel are produced by the electric furnace method. Stainless and heat resistant steels are made almost exclusively by that method.

Electricity is used for the production of heat. Nevertheless, the electric furnace method gives certain advantages impossible in other steel melting processes. The electric furnace generates extremely high temperatures. The composition of the metal and the temperature can be accurately controlled. The electric furnace is a circular metal shell lined with refractory material. The lining may be either acid or basic depending upon the type of charge to be remelted. The electric furnace is mounted on rockers or trunnions so that it can be tilted to pour off molten metal and slag. Work material is charged into some furnaces through the doors, into others through the top by removing the roof.

The electrodes enter the furnace through the roof and carry the current to the steel charge. The heat of the arc created between the electrodes and the charge melts the metal. Electrodes may be either graphite or amorphous carbon.

Electric furnaces are used principally, of course, for melting steel but their use for production of high-test and alloy cast-iron products is increasing. The cost of operation is high, but it is warranted when castings of the finest quality are demanded.

Furnace capacity ranges from 3 to 200 tons.

Post-Text Exercises

1 Заполните пропуски в предложениях глаголами, данными ниже. Используйте их в страдательном залоге.

to produce; to use; to control; to mount; to charge; to tilt

- 1 The finest grades of steel ... by the electric furnace.
- 2 Electricity for the production of heat.
- 3 The composition of the metal and the temperature can ...
- 4 The electric furnace ... on rockers.
- 5 The electric furnace ... to pour off molten metal and slag.
- 6 Work material into some furnaces through the doors.

2 Переведите на русский язык следующие словосочетания:

the finest grades of steel; heat resistant steels; stainless steel; certain advantages; steel melting process; the composition of the metal; a circular metal shell; refractory material; depending on the type of the charge; the cost of operation; furnace capacity.

3 Дайте ответы на следующие вопросы:

- 1 What steels are produced by the electric furnace method?
- 2 What is the electric furnace?
- 3 How is work material charged into furnaces?
- 4 What is the function of the electrodes?
- 5 What kinds of electrodes are used in the electric furnaces?

6 What can you say about the cost of operation?

7 What is furnace capacity?

4 Проверьте друг у друга, усвоили ли вы английские эквиваленты следующих слов и словосочетаний:

сорта стали, нержавеющая сталь, жаропрочная сталь, сталеплавильный процесс, свод печи, загрузочное окно, футеровка, кислый огнеупор, основной огнеупор, цапфа, состав металла, выливать расплавленный металл и шлак.

5 Прочтите текст В и перескажите его на английском языке по своему плану:

Text В

Electric Furnace

The most highly perfected steelmaking units are electric furnaces in which electric energy is converted by various methods into thermal energy for heating and melting the metal.

Electric furnaces used in making steel are of two types – arc and induction furnaces. The first are more widely employed in metallurgy.

Electric furnace steelmaking processes have many advantages in comparison with open-hearth and other steelmaking processes. It is possible in electric furnaces: 1) to obtain very high temperatures and to melt metals with a high concentration of components with melting points; 2) to operate with highly basic slag and to remove a large part of the phosphorus and sulphur from the metal; 3) set up a reducing atmosphere or a vacuum /in induction furnaces/ there by achieving better deoxidation and degasification of the metal.

Arc furnaces with a basic lining produce steel by one of the two principal methods:

- 1) with oxidation of the carbon and other components of the charge;
- 2) without oxidation of the charge /remelting method/.

6 Переведите текст С на русский язык без словаря:

Text С

Steelmaking Processes

In the Bessemer process no fuel is used. The pig iron from the blast-furnace is poured molten into the convertor and the air is blown through it. The air first oxidizes the silicon and manganese which, together with some iron oxide, rise to the top and form a slag. The blowing is continued until the carbon content is lowered to about 0.05%. When the blow is completed carbon, manganese, and silicon are added to the molten metal. The finished steel is then poured into a ladle. Bessemer steel is still used because of low cost of its production.

The open-hearth furnace accommodates from 15 to 200 tons of metal. The purpose of this furnace is to convert various types of ferrous material into finished

steel of proper composition and quality. The open-hearth process is a very versatile one, for it involves melting refining and deoxidation.

Electrical furnaces are used in making high-grade steels from cold material; they are also used in additional refining of steel produced by the Bessemer and open-hearth processes. The electric furnace is now capable of making high-grade tool steels equal in quality to the steels produced by crucible process.

LESSON 18

1 Запомните следующие слова и словосочетания:

forging	ковка
to forge	ковать
to build up	собирать, монтировать
tool	инструмент, станок
machine tool	металлорежущий станок
to acquire	приобретать
exact dimension	точный размер
surface finish	чистота поверхности, чистовая обработка
extremely	чрезвычайно, крайне
to calculate	вычислять, подсчитывать
to subject	подвергать (воздействию, влиянию)
stamping	штамповка
to smelt	плавит, выплавлять
to improve	улучшать, совершенствовать
to reduce	сокращать, уменьшать
to consume	потреблять, расходовать
hammer	молот
widespread	широко распространенный

Text A The importance of forging in machine building

All machines are built up of parts made of different materials by various manufacturing processes. Some parts are cast from metals, some are forged, while others are produced by machining on different kinds of machine tools. Castings and forgings have to be machined before they acquire their proper shape, exact dimensions and surface finish.

Forging processes are extremely important in the machine-building industry. No machine, whether simple or complicated, can be built without the use of forgings.

It has been calculated that from 15 to 20 per cent of all the metals produced are subjected to forging; and that about one – third of all the steel smelted is subjected to forging and stamping.

Hammer forging and stamping is particularly widespread in the tractor, automobile, agricultural machinery, ship-building, locomotive building and other industries. For instance, in the railway car¹ building industry up to 70 per cent of

all the parts are forgings. Not only parts of machines, but also many tools are manufactured by forging.

The widespread use of forgings is explained by the fact that forging improves the quality of steel; after forging steel becomes stronger. For this reason, machine parts which are subjected to heavy duty² are generally made of forgings. Moreover, the time required for the manufacture of a part or a tool is very often reduced by forging, much less steel is consumed in its production and, consequently, the cost of any given part is reduced.

The enormous importance of forging operations is shown by the fact that nearly every machine-shop has a forge division³ and every machine-building plant has a forge shop.

Notes:

1 - railway car – вагон

2 - heavy duty – тяжелый режим работы

3 - forge division – ковочный участок

Post-Text Exercises

1 Найдите в тексте английские эквиваленты следующих слов и словосочетаний

1 Различные материалы. 2 Различные процессы поточно-массового производства. 3 Различные типы металлорежущих станков. 4 Точные размеры. 5 Чистота поверхности. 6 Кованные детали. 7 Ковочные процессы. 8 Машиностроение. 9 Выплавленная сталь. 10 Детали, которые подвергаются тяжелому режиму работы. 11 Стоимость.

2 Найдите английские эквиваленты:

1 ковка	1 cost
2 например	2 importance
3 следовательно	3 forging
4 особенно	4 hammer
5 важность	5 consequently
6 подвергать	6 moreover
7 гораздо меньше	7 much less
8 потреблять	8 consume
9 стоимость	9 particularly
10 более того	10 for instance
11 молот	11 subject

3 Прочтите и передайте краткое содержание текста В на английском языке.

Text B

Forging operations

Forging is the hot working of metals performed by means of hammer blows or under the pressure (давление) of a press. Various kinds of machine parts, of different shapes and sizes, are made by forging or stamping operations.

Forging enhances (повышать) the mechanical properties of metal and improves its structure. For this reason the more important parts of machines are manufactured either by hammer forging or die forging (горячая штамповка)

Forging operations can be hand and machine (mechanical) operations. Hand forging is carried out on anvils (наковальня) with the aid (помощь) of hand forging tools. Machine forging is done under forge hammers (кузнечный молот) or presses. As a rule, in machine forging, heavy forgings are produced in hydraulic presses, and lighter (более легкие) ones by hammers.

Depending on the method of the production of forgings, forging processes are classified as hammer forging and die forging.

In hammer forging the shape of the metal is changed by pressing it between the dies (штампами) of a hammer or a press. The flow (течение) of the metal (i.e., the changing of its dimensions and shapes) is controlled with the aid of various tools.

In die forging the flow of metal is limited by the surfaces of the recesses (выемка) in the dies, in which the metal takes its predetermined (заранее заданный) shape and dimensions.

Forgings which have to undergo (подвергаться) subsequent (последующий) machining are called blanks (заготовка).

Those which do not require any further machining are known as finished forgings.

4 Переведите текст С на русский язык без словаря.

Text C The technological process of hammer forging

One and the same component can be forged by different methods and on different forging machines. However, it is always necessary to select the most suitable method for forging which will; a) ensure (обеспечить) a high – quality forging; b) ensure high productivity; c) entail (влечь за собой) the minimum consumption (расход) of physical energy; d) entail the minimum consumption of metal; and e) ensure complete safety (безопасность) during forging.

The process of making a part by forging consists of several separate (отдельный) operations, the chief of which are; 1) selecting (выбор) and preparing the stock (сырье, заготовка) for forging; 2) heating the metal for forging; 3) forging the stock to the requisite (требуемый) shape and dimensions. The process of making any piece of work by the hammer forging method entails many different forging operations: cutting, upsetting (высадка), bending (гибка), drawing (вытяжка, протяжка), and others. The production of any kind of forging necessitates (делать необходимым) the employment (применение) of some or all

of operations in different sequence. Sometimes one, two or three operations (steps) have to be repeated several times.

Every blacksmith (кузнец) should always try to make his forgings in the least possible number of operations. This will reduce the time needed for making the forging, reduce the number of heating and, consequently, increase his productivity. Before commencing (начало) to make any forging, the blacksmith should know exactly which operations are to be employed, and in what sequence. The tools and devices which he selects will depend on the method of forging.

The basic document for making forging the so- called technological process chart (карта технологического процесса) specifies (предусматривать) : 1) the grade of steel required for a given forging; 2) the dimensions and weight of the stock for the forging; 3) the tools and equipment required for making the forging; 4) the time required for heating the steel to the forging temperature; 5) the initial forging temperature; 6) the final forging temperature and so on.

Тексты для внеаудиторного чтения

Basic Engineering Processes

The processing of metals is considered to be the most indispensable part of fabricating a wide range of products. Metal processing is known to involve the following major techniques: casting, forming, machining, joining, and heat treatment, each of these manufacturing processes representing particular branch of the metal-processing industry.

Casting may be described as shaping by means of transforming the metal from liquid to solid state in specially designed moulds. There are several casting techniques at the disposal of foundry men, their selection depending upon the metal or alloy the part is to be made of, the quantities to be produced, the shape and the size desired, the tolerances and the relative cost. The most commonly used casting processes are: sand casting, mould casting, investment and precision casting, centrifugal casting, and others, each of them possessing its own peculiarities, advantages and disadvantages.

Forming, contrary to casting, applies to shaping the metal in the solid state. Forming is generally assumed to include: rolling, forging, stamping and pressing, that is, the process involving plastic deformation of the metal being shaped.

Rolling is considered to be the most economical process for producing a large quantity of simple shapes, such as, billet, plate, sheet, strip, bar, rod, wire, tube, etc., on corresponding rolling mills and may be both hot and cold. Rolling operations are aimed at reducing the initial cross-section of the material in such a way that the final predetermined thickness may be either uniform throughout the whole length of the piece, or varying, as desired.

Forging, stamping, and pressing may be briefly defined as the art of plastically deforming a piece of metal by means of hammering, squeezing, or bending, that is, by applying either impact or static pressure. Forging is used to

produce a desired shape with good mechanical properties by means of dies. There are various types of forging stamping and pressing machines, each type designed for specific purposes.

Machining is the term applied to a group of processes consisting in removing excess metal from cast, rolled or forged parts in order to obtain a desired shape. To achieve the desired result various kinds of machine-tools are employed, the most important ones are: milling, boring, turning and grinding machines and the lathe.

Joining comprises a variety of methods, such as welding, soldering, brazing, and riveting, which are used for attaching one surface to another.

Heat treatment is used to cause the desired property by means of temperature changes. Only by heat treatment it is possible to impart metal the high mechanical properties required for the operation of modern machinery and tools.

Hot and cold working of metals

One of the most important properties of the metals is that of plasticity, or their ability to be permanently changed in shape without rupture. This property of metals allows us to carry out one of the most important operations in the manufacture of many articles made from metal, namely that of forging.

Forging and press-production methods of shaping metal are of tremendous importance in machine-building in general, and in automobile and tractor industry in particular.

Nearly 75 per cent of all automobile and tractor parts are made of pieces produced at powerful forge and press shops of the plant, or at specialized forge and press plants.

Here are features and advantages of forge and press production methods (mechanical working of metal) as compared with other methods of cutting metals.

1. Not only are the mechanical properties of the metal being worked not affected, but in many cases they become much better, which results in producing a number of various machine parts of extreme strength.

2. The forge and press methods allow the production of pieces with minimum tolerance for further machining of the part, thereby lowering the cost of production as a whole.

3. The stamping production methods allow the production of duplicate parts in large quantities, thus providing conditions for continuous mass production.

Rolling

The actual mechanism of the hot mechanical working of steel is divided into two classifications: rolling and forging. The subdivision is by method of application of mechanical force. Rolling, as the term implies, works the metal by rolls; forging works the metal by means of hammers, presses, and forging machines.

Hot Rolling. – Hot rolling is a mechanical method of hot working metal by causing the metal while hot to be fed between two rolls rotating in opposite directions. Hot rolling accomplishes three main purposes: reduction of cross-sectional area, refinement of structure, and shaping of the metal into desired forms

such as bars, sheets, rails, angles, and I-beams. The flow of metal in the rolling operation is continuous and almost entirely in longitudinal direction.

Blooming Mill. – The rolling mill in which the first hot mechanical working of the cast ingot is done is known as the “bloomer” or “blooming mill”. The function of the bloomer is to take the hot ingot as received from the soaking pit and break it down or reduce it to a smaller size called a bloom or billet. This bloom is a semifinished product to be rolled subsequently on a billet mill or finishing mill, or used for forgings.

Characteristics of the Principal Welding Processes

Welding is the process of joining together pieces of metal or metallic parts by bringing them into intimate proximity and heating the places of contact to a state of fusion or plasticity. This leads to interpenetration of the atoms of the metals in the weld zone, and a strong inseparable joint is formed after the metals have cooled.

Welding finds widespread application in almost all branches of industry and construction. Welding is extensively employed in the fabrication and erection of steel structures in industrial construction and civil engineering (frames of industrial buildings, bridges, etc.), vessels of welded-plate construction (steel reservoirs, pipelines, etc.) and concrete reinforcement.

Welding processes may be classified according to the source of energy employed for heating the metals and the state of the metal at the place being welded.

In fusion welding the welding area is heated by a concentrated source of heat to a molten state and filler metal must be added to the weld.

In accordance with the method applied for feeding the filler metal to the weld, welding procedures are classified as manual, semi-automatic or automatic welding.

Pressure welding processes involve the heating of the metallic parts only to a plastic or slightly fused state and forcing them together with external pressure. Pressure welding processes are applied to metals which are capable of being brought to a plastic state by heating or due to the action of external forces. It has been established that in this process the most weldable metals prove to be those metals which have higher thermal conductivity. Such metals more rapidly dissipate heat from the weld zone and do not allow an excessively high temperature to be concentrated in a small area (the latter may lead to considerable internal stress).

The quality of the joint obtained in pressure welding depends to a great extent upon the magnitude of the applied pressure and the temperature to which the metal is heated at the moment of welding. The higher this temperature, the less unit pressure will be required to produce the weld.

Proper cleaning of the surface to be joined is one of the main conditions for obtaining high-quality welds in pressure-welding procedures.

Mendeleev's Periodic Table

It was found that each element has certain peculiar properties that distinguish it from all other elements. However, if all the elements are considered together, we may see that there are certain groups that have very similar chemical properties. D.I. Mendeleev, famous Russian chemist, was the first to discover the law of dependence of the properties of elements upon their atomic weights, and in 1869 he proposed a system of classification in which the elements are arranged according to this law. This system is known as the periodic system.

The fundamental idea expressed by the arrangement of the elements in Mendeleev's Table is that of the periodic recurrence of properties as the atomic weights increase.

The value of the Periodic System was demonstrated in a very striking fashion by the prediction of unknown elements made by Mendeleev. When he was constructing his table, it was obvious that several gaps should be left in order to have the succeeding elements fall into their proper groups. Such gaps were to be found in the places now filled by scandium, gallium, germanium and from the properties of the adjacent elements and their atomic weights Mendeleev predicted the properties of the unknown elements. The remarkable accuracy of these predictions is clearly illustrated by the comparison of the unknown element called by Mendeleev "ekasilicon" with germanium discovered later by Winkler.

In the table elaborated by Mendeleev the symbols of the elements are given with their atomic weights. A study of the chart reveals that the elements are arranged in horizontal rows of ten in the order of increasing atomic weights. There are nine regular groups marked "Groups 0 to VIII", and the elements contained in each of these groups have similar chemical properties. The groups are further divided into /a/ and /b/ subgroups. The elements in subgroup /a/ have some properties in common that differentiate them from the elements in subgroup /b/. However, all the elements in vertical groups have one important chemical property in common which is known as valence.

Valence was earlier defined as the property of an atom which enables it to combine with a certain number of atoms of another element. The elements in group 0 do not have the power of combining with other elements, hence their valence is zero. The elements of group I may have valence of one, the elements of group II – valence of two, etc. Elements may have positive valence /+/ or negative valence /-/.

Characteristic Features of Some Elements

It is necessary to know some properties of the elements that play an important part in metallurgy. These elements are oxygen, hydrogen, carbon, sulphur.

Oxygen is an element of utmost importance for us. Nearly 50 per cent of matter composing the earth and its atmosphere is known to be oxygen and about one-fifth of air volume is free oxygen. We know oxygen to become liquid at -183°C /minus 183 degrees centigrade/ and solid at -218°C . Oxygen being very active element will combine with all but a few of the other elements. The combining of oxygen with another substance is called oxidation. Iron is found to

rust and many other metals to tarnish when exposed to oxygen. This rusting or tarnishing is caused by combining of the metals with oxygen of the air.

When oxygen combines with another substance, an oxide is formed. Oxides of metals when found naturally are called ores. Iron is known to be produced from an iron oxide, or an iron ore, by process of reduction.

Hydrogen. Very little hydrogen is known to be found in nature. Combined hydrogen is found in all living things. Hydrogen is the lightest substance known. Pure hydrogen when burnt with oxygen produces a very high temperature but very little light. Hydrogen is believed to have a strong tendency to combine with oxygen. This tendency is sufficiently strong for hydrogen to take oxygen away from metallic oxides. We know this process to be called reduction.

Carbon. Carbon occurs in several allotropic forms. Diamonds are crystalline forms of pure carbon. Graphite is another form of crystalline carbon. Carbon is known to be also found in amorphous forms, that is, forms that do not have a definite structure. At high temperatures carbon acts as reducing agent and thus removes oxygen from the oxides of many metals. This is essentially the process of reducing metals from their ores.

Sulphur. This element is found free in nature and in the combined state. Compounds of sulphur are found in iron ore, in limestone and in coal. Sulphur itself is pale yellow in colour, has a melting point of about 115°C and burns in air to SO_2 . Sulphur is a detrimental constituent in steel and must be eliminated as completely as possible.

Physical properties of metals and alloys

Constitution of metals denotes the manner of arrangement of the metal atoms as to geometrical form in solid crystals, and the regular or ordered arrangement of different kinds of metal atoms and their relation to each other in such a crystal.

The pattern formed by this arrangement of the atoms is known as the space lattice.

Most metals crystallize with one of the three following lattice structures:

Close-packed cubic: copper, nickel, lead, aluminium, cobalt, silver, gold, platinum;

Body-centred cubic: iron, molybdenum, tungsten, chromium;

Hexagonal close-packed: zinc, cadmium, magnesium, beryllium, titanium.

This union of atoms into a geometric array is the physical difference between liquid and solid metals.

Electrical conductivity. – Metals are built up of individual crystals, and it is important to note that they conduct electricity better through the crystals than across the crystal boundaries. The electrical resistance of metals or alloys is increased by decreasing the size of the crystal and, therefore, increasing the number of crystal boundaries. The resistivity of metals is also increased in most cases by an increase in temperature.

Heat Conductivity. – The relative heat conductivity of some metals and alloys are based on the conductivity of silver as 100 per cent.

Melting and boiling points. – The temperature at which a metal melts, is called the melting point, the metals of lower melting points are generally the soft metals and those of high melting points - the hard metals.

The boiling point of a substance depends on the surrounding pressure. The term “boiling point” refers to the temperature at which the metal boils under normal atmospheric pressure.

Density and porosity. – Porosity, the quality of containing pores, is lack of denseness. Density, on the other hand, denotes weight per unit of volume. The distinction between them is in the following: some heavy metals, like grey cast iron, are porous enough to leak under heavy hydraulic pressures, whereas some lightweight metals, like aluminium, are dense and compact.

Most metals expand on heating and contract on cooling.

Magnetism.- Iron, cobalt and nickel are the only metals possessing considerable magnetism at room temperature, and they become non-magnetic when heated to a certain temperature. Strong permanent magnets have been made of one of several compositions of steel, but in recent years a number of magnet alloys of much greater magnetism have been developed.

Colour. – Most of metals are silvery white or grey in colour. Copper is the only red metal, and gold the only yellow one, although a number of copper-base alloys are also yellow. All solid metals have metallic luster, although the true colour and luster of many metals are often obscured by a coating of oxide – which may be white, grey, red, brown, bluish or black.

Foundry

A casting may be defined as “a metal object obtained by allowing molten metal to solidify in a mold”, the shape of the object being determined by the shape of the mold cavity.

Founding, or casting, is the process of forming metal objects by melting metal and pouring it into molds. A foundry is a commercial establishment for producing castings. Wrought metal products differ from cast metal products in that the metal has received mechanical working treatments such as forging, rolling, or extruding. Practically all metal is initially cast. Castings obtain their shape principally when molten metal solidifies in the desired form. Wrought objects, however, are cast as ingots and then plastically worked to approximately the desired shape.

The strength of the foundry industry rests in the fundamental nature of casting as a process for causing metals to take shapes that will serve the needs of man. Other methods of shaping exist, each with its own specific merits: machining, forging, welding, stamping, hot working, etc.

Certain advantages are inherent in the metal-casting process. These allow to choose casting as a process to be preferred over shaping process in a particular case.

Some of the reasons for the success of the casting process are:

1. The most intricate shapes, both external and internal, may be cast. As a result, many other operations such as machining, forging and welding may be minimized or eliminated.

2. Because of their metallurgical nature, some metals can only be cast to shape since they cannot be hot-worked into bars, rods, plates, or other shapes from ingot form.

3. Construction may be simplified. Objects may be cast in a single piece which would otherwise require construction in several pieces and subsequent assembly if made by other methods.

4. Metal casting is a process highly adaptable to the requirements of mass production. Large numbers of a given casting may be produced very rapidly. The use of castings in the automotive industry provides ample illustration of this point.

5. Extremely large, heavy metal objects may be cast when they are difficult or economically impossible to produce otherwise. Large pump housings, valves, and hydroelectric plant parts weighing up to 200 tons illustrate this application.

The list of advantages occurring in the metal-casting process may be expanded. But it is important to stage the conditions where the casting process must give way to other methods of shaping. For example, machining produces smooth surface and dimensional accuracy; forging develops strength and toughness in steel; welding provides joining products into more complex structures; and stamping produces light weight sheet-metal parts. Thus the engineer may select from a number of metal-processing methods that one which is most suited to the needs of his work.

Characteristic features of some metals

Pure iron

The pure iron, free from slag and carbon, is not a commercial product. The purest iron may contain as much as 99.8 per cent of iron. It can only be obtained in small quantities by carefully conducted laboratory manipulations. It is almost white in appearance and very ductile. It is soft, however, it has the virtue of great toughness, i.e. does not crack easily but tends to deform under a load or blow.

Titanium

Titanium is the ninth element in abundance in the Earth's crust. Practically all crystalline rocks, sand, clay and other soils contain titanium. Its symbol is Ti, atomic number 22, atomic weight – 47,90.

The most promising properties of titanium are its low density, good strength, ductility and hence ease in manufacture and excellent corrosion resistance. These properties, particularly strength and ease in fabrication, depend to a great extent on the purity of metal. In general, the higher the purity of titanium, the easier it is to fabricate, but the lower is its strength.

Tungsten

Tungsten is valuable because of several remarkable properties. It is a hard metal with a very high melting point. It does not rust and is not attacked by cold

acids. Thus it is exceedingly useful for electric-lamp filaments and for high-speed cutting tools. As such, it is now considered one of the key metals of industry.

Its symbol is W, atomic number – 74, atomic weight – 183,92.

Aluminum

The third most abundant metal on Earth after oxygen and silicon, and found practically everywhere in the earth's crust / at least in 250 minerals / aluminium was discovered in 1825.

The commercial production of this metal began only in 1888.

Even today there is a certain difficulty in the production of aluminium from its ores.

As it is known aluminium occurs only in the combined state. Bauxite is the principal compound used in aluminium manufacture. The ore containing aluminium may be subjected to ore-dressing methods, if necessary.

Aluminium has a very low density, 2,7. It is ductile, malleable, and can be rolled. Its tensile strength is low in comparison with that of iron; it cannot be machined and polished readily and does not yield good castings. These defects can be overcome by alloying it with other metals. Alloys of copper and aluminium which contain from 5 to 10 per cent of the latter are called aluminium bronzes.

Copper

As it is known mankind came to know copper more than 5 thousand years ago. Copper and its alloy with tin /i.e. bronze/ had for a long time been the most widely used metals. These two materials marked a whole epoch in the history of mankind – the Bronze Age.

Why did copper play such an important part?

Copper is fairly abundant in nature and can readily be worked. At first people used only native copper but later rising demand led to the processing of copper ores.

It is comparatively easy to smelt the metal from ores with high copper content.

The alloying of copper with other elements increases the strength of the metal in some cases and improves the anticorrosive and antifriction properties in others. Copper alloys comprise two main groups - brasses and bronzes. Alloys of copper and zinc are called brasses. Alloys of copper with a number of elements including tin, aluminium, manganese, iron and beryllium are called bronzes.

Silicon

Silicon is one of the most abundant elements found in the earth's crust. It is second to oxygen in abundance.

Silicon never occurs free, but in combination with oxygen, or with oxygen and metals. It forms a great variety of organic and inorganic compounds.

Elementary silicon is used as an alloying constituent to strengthen aluminium, copper, magnesium and other metals. It has a dioxiding effect on steel.

Silica /quartz/ is a crystalline form of silicon dioxide.

Silica bricks, made of nearly pure silica, are extensively used in metallurgical industry.

Carbon and Its Industrial Uses

Carbon is a nonmetallic element, symbol C, existing naturally in several allotropic forms, and in combination as one of the most widely distributed of all the elements.

Amorphous carbon. It is stable and chemically inactive at ordinary temperatures. At high temperatures it burns and absorbs oxygen, forming the simple oxides CO and CO₂.

Carbon dissolves easily in some molten metals, especially iron, exerting great influence on them. Steel, with small amounts of chemically combined carbon, and graphitic carbon, are examples of this.

Carbon dissolves easily in some molten metals, especially iron, exerting great influence on them. Steel, with small amounts of chemically combined carbon, and graphitic carbon, are examples of this.

Carbon occurs as hydrocarbons in petroleum, and as carbohydrates in coal and plant life.

Industrial uses of carbon. Carbon for chemical and metallurgical industries is used in the form of compounds in large number of different grades, sizes and shapes; or as activated carbon, charcoal, graphite or as formed parts with or without metallic inclusions. Natural deposits of graphite, coal tar and petroleum coke are important sources of elemental carbon.

Carbon fibers are used for filtering hot gases and liquids.

Carbon brick is used as a lining in the chemical-processing industries.

Graphite brick is more resistant to oxidation and has a higher thermal conductivity, but it is softer.

Porous carbon is used for filtration of corrosive liquids and gases. It consists of uniform particles of carbon pressed into plates, tubes or discs, leaving interconnecting pores of about 0.001 in diameter.

Carbon steels. There are “plain carbon steels”. By definition, plain carbon steels are those containing up to 1% carbon. For all plain carbon steels, carbon is the principal determinant of many properties. Carbon has a strengthening and hardening effect. At the same time it lowers ductility. In addition, an increase in carbon content lowers machinability and decreases weldability. The amount of carbon present also affects physical properties and corrosion resistance. With an increase in carbon content, thermal and electric conductivity decreases, corrosion resistance is lowered. Plain carbon steels are commonly divided into three groups, according to carbon content:

low carbon steels – up to 0.30%

medium carbon steels – up to 0.40%

high carbon steels – up to 1%

1. Low carbon steels are generally used where ease of forming is more important than strength and hardness. They are also more easily welded. The hardness of low carbon steels cannot be improved to any marked extent by heat-treatment.

2. Medium carbon steels are heat-treated and their properties depend very largely on whether or not they are so treated. Heat treatment can result in doubling the strength and hardness with reduction in elongation.

3. High-carbon steels have great hardness with maximum mechanical properties. These steels are used mainly for tools, springs etc. with lower proportions of carbon for parts requiring toughness and high-carbon content for those requiring extreme hardness.

Contents

1	Lesson 1.....	3
2	Lesson 2.....	6
3	Lesson 3.....	11
4	Lesson 4.....	16
5	Lesson 5.....	19
6	Lesson 6.....	23
7	Lesson 7.....	29
8	Lesson 8.....	33
9	Lesson 9.....	36
10	Lesson 10.....	40
11	Lesson 11.....	44
12	Lesson 12.....	47
13	Lesson 13.....	51
14	Lesson 14.....	54
15	Lesson 15.....	57
16	Lesson 16.....	60
17	Lesson 17.....	63
18	Lesson 18.....	66
19	Тексты для внеаудиторного чтения	69
	Basic Engineering Processes.....	69
	Hot and cold working of metals.....	70
	Rolling.....	70
	Characteristics of the Principal Welding Processes.....	71
	Mendeleev's Periodic Table	72
	Characteristic Features of Some Elements.....	72
	Physical properties of metals and alloys.....	73
	Foundry.....	74
	Characteristic features of some metals.....	75
	Carbon and Its Industrial Uses.....	77

**В.И.МИШИНА
Л.А.ШТАБА**

УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ

**УЧИТЕСЬ ЧИТАТЬ
ЛИТЕРАТУРУ ПО СПЕЦИАЛЬНОСТИ
НА АНГЛИЙСКОМ ЯЗЫКЕ**

Подп. в печать
Офсетная печать
Тираж 500 экз.

Усл.печ.л. 5.
З.№

Формат 60x90/16
Уч.-изд.л. 3,63.

ДГМА. 84313 Краматорск, ул.Шкадинова, 72

УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ

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**КРАМАТОРСК
2005**

