Chapter 1:

Reading: Iron and steel

The earth **contains** a ***large number*** of metals which are useful to man. One of the most important of these is iron. Modern industry needs ***considerable quantities*** of this metal, either in the form of iron or in the form of steel. A ***certain number*** of non-ferrous metals, **including** aluminum and zinc, are also important, but even today ***the majority*** of our engineering products are of iron or steel. Moreover, iron possesses magnetic properties, which have made the development of electrical power possible.

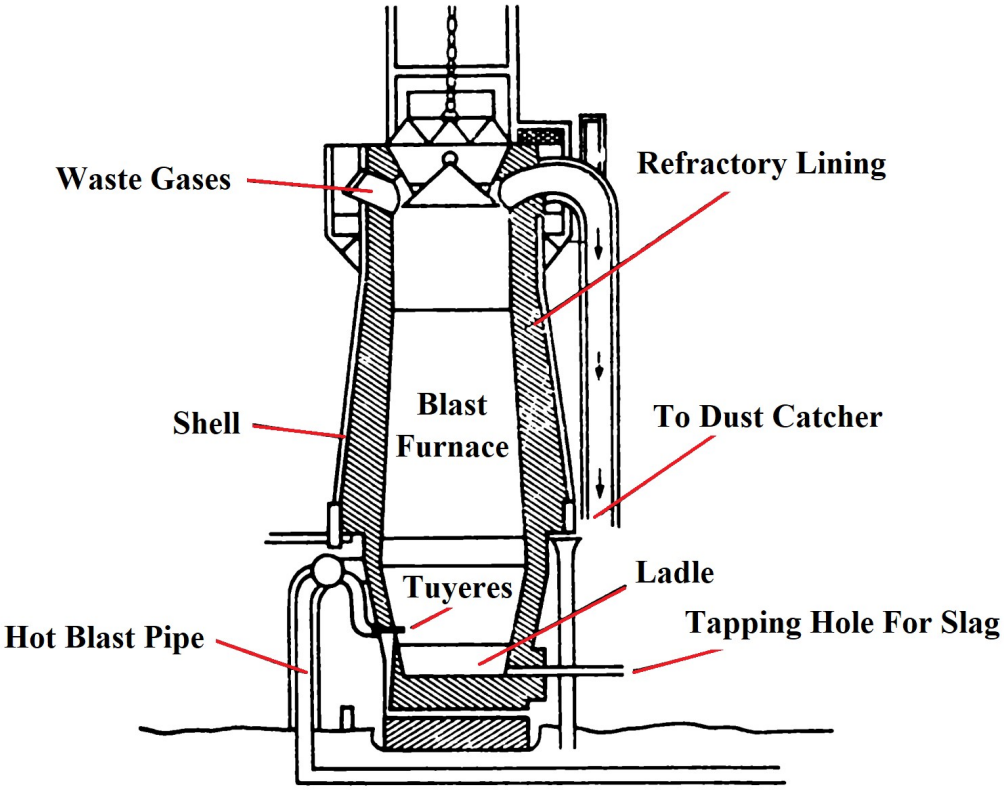
The iron ore which we find in the earth is not pure. It ***contains*** some impurities which we must remove by smelting. The process of smelting **consists** of heating the ore in a blast furnace with coke and limestone, and reducing it to metal. Blasts of hot air enter the reduction of the ore. The ore becomes molten, and its oxides combine with carbon from the coke. The non-metallic **constituents** of the ore combine with the limestone to form a liquid slag.

This floats on top of the molten iron, and passes out of the furnace through a tap. The metal which remains is pig-iron.

We can melt this down again in another furnace – a cupola – with more coke and limestone, and tap it out into a ladle or directly into moulds. This is cast-iron. Cast-iron does not have the strength of steel. It is brittle and may fracture under tension. But it possesses certain properties which make it very useful in the manufacture of machinery. In the molten state it is very fluid, and therefore it is easy to cast it into intricate shapes. Also it is easy to machine it. Cast-iron **contains** ***small proportions*** of other substances. These non-metallic **constituents** of cast-iron **include** carbon, silicon and sulphur, and the presence of these substances affects the behavior of the metal. Iron, which **contains** a

negligible quantity of carbon, for example wrought-iron, behaves differently from iron which **contains a** lot of carbon.

The carbon in cast-iron is present partly as free graphite and partly as a chemical combination of iron and carbon which we call cementite. This is a very hard substance, and it makes the iron hard too. However, iron can only hold about 1 ½ % of cementite. Any carbon **content** above that *percentage* is present in the form of a flaky graphite. Steel **contains** no free graphite, and its carbon **content** ranges from almost nothing to 1 ½ %. We make wire and tubing from mild steel with a very low carbon **content**, and drills and cutting tools from high carbon steel.



Cross-section of blast furnace

Word study

Negligible, Considerable, Substantial, etc.

A *negligible* amount of something is very small.

It is so small that we can *neglect* or ignore it.

A ***considerable***
An ***appreciable***
A ***substantial***
A ***material***
} amount of something is quite large.

An ***appreciable*** amount is large enough to be worth ***appreciating*** or ***noticing***.

A ***considerable*** amount is large enough to be worth ***considering*** or ***noticing***.

A ***substantial*** amount is large enough to be noticed, like a ***substance***.

A ***material*** amount is large enough to be noticed, like a ***material***.

Melt, Molten, Smelt

Ice-cream ***melts*** in the sun.

Ice ***melts*** in the summer.

The ***melted*** ice comes down the mountain in rivers.

At a certain temperature, metals ***melt***. They become ***molten***.

The ***molten*** iron passes out of the furnace into moulds.

We ***smelt*** iron ore by heat, and change the ore into its metal state.

During ***smelting***, the temperature in the furnace is raised and iron ***melts***.

When the ore is ***smelted***, it becomes pig-iron.

Property

Every metal possesses certain properties, or ***characteristics*** or ***qualities*** which we can find by experiment; these ***properties*** may make the metal suitable or unsuitable for any particular purpose. Designers of high-speed aircraft need new materials with special ***properties*** such as heat resistance and strength at high temperatures.

Here are some of the properties which metals may have:

The metal is	***fluid.***	It has	***fluidity.***	It flows easily when it melts.
	plastic.		***plasticity.***	It pulls out of shape without breaking.
	elastic.		***elasticity.***	It always returns to its original shape.
	ductile.		***ductility.***	It can be stretched without breaking.
	malleable.		***malleability.***	It can be hammered out of shape without breaking.

Patterns

1. Make + *Noun* + *Adjective*

This	makes	the problem	easy. difficult. interesting.				
	makes renders	the metal	hard. soft. strong. though.				
This	makes renders	the metal	harder. softer. stronger. thougher.		WITH A FEW COMPARATIVES, ANOTHER STRUCTURE IS POSSIBLE		
					This	harder. softer. stronger. thougher.	the metal.
This	makes	the metal	longer. shorter.	=	This	longehens. shortens.	the metal.
		the screw	tighter. looser. flatter.			tightens. loosens. flattens.	the screw.
		the hole	wider. deeper. broader.			widens. deepens. broadens.	the hole.

2. Quantity

The earth contains			few not many a few some		precious metals.
		a	small moderate certain	number of	
			large great considerable		useful substances.
			a great many a lot of plenty of		
The earth contains			little not much a little some		uranium.
		a	small moderate certain	amount of	
			large great considerable		iron ore.
			a great deal of a lot of plenty of		
The engine The motor	produces	a	certain negligible small moderate considerable large great	amount of	power.
A	certain moderate considerable large	percentage proportion part amount	of the world's coal lies in this country.		

3. Contents

Contains, Consist, Comprise, Constitute, Include

1.	The packet	***contains***	20 cigarettes.
2.	The gas		about 5 ½ % of carbon monoxide.
3.	The alloy		5% nickel and 5% iron.
4.	The tank		100 gallons of oil

5.	The carbon monoxide	***content***	was about 5%.
6.	The moisture		of the cylinder increased.
7.	Part of the heat		of the gases is lost.

8. He emptied out the ***contents*** of the box.
9. A tank is large ***container*** for holding liquids.
10. The class ***consists of*** twenty-four students.
11. The atmosphere ***comprises*** a number of gases.
12. The machine ***is composed of*** several different parts.
13. Cast-iron ***is made up of*** about six different substances.
14. The factory produces ***components*** or aircraft.
15. The resultant force acting on aircraft wing may be resolved into a vertical ***component*** and horizontal ***component***.
16. The ***composition*** of cast-iron is different for different purposes.
17. Twenty-four students ***constitute*** the class.
18. A number of gases ***from*** the atmosphere.
19. Ferrite and carbon ***make up*** mild steel.
20. Ferrite and carbon are the ***constituents*** of mild steel.
21. The students in the class ***include*** three from Germany and four from France.
22. The gases in the atmosphere ***include*** oxygen and nitrogen
23. The mixture in the furnace ***includes*** certain amount of limestone.