PREPARATION OF POTASH ALUM

PREPARATION OF POTASH ALUM FROM SCRAP ALUMINIUM.

Chemistry Project
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Rao Karthik Srinivas

Reg. No.

Name of Institute: Sindhi High School, Hebbal

Laboratory Certificate

This is to certify that Mr. *Rao Karthik Srinivas* of class twelve, Sindhi High School, Hebbal has satisfactorily completed the project in Chemistry for the AISSCE as prescribed by CBSE in the year 2008-2009.

Date :

Registration No. :

Signature of Internal Examiner

Signature of External Examiner

Acknowledgement

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Introduction

Aluminium because of its low density, high tensile strength and resistance and resistance to corrosion is widely used for the manufacture of aeroplanes, automobiles lawn furniture as well as for aluminium cans. Being good conductor of electricity it is used for transmission of electricity. Aluminium is also used for making utensils. The recycling of aluminium cans and other aluminium products is a very positive contribution to saving our natural resources. Most of the recycled aluminium is melted and recast into other aluminium metal products or used in the production of various aluminium compounds, the most common of which are the alums. Alums are double sulphates having general formula

$$X_2SO_4.M_2(SO_4)_3.24H_2O$$

Introduction

Some important alums and their names are given below:

$K_2SO_4.Al_2(SO_4)_3.24H_2O$ - Potash Alum

$Na_2SO_4.Al_2(SO_4)_3.24H_2O$ - Soda Alum

$K_2SO_4.Cr_2(SO_4)_3.24H_2O$ - Chrome Alum

$(NH)_2SO_4.Fe_2(SO_4)_3.24H_2O$ - Ferric Alum

Potash alum is used in papermaking, in fire extinguishers in food stuffs and in purification of water soda alum used in baking powders and chrome alum is used in tanning leather and water proofing fabrics.

In addition to these primary uses, alum is also used as

(i) *an astringent* A substance or preparation, that draws together or constricts body tissues and is effective in stopping the flow of blood or other secretions. Alum has also been used by conventional hairdressers for treating shaving cuts,

(ii) *a mordant* Substances used in dyeing to fix certain dyes on cloth. Either the mordant (if it is colloidal) or a colloid produced by the mordant adheres to the fiber, attracting and fixing the colloidal mordant dye. The insoluble, colored precipitate that is formed is called a lake. Alum is a basic mordant used for fixing acid dyes,

(iii) *for the removal of phosphate from natural and waste waters* The aluminum ions of alum combine with the orthophosphate around pH 6 to form the solid aluminum hydroxyphosphate which is precipitated and

(iv) *for fireproofing* fabrics.

The major uses of alums are based on two important properties, namely precipitation of $Al(OH)_3$ and those related to the acidity created by the production of hydrogen ions.

$$Al(H_2O)_6^{+3} \rightarrow Al(OH)_3 \downarrow + 3H_2O + 3H^+$$

The H^+ ions generated are used for reacting with sodium bicarbonate to release CO_2. This property is made use of in baking powder and CO_2 fire extinguishers.

Aim

To prepare potash alum from aluminium scrap

Requirements

- 250 ml flask
- Funnel
- Beaker
- Scrap aluminium or cola can
- Potassium hydroxide solution (KOH)
- 6 M Sulphuric Acid (H_2SO_4)
- Water Bath
- Ethanol

Theory

Aluminum metal is treated with hot aqueous KOH solution. Aluminium dissolves as potassium aluminate, $KAl(OH)_4$, salt.

$$\mathbf{2Al_{(s)} + 2KOH_{(aq)} + 6H_2O_{(l)} \longrightarrow 2KAl(OH)_{4\,(aq)} + 3H_2}$$

Potassium aluminate solution on treatment with dil. Sulphuric acid first gives precipitate $Al(OH)_3$, which dissolves on addition of small excess of H_2SO_4 and heating.

$$\mathbf{2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow 2Al(OH)_{3\,(s)} + K_2SO_{4(aq)} + 2H_2O_{(l)}}$$

$$\mathbf{2Al(OH)_{3\,(s)}} + 3\ \mathbf{H_2SO_{4(aq)} \longrightarrow Al_2(SO_4)_{3(aq)} + 6H_2O_{(l)}}$$

The resulting solution is concentrated to near saturation and cooled. On cooling crystals of potash alum crystallize out.

$$\mathbf{K_2SO_{4(aq)} + Al_2(SO_4)_{3(aq)} + 24H_2O_{(l)} \longrightarrow K_2SO_4.Al_2(SO_4)_3.\ 24H_2O_{(s)}}$$

Reactions

$$2Al_{(s)} + 2KOH_{(aq)} + 6H_2O_{(l)} \longrightarrow 2KAl(OH)_{4\,(aq)} + 3H_2$$

$$K_2SO_{4(aq)} + Al_2(SO_4)_{3(aq)} + 24H_2O_{(l)} \longrightarrow K_2SO_4.Al_2(SO_4)_3.\ 24H_2O_{(s)}$$

$$2Al(OH)_{3\,(s)} + 3\ H_2SO_{4(aq)} \longrightarrow Al_2(SO_4)_{3(aq)} + 6H_2O_{(l)}$$

$$2KOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow 2Al(OH)_{3\,(s)} + K_2SO_{4(aq)} + 2H_2O_{(l)}$$

$$K_2SO_{4(aq)} + Al_2(SO_4)_{3(aq)} + 24H_2O_{(l)} \longrightarrow K_2SO_4.Al_2(SO_4)_3.\ 24H_2O_{(s)}$$

Procedure

- Clean a small piece of scrap aluminium with steel wool and cut it into very small pieces. Aluminium foil may be taken instead of scrap aluminium.

- Put the small pieces of scrap aluminium or aluminium foil(about 1.00g) into a conical flask and add about 50 ml of 4 M KOH solution to dissolve the aluminium.

- The flask may be heated gently in order to facilitate dissolution. Since during this step hydrogen gas is evolved this step must be done in a well ventilated area.

- Continue heating until all of the aluminium reacts.

- Filter the solution to remove any insoluble impurities and reduce the volume to about 25 ml by heating.

Procedure

- Allow the filtrate to cool. Now add slowly 6 M H_2SO_4 until insoluble $Al(OH)_3$ just forms in the solution.
- Gently heat the mixture until the $Al(OH)_3$ precipitate dissolves.
- Cool the resulting solution in an ice-bath for about 30 minutes whereby alum crystals should separate out. For better results the solution may be left overnight for crystallization to continue.
- In case crystals do not form the solution may be further concentrated and cooled again.
- Filter the crystals from the solution using vacuum pump, wash the crystals with 50/50 ethanol-water mixture.

- Continue applying the vacuum until the crystals appear dry.

- Determine the mass of alum crystals.

Observations

Mass of aluminium metal =…….g

Mass of potash alum =…….g

Theoretical yield of potash alum =……g

Percent yield =……%

Result

Potash alum was prepared from aluminium scrap.

Bibliography

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- Wikipedia
- Chemicalland.com
- books.google.co.in