Lecture 04 Non-ferrous Materials Production

1. Non-Ferrous Materials

Non-ferrous metals contain metals other than iron as their main constituents such as aluminum, copper, zinc, magnesium, lead, tin, nickel and their alloys and non-metallic materials.

1.1. Aluminum

Pure aluminium has silvery color. It is ductile, malleable and very good conductor of heat and electricity. It has a very high resistance to corrosion than the ordinary steel. Its good electrical conductivity is an important property and is broadly used for overhead cables. There are several of alumimum alloys depending upon the main additive items as shown in table

Series Number	Alloying Element	Alloy Category
1XXX	Aluminum	Commercially Pure
2XXX	Copper	Heat-Treatable
3XXX	Manganese	Non Heat-Treatable
4XXX	Silicon	Non Heat-Treatable
5XXX	Magnesium	Non Heat-Treatable
6XXX	Magnesium and Silicon	Heat-Treatable
7XXX	Zinc	Heat-Treatable

Extraction of Aluminium

The aluminium production process can be broken down into three stages:

- first Bauxite, ore which contain aluminium, are extracted from the ground.
- Second, bauxites are processed into aluminium oxide or alumina (white powder from which aluminium can be extracted)
- Third, pure aluminium is produced using electrolytic reduction,

Fig 2.6 Bauxite Ore of Aluminium

The extraction is done by electrolysis which it does dissolve in molten cryolite (double fluoride of aluminium and sodium). The negative electrodes (cathodes) and the positive electrodes (anodes) are made of graphite, a form of carbon.

During electrolysis:

- positively charged aluminium ions gain electrons from the cathode, and form molten aluminium
- oxide ions lose electrons at the anode, and form oxygen molecules. The oxygen reacts with the carbon in the electrodes, forming carbon dioxide which bubbles off. Carbon is therefore lost from the positive electrodes, so they must be replaced frequently. This adds to the cost of the process.

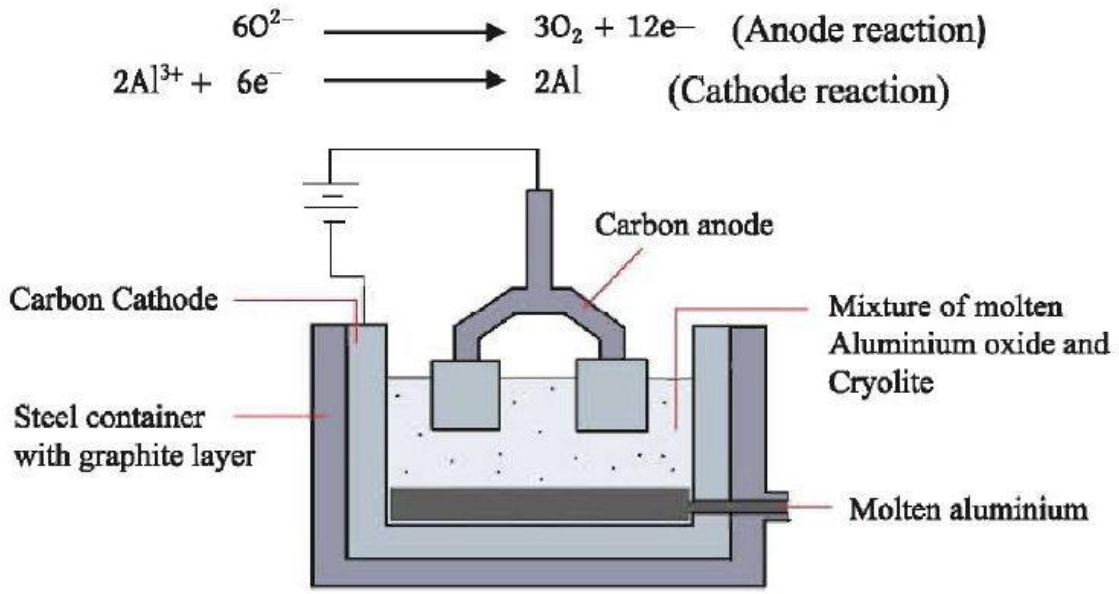

Fig 2.7 Extraction of Aluminium

A process in which aluminium oxide is broken down into its components using electric current. About 4-5 tons of bauxites get processed into 2 tons of alumina from which about 1 ton of aluminium can be made.

1.2. Copper

Copper is one of the most widely used non-ferrous metals in industry. Pure copper is soft, malleable and ductile metal with a reddish-brown appearance. It is a good conductor of electricity. It is non-corrosive under ordinary conditions and resists weather very effectively.

1.2.1. Copper Ores

Name	Formula	% Copper
Chalcopyrite	$CuFeS_2$	34.5
Chalcocite	Cu_2S	79.8
Malachite	$CuCO_3.Cu(OH)_2$	57.7
Azurite	$2CuCO_3.Cu(OH)_2$	55.1

1.2.2. Copper Extraction

It is extracted from ores of copper such as copper glance, copper pyrites, melachite and azurite. Copper ore is first ground and then smelted in a reverberatory or small blast furnace for producing an impure alloy. Then the air is blown through the molten metal to remove Sulphur and iron contamination to obtain blister copper in the converter. Copper is then refined further using electrolysis processes.

The following copper alloys are important

a. Copper-zinc alloys (Brasses)
b. Copper-tin alloys (Bronzes)

Copper is mainly used in:

1. making electric cables and wires for electric machinery, motor winding, electric conducting appliances, and electroplating etc.
2. It can be easily forged, casted, rolled and drawn into wires.
3. Copper in the form of tubes is used widely in heat transfer work of boilers, condensers, roofing etc.

1.3. LEAD

Lead is a bluish grey metal with a high metallic lustre when freshly cut. It is a very durable and versatile material. The heavy metal obtained from the bottom of the furnace is further oxidized in Bessemer's converter to remove most of the impurities.

Lead has properties of high density and easy workability. It has very good resistance to corrosion and many acids have no chemical action on it. It is the softest and heaviest of all the common metals. It can readily be scratched with fingernail when pure.

Applications

a. Lead is used in safety plug in boilers, fire door releases and fuses.
b. It is also used in various alloys such as brass and bronze.
c. In the soldering process, an alloy of lead and tin is most widely utilized as a solder material for joining metals in joining processes.

1.4. ZINC

Zinc is bluish grey in color and is obtained from common ores of zinc are zinc blende (ZnS), zincite (ZnO), calamine (ZnCO3). These ores are commonly available in Burma. The oxide is heated in an electric furnace where the zinc is liberated as vapor. The vapors are then cooled in condensers to get metallic zinc. Zinc possesses high resistance to corrosion.

Zinc is the fourth most utilized metal after iron, aluminium, and copper.it is commonly used as:

a. a protective coating on iron and steel in the form of a galvanized or sprayed surface.
b. It is used for generating electric cells and making brass and other alloys.
c. The oxide of zinc is used as pigment in paints.
d. Parts manufactured by zinc alloys include carburetors, fuel pumps, automobile parts, and so on.

1.5. TIN

Tin is considered as a soft and ductile material. It possesses very good malleability. Tin is recognized as brightly shining white metal. It does not corrode in wet and dry conditions. Therefore, it is commonly used as a protective coating material for iron and steel. The main source of tin is tinstone.

Applications

a. Tin-base white metals are commonly used to make bearings that are subjected to high pressure and load.
b. Tin is used as coating on other metals and alloys owing to its resistance to corrosion.
c. Because of its high malleability, it finds application in tin cans for storing food and food items.

YouTube: https://youtu.be/DhJVR0ZAAm8