

Some Important Metals and their Uses

Aluminium (Al)

It is a third most abundant element of Earth's crust. It is extracted from bauxite ($\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$). Aluminium powder is used in fireworks, flash light powder, thermite welding.

Ammonal (a mixture of aluminium powder and ammonium nitrate) is used as an explosive.

Ruby and sapphire are essentially Al_2O_3 . Ruby is red due to the presence of Cr and sapphire is blue due to Fe and Ti. Emerald is green, it contains Ca/Cr and aluminium silicates (Al_2SiO_3).

Tin (Sn)

The important ore of tin is cassiterite (SnO_2) or tin stone. In cold countries, white tin is converted to grey tin (powder), the process is known as **tin disease** or **tin plague**. Tin plating is done to prevent the rusting of iron. Tin amalgam is used in making mirrors. Pentahydrate of stannic chloride ($\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$), is called butter of tin used as mordant in dyeing.

Lead (Pb)

Lead is mainly found in the form of sulphide ore called **galena** (PbS). Red lead (minium or sindhur) is Pb_3O_4 used for making protective paint for iron and in match industry.

Zirconium (Zr)

It is used for making core of nuclear reactors and for making pumps, valves and heat exchangers.

Vanadium (V)

Vanadium pentoxide (V_2O_5) is a very good catalyst for manufacturing of sulphuric acid by contact process.

Tungsten

Tungsten filaments are used in electric bulbs. Calcium tungstate is used in X-ray tube.

Iron (Fe)

It is extracted from its haematite ore.

Cast iron It is the most impure form of iron and contains 2.5–4% carbon.

Wrought iron or **Malleable iron** is the most purest form of iron and contains minimum amount of carbon (0.12–0.5%)

Iron (II) is present in haemoglobin (blood).

Mild steel contain 0.25%–0.5% carbon while hard steels contains 0.5%–1.5% carbon. Soft steels contain carbon upto 0.25%

Stainless steel is an alloy of iron (Fe), chromium (Cr) and nickel (Ni). Ferric chloride (FeCl_3) is used as styptic to stop bleeding from a cut. Ferrous sulphate (FeSO_4) is used in making blue black ink.

Copper, Silver and Gold (Cu, Ag and Au)

These are called coinage metals. Silver is used as amalgam for filling teeth and in silvering mirrors. Silver bromide (AgBr) is used in photography. AgNO_3 is called **lunar caustic** used in preparing marking inks and hair dyes.

$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ is called **blue vitriol** or **nila thotha** and CuFeS_2 is called fool's gold.

Mercury (Hg)

Mercuric sulphide (HgS) is used as a cosmetic in Ayurvedic medicine as Makardhwaja.

Zinc (Zn)

It is used in galvanization to prevent rusting of iron. Zinc sulphide is used in the preparation of X-ray screens. Zinc oxide is known as **philosopher's wool**. Zinc sulphate ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$) is white vitriol.

Metallurgy

The process of extraction of metals from their ores is called metallurgy.

Minerals, Ores and Gangue

The natural substance in which metals and other impurities found in combined state, are called minerals.

The minerals from which metal can be extracted conveniently and beneficially, are called ores. **Gangue or matrix** are the impurities associated with the ore.

Metal	Ores	Chemical composition
Sodium	Rock salt Chile saltpetre Borax	NaCl NaNO ₃ Na ₂ B ₄ O ₇ · 10H ₂ O
Potassium	Carnallite Sylvine	KCl · MgCl ₂ · 6H ₂ O KCl
Magnesium	Carnallite Magnesite Asbestos	KCl · MgCl ₂ · 6H ₂ O MgCO ₃ CaSiO ₃ · 3MgSiO ₃
Calcium	Lime stone Gypsum Fluorspar	CaCO ₃ CaSO ₄ · 2H ₂ O CaF ₂
Aluminium	Bauxite Cryolite Feldspar	Al ₂ O ₃ · 2H ₂ O Na ₃ AlF ₆ KAlSi ₃ O ₈
Manganese	Pyrolusite Manganite Manganese blende	MnO ₂ Mn ₂ O ₃ · H ₂ O MnS
Iron	Haematite Magnetite Iron pyrites Siderite	Fe ₂ O ₃ Fe ₃ O ₄ FeS ₂ FeCO ₃
Copper	Copper glance Copper pyrites Malachite Azurite	Cu ₂ S CuFeS ₂ Cu(OH) ₂ · CuCO ₃ 2CuCO ₃ · Cu(OH) ₂
Silver	Silver glance Horn silver	Ag ₂ S AgCl
	Ruby Silver	Ag ₂ S · Sb ₂ S ₃
Gold	Calverite Sylvanite	AuTe ₂ AuAgTe ₄
Zinc	Zinc blende Calamine Zincite Franklinite	ZnS ZnCO ₃ ZnO ZnO · Fe ₂ O ₃
Mercury	Cinnabar	HgS
Tin	Cassiterite	SnO ₂
Lead	Galena	PbS

	Cerrusite Anglesite	PbCO ₃ PbSO ₄
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Non-Metals

These may be solid, liquid or gas (bromine is the only liquid non-metal).

These are soft, non-lustrous, brittle, non-sonorous and non-conductor of heat and electricity. These have low melting and boiling points. These form oxides with oxygen which are generally acidic. Their examples include noble gases, i.e. helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and some other p-block elements like chlorine (Cl₂), bromine (Br₂) and phosphorus (P) etc.

ALLOYS - Alloys are homogeneous mixtures of metals and cannot be separated into their components by physical methods.

Pure metals have poor mechanical properties. Hence, they are not used in their pure form in industry. Their properties are modified by adding other elements.

Characteristics of alloys:

Alloys are harder and tougher than the base metal and are resistant to corrosion.

They are inert to commonly used chemicals and are magnetisable and ductile.

Alloy is considered as a mixture because it shows the properties of its constituents and can have variable composition.

Amalgams

Alloys of mercury with other metals like sodium, potassium, gold and zinc etc. are called amalgams. Amalgams stored in iron bottles as iron cannot form amalgam with mercury.

Brass

Composition- zinc 30%, copper 70% uses- In making of utensils, pipes and radiator statues etc.

Yellow Brass

Composition - Cu 67%, Zn 33% uses - Hardware items.

Bronze

Composition - Copper 90%, Tin 10%

uses - In making of coins, ornaments, utensils and statues.

Stainless steel

Composition - Fe 82%, (Ni + Cr) 18 %.

Uses - In making of surgical instruments, watches and utensils etc.

Magnalium

Composition- Al 95%, Mg 5%

Uses - In making light articles and physical balance etc.

Duralumin

Composition- Al 95%, Cu 4%, Mn 0.5%

Uses -In making parts of aeroplane and ship etc.

Alnico

Composition - Al 8-12%, Ni 15-26%, Co 5-24%, Cu 6%

Remaining: Fe, Ti

Uses - It is useful in making of magnets.

German silver

Composition - Cu 60%, Zn 20%, Ni 20%

Uses - It is useful in electroplating and making of utensils.

Sterling Silver

Composition - silver 92.5%, copper 7.5%

Uses - jewelry, art object

Gun metal

Composition - Cu 88%, Sn 10%, Zn 2%

Uses - It is useful in making of guns, machine parts and canons.etc

Solder metal

Composition - Pb 50%, Sn 50%

Uses - It is mainly useful to join electric wires.

Bell Metal

Composition - copper - 77%, tin - 23%

Uses- casting of bells

Coin metal

Composition - copper 75%, nickel 25%

Uses - U.S coins

Wood's metal

Composition - Bi 50%, Pb 25%, Sn 12.5%, Cd 12.5%

Uses - fuse plugs, automatic sprinklers.

Monel

Composition - Ni 67% and copper, with small amounts of iron, manganese, carbon, and silicon.

Uses - It is resistant to corrosion and acids and thus used for making valves, pumps, shafts, fittings, fasteners, and heat exchangers.

Plumber's solder

Composition - Pb 67%, Sn 33%

Uses- soldering joints.