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Expt: 5

SYNTHESIS OF POTASH ALUM FROM SCRAP ALUMINIUM A RECYCLING OF ALUMINUM WASTE

Aim: To prepare the crystals of potash alum, K_2SO_4, $Al_2(SO_4)_3.24H_2O$, starting from aluminium waste.

Introduction: Scrap is a term used to describe recyclable and other materials left over from every manner of product consumption, such as parts of vehicles, building supplies, and surplus materials. Recycling scrap metals can be quite beneficial to environment. Aluminium recycling is the process by which scrap aluminium can be reused in products after its initial production. The process involves simply re-melting the metal, which is far less expensive and energy-intensive than creating new aluminium through the electrolysis of aluminium oxide (Al_2O_3), which must first be mined from bauxite ore.

At the same time, we can prepare some valuable compounds by using scrap aluminium. One of such compound is, potash alum is commonly used in water purification, leather tanning, fireproof textiles, and baking powder. It also has cosmetic uses as a deodorant and as an aftershave treatment.

Theory:

Alum has been used as a coagulant , astringent, mordant, for the removal of phosphate from natural and wastewater and for fireproofing of fabrics. This experiment demonstrates the conversion of scrap aluminum to a highly useful aluminum compound, potash alum, K_2SO_4. $Al_2(SO_4)_3$. $24H_2O$. Aluminum reacts with hot aqueous KOH to give K $Al(OH)_4$:

$$2Al + 2KOH + 6H_2O \rightarrow 2K\ Al(OH)_4 + 3H_2$$

By reacting K $Al(OH)_4$ with sulphuric acid, potash alum is obtained.

$$2K\ Al(OH)_4 + H_2SO_4 \rightarrow 2Al(OH)_3 + K_2SO_4 + 2\ H_2O$$

$$2Al(OH)_3 + 3\ H_2SO_4 \rightarrow 2\ Al^{+3} + 3\ SO_4^{-2} + 6\ H_2O$$

Octahedral-shaped crystals of K_2SO_4, $Al_2(SO_4)_3.24H_2O$ are formed when the solution is cooled in an ice bath.

Potash alum is double salt, yielding the ions K^+, $Al(H_2O)_6^{3+}$ and SO_4^{2-} when dissolved in water. The term “alum” also denotes a series of crystallized double salts that have

the general formula M(I) M(III) $(SO_4)^2$. 12 H_2O, for example, chrome alum $KCr(SO_4)_2$. 12 H_2O.

In this experiment, crystals of potash alum, K_2SO_4, $Al_2(SO_4)_3.24H_2O$ will be prepared, starting from aluminum foil.

Materials Required:

Glassware:

1. 250mL Beaker – 2No.
2. Watch Glass – 1No.
3. Funnel – 1No.
4. Measuring Cylinder 25mL – 2No.
5. Glass rod – 1No.
6. Cotton
7. Water bath

Chemicals:

1. Aluminium Scrap or Powder – 0.5gm
2. KOH
3. 6M H_2SO_4 (5 mL of standard H_2SO_4 into 10 mL of dist. water)

Procedure:

1. Weigh out 0.5 g of aluminum foil, cut it into very small pieces, and place it in a 250 ml beaker
2. Very carefully, add 15 ml of KOH solution (1.75 g of KOH in 15 ml of water)
3. Heat the solution gently. Hydrogen will be evolved. Cover it with a watch glass. Control the heating so that reaction does not become too vigorous.
4. Continue heating till all the aluminum has dissolved. An ash-colored solution will be obtained (Do not heat to dryness. Replenish the water in case of excessive evaporation)
5. Filter the warm solution carefully through a thin layer of cotton or glass wool.
6. Cool the solution. Slowly add 15 ml of 6M H_2SO_4 while stirring. A solid precipitate is obtained.
7. Heat the solution gently till all the solids dissolve.
8. Cool the clear solution in an ice bath for 20 minutes. Alum crystals will be formed.
9. Filter the solution using a funnel and filter paper.

10. After drying the product, determine the yield and yield%.

RESULTS

1. Yield = ... 2. Yield% = ...