Chemistry
Chapter 10
Mineral Resources: Metal-Nonmetal

☐ What are minerals?

The substance available in above and underneath the soil from where metal and nonmetal can be extracted to make various products is called minerals.

☐ Earth Ingredients:

Ingredient	Symbol	Percentage
Magnesium ,	Mg	2%
Sodium	Na	3%,
Potassium	K	3%,
Calsium	Ca	4%,
Iron	Fe	5%,
Aluminium	Al	8.5%,
Silicon	Si	27%,
Oxygen	O	46%
Others	2%	

☐ Rocks

• Rocks are the hard particles created from the mix up of the minerals.

• Basically three types : Igneous rock, Sedimentary rock and Metamorphick rock

■ Igneous Rock:

• Magma is the molten substance poured from the volcanoes.

• Igneous rock are created from the magma being cool down and solidified.

• Example : Granite

■ **Sedimentary Rock:**

• Sediments are formed from the clay and sand from the earth's crust being washed away.

• Different particles in sediments organizes in layers and transforms into sedimentary rock.

• Example : Sandy Stone

■ **Metamorphick Rock:**

• Igneous and sedimentary rock transforms into metamorphick rock.

• Example : Coal

❒ Minerals and Ores

■ **Ores :**

• The minerals from metal and nonmetal can be extracted profitably are called ores.

• Galena (PbS), Bauxite and Pyrites are ores.

• Lead (Pb), Aluminium (Al) and Iron (Fe) can be extracted from the ores above.

❒ Metal Extraction

• Reactive metals are found as oxides, sulfides, nitrated and carbonates.

• Reactive metals are extracted by reduction or electrolysis process.

■ **Steps of Extraction:**

■ **Crushing the ore:**

• Joe Crusher crushes the ore into small pieces.

• Ball Crusher crushes those small pieces into powder or small lattices.

■ **Condensation of Ore:**

• The process to separate impurities from the intended metal is called condensation of ore.

• Hydrolytic, Magnetic Separation, Chemical and Froth Floatation are method of condensation.

◪ **Hydrolytic Method:**

• Applied to oxide ores

• Ore poured on a slanted, chambered table

• Impurities get washed away with water and ores go inside the chamber.

◩ **Forth Floatation Method:**

• Applied to sulfide ores

• Ores taken to a large tank with water

• Later oil is added slowly

• When air is blown, sulfer dissolves in oil and floats up as froth.

◩ **Magnetic Separation Method:**

• Applied to the gangue or ore having magnetic property

• Ores passed through a plastic conveyor belt having a outer layer with magnetic property

• Magnetic ores get separated being attracted by the magnetic outer layer.

• Fe and Ti is seprated from Chromites ($Fe0.Cr_2O_3$) and Rutile (TiO_2) in this method.

◩ **Chemical Method:**

• To extract Al from Bauxite ($Al_2O_3.2H_2O$).

Steps:

• (Bauxite + NaOH) heated up to 1500-2000 degree celsius.

• Produced $NaAlO_2$ undergoes a reaction with water and create $Al(OH)_3$.

• $Al(OH)_3$ heated upto 1100 degree celsius producing AlO_2 and water

■ **<u>Conversion of Condensed Ores</u>:**

◩ **Calcination:**

• The process to remove impurities by heating ores at a temperature below melting point

◩ **Roasting:**

• Same process as calcination but applied to nonmetal made the difference

■ **<u>Conversion of Metallic Oxide to Free Metals</u>:**

• Extract free metals by reduction

◩ **Electrolysis:**

• Highly reactive metals extracted through this method

• Molten metal oxide used as electrolyte (Formula of Cryolite Na_3AlF_6)

• After supplying electricity free metal is found at the cathode

◩ **Carbon Reduction:**

- Medium reactive metal gets free from their oxide by substitute reaction of Carbon.

◩ **Auto Reduction:**

- Low reactive metals can be extracted by only heating

■ **Purification by Electrolysis:**

- Copper (Cu) can be 98% purified by electrolysis

❑ Alloy

- Alloys are the mixture of metals.
- Times between 5000 BC to 3000 BC is called Copper age.
- Times between 3000 BC to 1000 BC is called Bronze age.

Alloy	Ingredients
Steel	Iron (99%), Carbon (1%)
Stainless Steel	Iron (74%), Chromium (18%), Nickel (8%)
Brass	Copper (65%), Zinc (35%)
Bronze	Copper (90%), Tin (10%)
Duralumin	Al (95%), Cu (4%), Mg,Mn & Fe (1%)
24 Carat Gold	Gold 100%
22 Carat Cold	Gold (87.5%), Copper (12.5%)
18 Carat Cold	Gold (61.97%), Copper (8.33%) and others

❑ Prevention of corrosion of metals

- The prevention can be done through electroplating and galvanizing
- Copper slag consists of CuO, Cu2S etc

■ **Rust Creation Steps:**

- Fe donates electron and becomes Fe^{2+}
- Fe^{2+}, H^+ and O_2 undergoes a reaction and create Fe^{3+}
- Fe^{3+} and OH^- again reacts and creates $Fe(OH)_3$
- After a time while $Fe(OH)_3$ converts into $Fe_2O_3.3H_2O$ which is rust.

❑ Nonmetal Minerals

- Sulfer is a nonmetal mineral.

■ **Use of Sulfer:**

- Preparation of sulfuric acid
- Vulcanizing of rubber
- Creating medicines to kill bacteria

■ **Preparation of sulfuric acid (Contact Method):**

- (S + open air) heated at extreme temperature produces SO2
- SO2 in presence of V2O5 heated upto 450-500 degree celsius produces SO3
- Condensation of SO3 produces H2SO4
- Extra SO3 reacts with H2SO4 and creates H2S207 (Olium)
- (Olium + water) again turns back to H2SO4