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Where Minds Pollinate

Class 12
Chemistry

Chapter 20
Materials
Handwritten Notes

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MATERIALS

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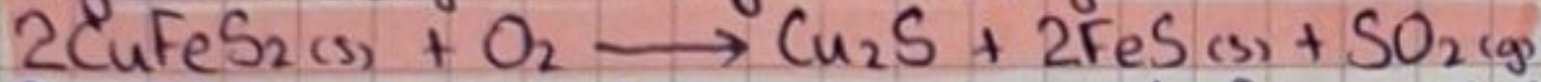
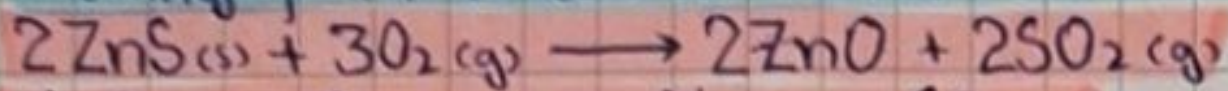
Extracting Material from Ores and Alloying

The reactivity of a metal determines how it is extracted.

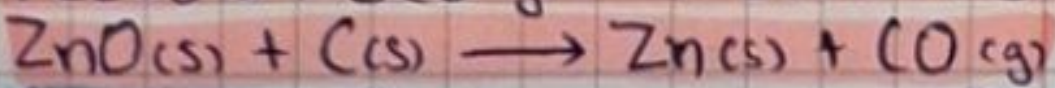
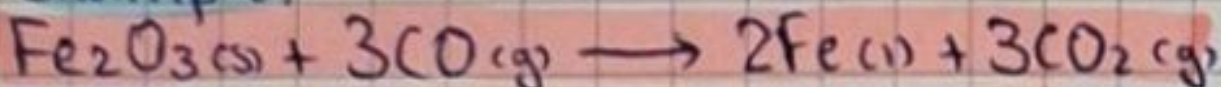
- **Extraction:** • **Crushing and Grinding:** The ore is crushed into small pieces and ground into fine powder. • **Concentration:**

Impurities are removed using methods such as froth flotation, magnetic separation, and gravity separation.

- **Roasting:** The concentrated ore is heated in air below its melting point to convert it into an oxide. For example;



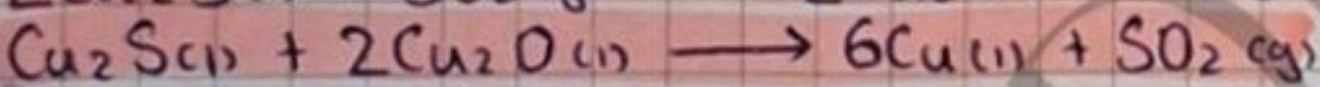
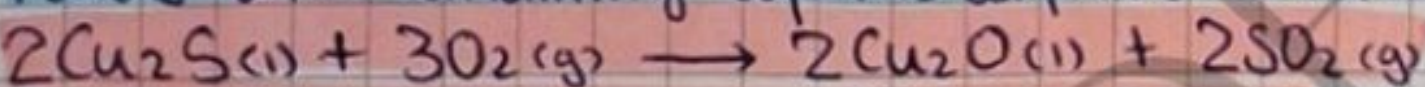
- **Smelting:** The oxide ore is reduced to free metal using reducing agents like carbon monoxide, coke, hydrogen. For example:



Copper smelting occurs in steps. The roasted ore is heated with coke and sand (1100°C) forming:

Matte ($2\text{FeS} + \text{Cu}_2\text{S}$) and Slag (FeSiO_3)

Then Bessemerization is done, in this process air is blown through the molten copper matte in a Bessemer converter. Any remaining iron sulphide (FeS) is oxidized and removed as slag. In the final smelting step cuprous sulphide (Cu_2S) is oxidized to form cuprous oxide, which reacts with remaining cuprous sulphide to form metallic copper.



The product, called blister copper is about 97% to 99% pure Cu, with entrapped bubbles of SO_2 gas.

- **Refining or purification of metals:** The metal obtained as a result of smelting contains some impurities. So, it must be refined. • **Electrolytic refining:** Used for metals like copper.

Impure metal acts as anode, pure metal as cathode, and acidified CuSO_4 as electrolyte. Pure copper deposits on the cathode, while impurities settle as anode mud. • **Distillation:** Used for metals with low boiling points like Hg and As.

- **Alloying:** Alloying is mixing a metal with other elements to improve properties like strength, hardness, and corrosion resistance.

• **Methods:** Melting and Mixing, Powder Metallurgy, Mechanical Alloying.

- **Shaping:** Casting, forging, rolling, and machining are used to give shape to metals.

- **Heat Treatment:** Annealing (improves ductility), Quenching (increases hardness), Tempering (balances hardness and toughness).

Importance of Alloy Making

Alloys are harder, more corrosion-resistant, and often have lower melting points than pure metals. Alloying improves casting quality, changes metal color, and reduces corrosion. Examples: Bronze resists weathering, Stainless Steel resists rust and staining due to chromium content.

Example of Alloys:

Steel: iron + carbon

Bronze: copper + tin

Brass: copper + zinc

Mechanism of Catalysts

Catalysis is the process in which the rate (speed) of a chemical reaction is changed by a substance called a catalyst. A catalyst is not consumed during the reaction and can be reused many times. Even a small amount of catalyst can significantly increase reaction speed. During the reaction, the catalyst usually forms a temporary unstable intermediate and then returns to its original state. Catalysts lower the activation energy required to start a reaction but do not change the overall energy of the reaction. Catalyzed reaction occurs faster than uncatalyzed reactions at the same temperature because more reactant molecules can cross the lower energy barrier. The reaction rate depends on the amount of

20-1, 20-4, 20-5
not included

Metals above carbon in the reactivity series must be extracted using electrolysis. Electrolysis can also be used to purify copper. Metal less reactive than carbon can be extracted from their ores by reduction using carbon, coke or charcoal. Platinum, gold, silver, and copper can occur native and do not need to be extracted.

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catalyst and the frequency of effective collisions in the slowest step of the reaction. Some substances catalyze. Inhibitors decrease catalytic activity. Promoters increase catalytic activity and may change the reaction temperature. Although catalysts are not used up, they can be poisoned or deactivated.

- Mechanism of Catalysts: Catalysts increase reaction rate by providing an alternative pathway with lower activation energy. Transition metals are good catalysts because their partially filled d-orbitals allow them to donate and accept electrons easily. The catalyst temporarily bonds with reactants, bringing them closer and making reactions faster and easier.

• **Example:** Decomposition of Hydrogen Peroxide $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$

Catalyst is MnO_2 . Hydrogen peroxide molecules adsorb on the MnO_2 surface, react via lower-energy pathway, and form water and oxygen, which then leave the surface. MnO_2 remains unchanged.

• **Example:** Contact Process $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$

Catalyst is V_2O_5 in the contact process for the preparation of sulphur trioxide from sulfur dioxide by oxidation.

SHORT QUESTIONS

What is the process of smelting in metal extraction.

Smelting is the process in which metal ions in an ore are reduced to free metal by heating the ore with a suitable reducing agent. Common reducing agents used in smelting are coke, carbon monoxide, and hydrogen. During smelting, the metal oxide reacts with the reducing agent at high temperature and is converted into the metal, while the oxygen combines with the reducing agent to form gases like CO_2 or H_2O . For example, iron is obtained by heating iron (III) oxide with carbon monoxide to produce iron and carbon dioxide.

Explain the role of a catalyst in a chemical reaction.

A catalyst is a substance that changes the rate of a chemical reaction without being consumed in the reaction. It works by providing an alternative pathway with lower activation energy, allowing more reactant molecules to react successfully at the same temperature. The catalyst often forms temporary intermediate compounds with reactants and then returns to its original form. Because of the lower activation energy, catalyzed reactions occur faster than uncatalyzed reactions, even when the amount of reactants remains the same.

Give an example of an alloy and its components.

An alloy is a mixture of a metal with one or more other elements to improve its properties. For example, bronze is an alloy made by combining copper and tin, usually containing about 90% copper and 10% tin. This alloy is harder and more corrosion-resistant than pure copper, which makes it suitable for making statues and tools. Alloying improves properties such as strength, durability, and resistance to environmental effects.

What is concentration in the context of ore processing.

Concentration is the process of removing unwanted impurities, called gangue, from the crushed ore before further extraction steps. After crushing and grinding, the ore is concentrated to increase the percentage of the desired metal. Common methods of concentration include froth flotation, magnetic separation, and gravitational separation. This step is important because it makes later processes like roasting and smelting more efficient.

How does refining improve the quality of metals.

Refining improves the quality of metals by removing remaining impurities from the metal obtained after smelting. One common method is electrolytic refining, where the impure metal acts as the anode and pure metal is deposited on the cathode. Impurities either remain in the solution or collect as anode mud. Other methods like distillation are used for metals with low boiling points. Refining increases the purity of metals, making them suitable for industrial and commercial use.