Construction Materials For Food Science and Engineering

Construction Materials: Non-Ferrous Metal

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Non-Ferrous Metal

Non-Ferrous metal: Non-ferrous metals are those which contain a metal other than iron as their chief constituent.

Non-ferrous metals are usually employed in industries due to the following characteristics:

1. Ease of fabrication (casting, rolling forging, welding and machining)
2. Resistance to corrosion,
3. High electrical and thermal conductivity,
4. Less Weight.

The various non-ferrous metals used in food engineering practices are:

1. Aluminum (Al)
2. Copper (Cu)
3. Lead (Pb)
4. Tin (Sn)
5. Zinc (Zn)
6. Nickel (Ni)
7. Magnesium (Mg)

Aluminum

1. Aluminum: It is white metal produced by electrical processes from its oxide (alumina, AlO), which is prepared from a clayey mineral called bauxite. The aluminium compounds in the bauxite may be present as gibbsite($Al(OH)_3$), boehmite(AlOOH) or diaspore(AlOOH); . It is a light metal having specific gravity 2.7 and melting point 658^oC. The tensile strength of the metal varies from 90 to 150Mpa.

Properties: The most important property of aluminum and alloy is lightness in weight. It is highly ductile and malleable and possesses moderate strength and great resistance of corrosion. It is a metal of high metallic luster and can be rolled into sheets.

Uses: Aluminum is used in certain portion of automobile bodies. It is used for making cylinders and pistons in aircraft engines. It is widely used for kitchen utensils. Relatively high conductivity combined with its lightness and strength, makes it suitable for long span transmission lines with high voltage.

Alloy of aluminum: It can be alloyed with copper, magnesium, manganese, silicon and nickel. Addition of small quantity of alloying elements converts soft and weak metal into hard and strong metal.

Duralumin is an important alloy of aluminum whose composition is copper = 3.5-4.5%, Manganese = 0.4-0.7%, Magnesium = 0.4-0.7% and remainder is aluminum. It is high in tensile strength (400Mpa) and used as manufacturing connecting rods, bars, rivets, pulleys etc.

Copper

2. Copper: The greatest proportion of the world's supply of copper is derived from copper pyrites ($CuFeF_2$). The ore is crushed to fine power, washed and melted in a reverberatory furnace that gives copper.

Properties: It is one of the most widely used non-ferrous metals in industry. It is a soft, malleable and ductile material with a reddish-brown appearance. It also posses excellent hot working and cold working properties. It has very high thermal and electrical conductivity and resistant to corrosion. Its specific gravity is 8.9 and melting point is 1083^{o}C.The tensile strength varies from 150 MPa to 400 MPa under different conditions.

Uses: Copper is available in rods, tubes, pipes, structural shapes and wires. Due to high conductivity copper is used as electric wires. It is also used as heat-exchanges tubes., plumbing and gas lines, gasoline and oil lines. Owing to its high resistance to attack by many industrial chemicals, copper is used for pipes, tubes, stills, condensers, evaporators, autoclaves and pumps. It is also used for making cooking and dining utensils, ornaments and decorative works.

Alloy of copper: Brass is one of the important alloy of copper with zinc (10 to 45% of zinc). It is strong and ductile.

Tin

3. Tin: Tin is obtained from the ore, tin-stone (back oxide of tin, SnO_2) known as Cassiterite containing 77% of tin which is melted with charcoal or coke in reverberatory furnace and refining of the crude tin derived by remelting.

Property of tin: This is a silvery white, lustrous, and extremely malleable metal as can be seen by its form in tin foils. It specific gravity is 7.3 and melting temperature is 235^{o}C. It oxidizes very slowly. Its tensile strength and ductility are very low. It cracks easily when bent and is extremely brittle at high temperature.

Use of tin: Tin is used quite extensively in the form of sheet tin and as tin foil. It is an important constituents of many valuable alloys. A large amount of tin is used as a coating on sheet iron and steel.

Alloy of tin: bronze is an important alloy of Tin with copper. Gun metal is another alloy of tin with copper and zinc (88% copper, 8-10% tin & 2-4% zinc). Pumps casting and impellers, water turbine runners, condenser head and cylinder linings is made by gun metal.

Lead

4. Lead: Lead is extracted from the ore containing lead sulphide (PbS) known as 'galena' which contains 86.6% lead. It is obtained melting the ore in the blast furnace and collecting the molten lead. Atomic number is 82,

Property of lead: Lead is bluish gray in color. Its specific gravity is 11.35 and melting temperature is 327.46^{o}C. It is soft, plastic, malleable, High density and excellent resistant to corrosive. On exposure to the moist air, it becomes oxidized and loses its luster.

Uses of lead: Lead is available in the form of sheets, tubs, pipes, rods, wires, cast lead fittings etc. It is used for plumbing works, solders, roof covering and damp roof courses. Steel pipes, tanks etc are coated with lead as it is resistant to corrosion. Because of its high density it is used as a shielding material in nuclear reactors against gamma rays to safe personnel. Lead is used to manufacture chemical such as red lead for metal protective paints, white lead as an exterior house paints.

Nickel and Tungsten

5. **Nickel:** Nickel is extracted from nickel-ferrous magnetic pyrities containing about 3% nickel and hydrated nickel magnesium silicate containing 6 to 8% nickel melting in blast furnace.

Property of nickel: Nickel is a brilliant metal, silver in color and takes good polish and does not corrode in dry weather. It is highly resistant to corrosion. It is quite ductile and fairly malleable.

Uses of Nickel: It is used for plating iron, steel and other metals because of it resistant against corrosion.

6. **Tungsten:** It has a very high melting point as 2800^{o}C and can be rendered perfectly ductile by repeated heating and is therefore used in filaments of electric bulbs. It is used for alloying with steel to which imparts strength, hardness, toughness and resistant to shocks.

Thanks