INTRODUCTION

Non-ferrous metals refer to metals that are not derived from iron ore, such as aluminium and its alloys, copper, brass and bronze. Aluminium finds ready use in window- and door-frames, handrails, balustrades and architectural work generally. Copper is used in water pipes and guttering. The malleability (softness) of most non-ferrous metals usually limits use to non-structural elements such as decorative work. Although many non-ferrous metals are chosen specifically for their colour and lustre, there are occasions when, for one reason or another, the metal must be painted in a protective coating.

WHAT IS NON-FERROUS METALS?

Non-ferrous metals are those which do not contain significant quantity of iron or iron as base metal. These metals possess low strength at high temperatures, generally suffer from hot shortness and have more shrinkage than ferrous metals. They are utilized in industry due to following advantages:
1. High corrosion resistance

2. Easy to fabricate, i.e., machining, casting, welding, forging and rolling

3. Possess very good thermal and electrical conductivity

4. Attractive colour and low density

TYPES OF NON-FERROUS METALS ,ITS PROPERTIES, USES, APPLICATION

1. Copper

The crude form of copper extracted from its ores through series of processes contains 68% purity known as Blister copper. By electrolytic refining process, highly pure (99.9%) copper which is re-melted and casted into suitable shapes. Copper is a corrosion resistant metal of an attractive

reddish brown colour. Copper metal has a dull brown metallic lustre but will oxidise to the familiar chalky green patina often seen on copper domes on heritage buildings.

Properties and Uses:

1) High Thermal Conductivity: Used in heat exchangers, heating vessels and appliances, etc.

2) High Electrical Conductivity: Used as electrical conductor in various shapes and forms for various applications.

3) Good Corrosion Resistance: Used for providing coating on steel prior to nickel and chromium plating

4) High Ductility: Can be easily cold worked, folded and spun. Requires annealing after cold working as it loses its ductility.

APPLICATION

Architectural applications. Cooking utensils. Spark plugs. Electrical wiring, cables and busbars.

2. Aluminium

Aluminium is white metal which is produced by electrical processes from clayey mineral known as bauxite. However, this aluminium ore bauxite is available in India in plenty and we have a thriving aluminium industry.

Properties and Uses :

(1) Like copper it is also corrosion resistant.

(2) It is very good conductor of heat and electricity although not as good as copper.

(3) Possesses high ductility and light weight so widely utilized in aircraft industry.

(4) Needs frequent annealing if cold worked since it becomes hard after cold working.

(5) In view of its ductility and malleability it has replaced copper in electrical transmission and appliances to some extent.

(5) It is used in manufacturing of household utensils including pressure cookers.

APPLICATION

The properties of the various aluminium alloys has resulted in aluminium being used in industries as diverse as transport, food preparation, energy generation, packaging, architecture, and electrical transmission applications

3. Lead

Lead is the heaviest of the common metal. Lead is extracted from its ore known as galena. It is bluish grey in colour and dull lusture which goes very dull on exposure to air.

Properties and Uses :

(1) Its specific gravity is 7.1 and melting point is 360°C.

(2) It is resistant to corrosion and many chemicals do not react with it (even acids).

(3) It is soft, heavy and malleable, can be easily worked and shaped.

(4) Lead is utilized as alloying element in producing solders and plumber's solders.

(5) It is alloyed with brass as well as steel to improve their machinability.

(6) It is utilized in manufacturing of water pipes, coating for electrical cables, acid tanks and roof covering etc.

APPLICATION

Lead is still widely used for **car batteries, pigments, ammunition, cable sheathing**, weights for lifting, weight belts for diving, lead crystal glass, radiation protection and in some solders. It is often used to store corrosive liquids.

4. Tin

It is a brilliant white metal with yellowish tinge. Melting point of tin is 240°C.

Properties and Uses:

(1) Tin is malleable and ductile, it can be rolled into very thin sheets.

(2) It is used for tinning of copper and brass utensils and copper wire before its conversion into cables.

(3) It is useful as a protective coating for iron and steel since it does corrode in dry or wet atmosphere.

(6) It is utilized for making important alloys such as fine solder and moisture proof packing with thin tin sheets.

APPLICATION

It takes a high polish and is used to coat other metals to prevent corrosion, such as in tin cans, which are made of tin-coated steel.

5. Zinc

The chief ores of zinc are blende (ZnS) and calamine ($ZnCO_3$). Zinc is a fairly heavy, bluish-white metal principally utilized in view of its low cost, corrosion resistance and alloying characteristics. Melting point of zinc is 420°C and it boils at 940°C.

Properties and Uses:
(1) High corrosion resistance: Widely used as protective coating on iron and steel. Coating may be provided by dip galvanizing or electroplating.

(2) High fluidity and low melting point: Most suitable metal for pressure die casting generally in the form of alloy.

(3) When rolled into sheets, zinc is utilized for roof covering and for providing a damp proof non-corrosive lining to containers.

(4) The galvanized wires, nails, etc. are produced by galvanizing technique and zinc is also used in manufacture of brasses.

APPLICATION

Zinc is also used in **alloys** such as brass, nickel silver and aluminium solder. Zinc oxide is widely used in the manufacture of very many products such as paints, rubber, cosmetics, pharmaceuticals, plastics, inks, soaps, batteries, textiles and electrical equipment.

6. Nickel

About at least 85% of all nickel production is obtained from sulphide ores.

Properties and Uses:

1. Pure nickel is tough, silver coloured metal, harder than copper having some but less ductility but of about same strength.

2. It is plated on steel to provide a corrosion resistance surface or layer.

3. Widely used as an alloying element with steel. Higher proportions are advantageously added in the production of steel such as monel or in conel.

4. It possesses good resistance to both acids and alkalis regarding corrosion so widely utilized in food processing equipment.

APPLICATION

Nickel metal has the following applications: Its principal use is as an alloying element in stainless steels, alloys steels, non-ferrous metals and other corrosion resistant alloys

7. Magnesium

Principal Ores of magnesium are magnesite and dolomite. Magnesium is extracted by **electrolytic process**.

Properties and Uses:

(1) It is the lightest of all metals weighing around two-thirds of aluminium.

(2) The tensile strength of cast metal is the same as that of ordinary cast aluminium, i.e., 90 MPa.

(3) The tensile strength of rolled annealed magnesium is same as that of good quality cast iron.

(4) Magnesium can be easily formed, drawn forged and machined with high accuracy.

(5) In powdered form it is likely to burn, in that situation adequate fire protection measures should be strictly observed.

(7) Its castings are pressure tight and achieve good surface finish. Magnesium castings include motor car gearbox, differential housing and portable tools.

APPLICATION

Magnesium is used in products that benefit from being lightweight, such as car seats, luggage, laptops, cameras and power tools. It is also added to molten iron and steel to remove sulfur.

8. Vanadium

It occurs in conjunction with iron pyrite, free sulphur and carbonaceous matter.

Properties and Uses:

(1) It is silvery white in colour.

(2) Its specific gravity is 5.67.

(3) Its melting point is 1710°C.

(4) When heated to a suitable temperature it can be hammered into any shape or drawn into wires.

(5) It is used in manufacture of alloy steels.

(8) Vanadium forms non-ferrous alloys of copper and aluminium from which excellent castings can be produced.

APPLICATION

About 80% of the vanadium produced is used as a steel additive. Vanadium alloys are used in nuclear reactors because of vanadium's low neutron-absorbing properties. Vanadium(V) oxide is used as a pigment for ceramics and glass, as a catalyst and in producing superconducting magnets.

9. Cadmium

It is obtained commercially as a by-product in the metallurgy of zinc and to some extent of lead.

Properties and Uses:

(1) White metal with bluish tinge, capable of taking a high polish.

(2) Its specific gravity is 8.67 and melts at 321°C.

(3) It is slightly harder than tin but softer than zinc.

(4) It is malleable and ductile and can be readily rolled and drawn into wires.

APPLICATION

Common industrial uses for cadmium today are in batteries, alloys, coatings (electroplating), solar cells, plastic stabilizers, and pigments. Cadmium is also used in nuclear reactors where it acts as a neutron absorber.

10. Brass

Brass is an alloy of copper and zinc, in proportions which can be varied to achieve varying mechanical, electrical, and chemical properties. It is a substitutional alloy: atoms of the two constituents may replace each other within the same crystal structure.

Properties and uses:

Tarnish-resistant
Low-friction

Malleable
Easily machined

APPLICATION

Locks, Gears, Bearings, Valves, Braces, Brackets, Base plates

THANK YOU