

Lecture 9: Classification, Composition, Synthesis and Properties of Straight Potassic Fertilizers

Classification of potassic fertilizers

Two types of potassium fertilizers are widely produced in India I. Potassium chloride (Muriate of potash) II. Potassium sulphate (Sulphate of potash)

Manufacturing processes and properties of potassic fertilizers

I. POTASSIUM CHLORIDE (KCl) [MOP]:

Potassium chloride is popularly known as muriate of potash [MOP] .The term muriate is derived from muriatic acid ,a common name for hydrochloric acid(HCl)) .It is the most important K-fertilizer used directly or in conjunction with P and N fertilizers.

Raw materials:

1. Sylvinite (or) brine

Unlike phosphate rock, K mineral salts do not require heat or strong acid treatment as they are water soluble.

Potassium chloride is recovered, from sylvinite adopting either of the two processes viz.,

1. Crystallization process

2. Flotation process

1. Crystallization process :

Principle: Crystallization process employed in separating potassium chloride from sodium chloride (Sylvinite: KCl .NaCl) is largely dependent on their different solubilities in hot (100 °C) and cold (20 °C) water . The solubility of KCl increases rapidly with a rise in temperature whereas the solubility of NaCl varies very slightly. Cool brine (20 °C) saturated with both the salts is heated to (100 °C) and passes over the finely ground sylvinite ore, when KCl rich brine solution is obtained .It is cooled by vacuum evaporation which produces KCl crystals, which are centrifuged , washed ,dried and packed .The filtrate (brine rich NaCl) is recycled for treating fresh ore.

2. Flotation process:

Separation of potassium chloride from its ore by mineral flotation is widely practiced all over the world relative to the crystallization process.

Principle: Flotation is a separation process in which a solid treated with a selective agent is suspended in an aerated aqueous liquid. The treated solid adheres to the bubbles of air, and the froth is floated off the suspension. Non floating material is removed as pulp. The sylvinite ore is a mixture of interlocked crystals of potassium chloride and sodium chloride plus small quantities of clay and other impurities.

Sylvinite ore is ground to a particle size of 10 mesh pulped in a saturated NaCl-KCl brine and scrubbed (Centrifuge) to disperse clay and other impurities. The resultant slurry is thus deslimed in spiral classifiers to remove finely divided clay slimes. Desliming or removal of clay is the most important step since this material consumes large quantities of flotation reagents. The deslimed slurry, relatively free of clay, is treated with binding agents such as starch or mannogalactan gums which selectively film the sylvinite particle so that they will float. The conditioned slurry is carried to flotation cells where air is drawn into the slurry. The air bubbles attach themselves to the reagent-treated sylvinite particle in the pulp, causing them to float to the surface as froth, which is mechanically skimmed off by paddles. The concentrate rich in KCl is further purified by sending it to cleaner cells to remove residual NaCl.

Physical properties of MOP

- MOP in pure form is white crystalline salt. However, colour ranges from white to red based on the impurities present in K minerals and methods of refinement.
- It has a solubility of 37 grams per 100 grams of water at 30 °C.
- The crystalline MOP is not very hygroscopic, flows freely and does not cake
- Has specific gravity is 1.98.

Chemical properties of MOP:

- MOP contains 58% by weight of K_2O and about 47% chloride
- MOP is neutral in reaction and does not produce acidity and alkalinity on soil application.

POTASSIUM SULPHATE (K_2SO_4) [or SOP]

The entire potassium sulphate fertilizer used in India is imported and it is more expensive than MOP.

Raw materials: 1) Langbeinite

The manufacturing process is of two types viz.

1. Langbeinite process
2. Mannheim furnace process

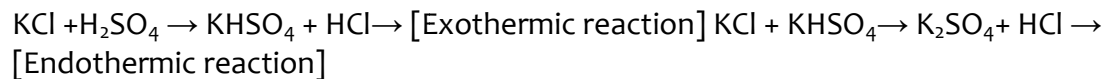
1. Langbeinite process:

The ore Langbeinite is a double sulphate of potassium and magnesium ($K_2SO_4 \cdot 2MgSO_4$). In this process Langbeinite is ground and dissolved in water and concentrated solution of KCl (brine) is added, when the potassium sulphate precipitates and is separated by centrifuging. The wet material is dried, screened and sent to storage. The chemical reaction involved is

$$K_2SO_4 \cdot 2MgSO_4 + 4KCl \rightarrow 3K_2SO_4 + 2MgCl_2$$

2. Mannheim furnace process:

In this process, potassium chloride (KCl) is reacted with sulphuric acid in a special furnace provided with rotary plough to form potassium bisulphate ($KHSO_4$) in exothermic reaction and to form potassium sulphate in endothermic reaction. HCl gas is evolved as a by product which is cooled and absorbed in water. Reactions that occur are



Physical properties of SOP

- Potassium sulphate [SOP] is a white crystalline salt, less hygroscopic as compared to MOP and free flowing.
- It has specific gravity of 2.66 and has a solubility of 13 g/100 grams of water at 30 °C.

Chemical properties of SOP:

- SOP contains 48 % K_2O and 18 % S by weight.
- Like MOP, it is also neutral salt providing neither acidity nor alkalinity on soil application.
- The SOP is widely desirable. The chloride content of KCl affects the burning quality of tobacco. Never use KCl (MOP) on tobacco crop.