

PROCESS METALLURGY

Metallurgy is a domain of materials science and of materials engineering that studies the physical and chemical behaviour of metallic elements.

Metallic minerals are subjected to extractive metallurgy, in which their metallic elements are extracted from chemical compound form and refined of impurities. Process metallurgy is one of the oldest applied sciences. Its history can be traced back to 6000 BC. Today there are eighty-six known metals. Before the 19th century, only twenty-four of these metals had been discovered and, of these twenty-four metals, twelve were discovered in the 18th century. Therefore, from the discovery of the first metals – **gold** and **copper** until the end of the 17th century, only twelve metals were known. Four of these metals, **arsenic**, **antimony**, **zinc** and **bismuth**, were discovered in the 13th and 14th centuries, while **platinum** was discovered in the 16th century. The other seven metals, known as the ‘Metals of Antiquity’, were the metals upon which civilisation was based. These seven metals were:

- 1 gold;
- 2 copper;
- 3 silver;
- 4 lead;
- 5 tin;
- 6 iron;
- 7 mercury.

The Mesopotamians, Egyptians, Greeks, and the Romans knew and used these metals. Of the seven metals, five can be found in their native states, e.g. gold, silver, copper, iron (from meteors), and mercury. However, the occurrence of these metals was not abundant and the first two metals to be used widely were gold and copper. The next metal to be discovered was **arsenic** in the 13th by Albertus Magnus. Arsenic (arsenious oxide) when heated with twice its weight of soap became metallic. By 1641, arsenious oxide was being reduced by charcoal. Arsenic is steel gray, very brittle, and crystalline; it tarnishes in air and when heated rapidly forms arsenious oxide with the odour of garlic. Arsenic compounds are poisonous. The symbol As is taken from the Latin *arsenicum*. Arsenic was used in bronzing and improving the sphericity of shot.

The next metal to be isolated was **antimony**. Stibium or antimony sulphide was roasted in an iron pot to form antimony. This technique is reported in 1560. Antimony, whose name comes from the Greek *anti plus monos* (a metal not found alone), has as its symbol Sb from the latin *stibium*. It is an extremely brittle flaky metal. Antimony and its compounds are highly toxic. Initial uses were as an alloy for lead as it increased



hardness. Stibnite is the most common ore. It was commonly roasted to form the oxide and reduced by carbon. By 1595, **bismuth** was produced by reduction of the oxide with carbon, however, it was not until 1753 when bismuth was classified as an element.

Zinc was known to the Chinese in 1400; however, it was not until 1738, when William Champion devised the zinc distillation process, that zinc came into common use. Before Champion's process, zinc, which was imported from China, was known as Indian tin or pewter. In 1781, zinc was added to liquid copper to make brass. This method of brass manufacture soon became dominant. One other metal was discovered in the 1500s in Mexico by the Spaniards. This metal was **platinum**. Although not 100% pure, it was the first metal to be discovered and sourced from the New World. The property which brought this metal to the prospectors attention was its lack of reactivity with known reagents. Early use of platinum was banned because it was used as a blank for coins, which were subsequently gold coated, proving that the early metallurgists understood not only density but also economics. Although, platinum was known to the western world, it was not until the 1800s that platinum became widely used.

READING COMPREHENSION

ACTIVITIES



● Answer the following questions.

- | | |
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| ① What is process metallurgy? | ⑤ Which metal was discovered by Albertus Magnus? |
| ② How many metals are known today? | ⑥ Which metal has the symbol Sb? |
| ③ Which metals are known as 'Metals of Antiquity'? Why? | ⑦ Who were the first to use zinc? |
| ④ What are the main properties of arsenic? | ⑧ What was platinum used for at first? |

VOCABULARY

● Explain in your own words the meaning of the following terms and expressions.

- | | |
|---------------------|-------------------|
| ① Compound | ④ Poisonous |
| ② Meteors | ⑤ New World |
| ③ Crystalline | ⑥ Coins |

TEXT COMPLETION

● While reading the following text on iron, fill in the blanks with the following words: nickel – hammered – Latin – meteors – farming – Greenland – oxide.

Iron was available to the ancients in small amounts from ①. This native iron is easily distinguishable because it contains 6-8% ②.

There is some indication that man-made iron was available as early as 2500 BC, however, ironmaking did not become a common process until 1200 BC. Hematite, an ③ of iron, was widely used by the ancients for beads and ornaments. It is also readily reduced by carbon. However, if reduced at temperatures below 700-800 °C, it is not suitable for forging and must be produced at temperatures above 1,100 °C.

Wrought iron was the first form of iron known to man. The product of reaction was a spongy mass of iron intermixed with slag. This was then reheated and ④ to expel the slag and then forged into the desired shape. In the early days, iron was five times more expensive than gold and its first uses were as ornaments.

Iron weapons revolutionised warfare and iron implements did the same for ⑤. Iron and steel were the building blocks for civilisation. Iron is rarely found in its native state the only known sources being ⑥, where the iron occurs as nodules in basalt that erupted through beds of coal and two very rare nickel-iron alloys. Iron's symbol is Fe from the ⑦ *ferrum*.