REGIONAL CENTRE OF EXPERTISE ON EDUCATION FOR SUSTAINABLE DEVELOPMENT

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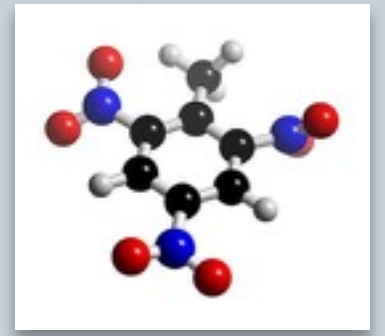
UNITED NATIONS UNIVERSITY

RCE PORT HARCOURT

SCHOOL CHEMICALS FROM SCRAP COKE COLA CANS AND CALCIUM CARBIDE-WATER REACTION RESIDUE



By

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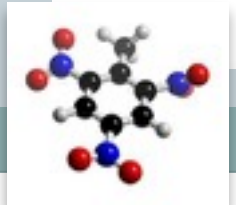
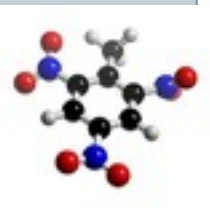
CASE STUDY 1

- Modern beverage containers are usually composed of either aluminum, in the form of aluminum cans, or the clear plastic beverage bottles.
- Approximately 30 million aluminum beverage cans are produced each day in Nigeria.
- Aluminum is one of the most indestructible materials used in metal containers.
- The average “life” of an aluminum can is about one hundred years.



- **Industrially to produce a single can, the energy needed is about the same as that required keeping a 100-watt bulb lit for 6 hours. That energy can be reduced by up to 95 percent by recycling used aluminum cans.**
- **Recycling also has the benefit of reducing litter from discarded cans although a number of states have passed laws requiring a deposit on aluminum cans to encourage recycling.**

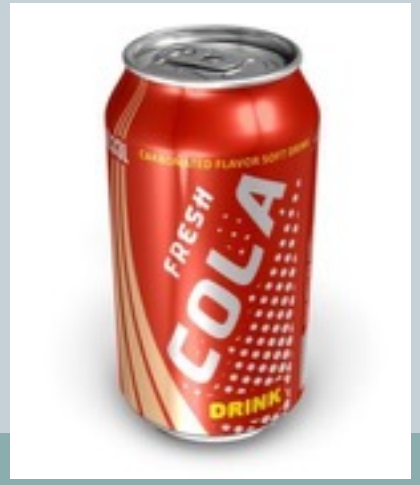


PRODUCTION OF ALUM FROM WASTE COKE COLA (ALUMINUM) CANS

Instead of recycling aluminum into new metal cans, we used some basic chemicals and apparatus found in a chemistry laboratory to transforms scrap aluminum into a useful chemical compound,

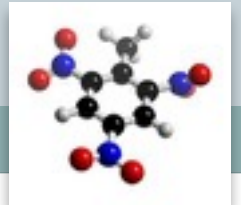
potassium aluminum sulfate dodecahydrate, $KAl(S0_4)_2 \cdot 12H_20$,

commonly called "Alum"



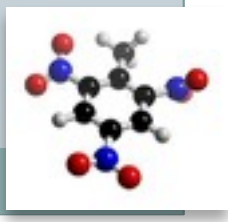
USES OF ALUM

Alum is widely used in the dyeing of fabrics, in the manufacture of pickles, in canning some foods, as a coagulant in water purification and waste-water treatment plants, and much more.



MATERIALS NEEDED

- Aluminum beverage can
- Potassium hydroxide, KOH
- 1.4 M solution Sulfuric acid, H_2SO_4
- 9 M solution Ethanol
- Sandpaper
- Scissors or metal snips
- Ruler
- Beakers
- Bunsen burner or hotplate
- Vacuum filtration apparatus
- Rubber tubing
- Filter paper
- Stirring rod
- Spatula
- Graduated cylinder



PROCEDURES

STEP I

Cut the aluminum cans to rectangular shapes.

Place in an oven to about 250^{o}C to all the paint/label to char, then wash off as completely as possible.

STEPII

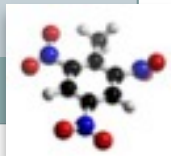
Cut your aluminum sample into small squares of about (small pieces will react at a faster rate) and place them all in a beaker.

STEP III

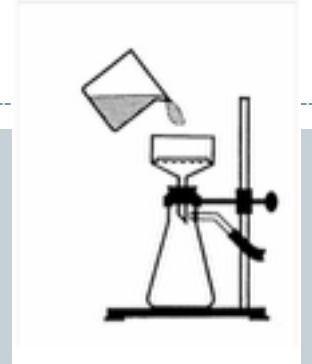
Add 50 mL of 1.4 M potassium hydroxide to the beaker containing the aluminum pieces. Place the beaker on a hotplate and heat.

Bubbles of hydrogen formed from the reaction between aluminum and aqueous potassium hydroxide.

The reaction is complete when the hydrogen evolution ceases and there are no visible pieces of aluminum metal.



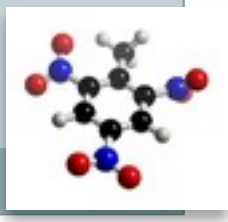
PROCEDURES II



(A vacuum filtration apparatus)

Filter the hot solution to remove any solid residue using vacuum filtration apparatus leaving a clear solution.

The filtrate should be clear with any dark residue left on the filter paper.



PROCEDURE III

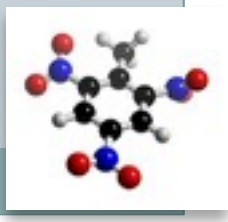
Transfer the clear filtrate into a clean beaker.

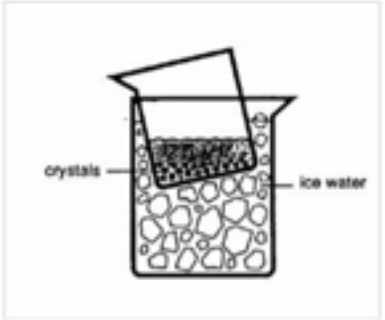
If the filtrate is not yet cool, place the beaker in a cooling bath of cold water.

Slowly and carefully, with stirring, add 20 mL of 9.0 M H_2SO_4 to the cooled solution.

Addition of the sulfuric acid will usually completely dissolve the $Al(OH)_3$. If necessary, warm the solution gently, while stirring, to completely dissolve any $Al(OH)_3$ that might have formed.

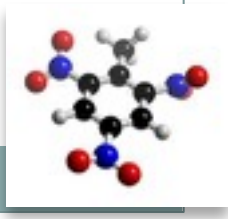
The final solution will contain potassium ions (from the KOH used), aluminum ions, and sulfate ions.





Set the reaction beaker into the ice-water bath to chill. Allow the mixture to chill thoroughly for about 15 minutes.

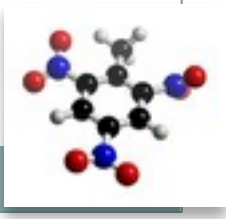
Crystals of the alum will begin to form in a few minutes.



Mix 12 mL ethanol with 12 mL water in a small beaker and chill the ethanol mixture.

Filtered the alum crystals from the chilled solution, transferring as much of the crystalline product as possible to the funnel.

(Ethanol in the wash solution reduces the solubility of the alum.)



(DURING THE PRACTICAL)

While the crystals are drying, I weighed a clean, dry beaker to the nearest 0.01 g. Recorded this mass.

Used a spatula to transfer all of the air-dried crystals from the filter paper into the beaker. Reweigh the beaker and the crystals.

Record the mass.

And Determine the mass of the alum crystals.

CASE STUDY 2

- **Calcium Hydroxide is traditionally called slake lime and is a colourless or white powdered inorganic compound.**
- **Calcium Hydroxide is also the bi-product of oxo flame weldering when Calcium carbide is used to produce Acetylene gas.**
- **Calcium Hydroxide is used in food preparation, in water and sewage treatment, etc.**

- **Study have shown that this compound is generated daily by metal fabrication companies as waste.**
- **Recycling also has the benefit of reducing this waste as it can further be used to produce laboratory chemicals when reacted with a few other chemicals.**

PRODUCTION OF SCHOOL CHEMICALS FROM CALCIUM CARBIDE-WATER REACTION RESIDUE

Calcium hydroxide is gotten from the reaction of calcium carbide and water.

We obtained the readily prepared calcium hydroxide known as welders waste from around metal fabrication companies around the university campus.

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$

(equation for the reaction)

THE FOLLOWING CHEMICALS WERE PREPARED FROM CALCIUM HYDROXIDE IN 4 EXPERIMENTS

Experiment 1

Production of Calcium Chloride from Calcium Hydroxide using Hydrochloric acid (HCl) as a co reagent

Balanced Equation

$$2HCl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O$$

Hydrochloric acid + Calcium Hydroxide → Calcium Chloride + Water

Experiment 2

Production of Calcium Sulphate from Calcium Hydroxide using Sulphuric Acid (H_2SO_4)

as a co reagent

Balanced Equation

$$H_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2H_2O$$

Sulphuric acid + Calcium Hydroxide Calcium Sulphate + W

Experiment 3

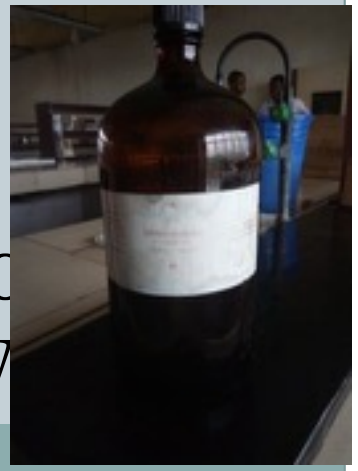
Production of Calcium Phosphate from Calcium Hydroxide using Phosphoric acid ($2H_3PO_4$)

as a co reagent

Balanced Equation

$$2H_3PO_4 + 3Ca(OH)_2 \longrightarrow Ca_3(PO_4)_2 + 6H_2O$$

Phosphoric acid + Calcium Hydroxide Calcium Phosphate + W



Experiment 4

Production of Calcium Nitrate from Calcium Hydroxide using Nitric acid (HNO_3) as a co reagent

Balanced Equation

$2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$

Nitric acid + Calcium Hydroxide Calcium Chloride + Water

MATERIALS NEEDED

- Beakers
- Bunsen burner or hotplate
- Vacuum filtration apparatus
- Rubber tubing
- Filter paper
- Stirring rod
- Spatula
- Graduated cylinder
- Weighing bottle
- 250cm3 Volumetric Flask
- Thermometer
- Measuring Cylinder
- Recrystallization dish
- Reagents

Experiment 1

Procedures

- Weight out about 2.5g of Calcium hydroxide
- Add the 2.5g of the powdered Calcium hydroxide to into a 250 ml flask and fill with distilled water.
- Using a measuring cylinder , measure 50 ml of 0.03 mol dm^{-3} acid
- Warm the solution to about 60 ^{o}c. while adding the acid, stir the aqueous 250ml Calcium hydroxide slowly, allowing the effervescence to die away between additions. Continue adding portions until there is no effervescence and some solid calcium compound can be seen in the beaker
- Filter the warm mixture into an evaporating basin. Evaporate the filtrate slowly over a hot water bath at about 60 ^{o}c until crystals form.
- Allow the concentrated solution to cool
- Filter off the crystals and put the filter paper and the crystals on a watch glass and dab dry with another piece of filter paper. Cover them with a piece of clean filter paper and leave them to dry at room temperature
- Label a sample tube with the name of the product and the date.

Weight the labelled sample tube and record its mass.

Experiment 2

Procedures

- Weight out about 2.5g of Calcium hydroxide
- Add the 2.5g of the powdered Calcium hydroxide to into a 250 ml flask and fill with distilled water.
- Using a measuring cylinder , measure 50 ml of 0.03 mol dm^{-3} acid
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- Label a sample tube with the name of the product and the date. Weight the labelled sample tube and record its mass.

Experiment 3

Procedures

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- Filter off the crystals and put the filter paper and the crystals on a watch glass and dab dry with another piece of filter paper. Cover them with a piece of clean filter paper and leave them to dry at room temperature
- Label a sample tube with the name of the product and the date. Weight the labelled sample tube and record its mass.

Experiment 4

Procedures

1.Weight out about 2.5g of Calcium hydroxide
2.Add the 2.5g of the powdered Calcium hydroxide to into a 250 ml flask and fill with distilled water.
3.Using a measuring cylinder , measure 50 ml of 0.03 mol dm^{-3} acid
4.Warm the solution to about 60 ^{0}c. while adding the acid, stir the aqueous 250ml Calcium hydroxide slowly, allowing
5.the effervescence to die away between additions. Continue adding portions until there is no effervescence and some
6.solid calcium compound can be seen in the beaker
7.Filter the warm mixture into an evaporating basin. Evaporate the filtrate slowly over a hot water bath at about 60 ^{0}c until crystals form.
8.Allow the concentrated solution to cool
9.Filter off the crystals and put the filter paper and the crystals on a watch glass and dab dry with another piece of filter paper. Cover them with a piece of clean filter paper and leave them to dry at room temperature
10.Label a sample tube with the name of the product and the date. Weight the labelled sample tube and record its mass.

(DURING THE PRACTICAL)

Uses of Calcium Chloride ($CaCl_2$)

•Used to increase water hardness in swimming pools. This process reduces the erosion of the concrete in the pool.
•Used as an ingredient for food.
•Used in the production of medicine.

Uses of Calcium Phosphate ($Ca_3(PO4)_2$)

•Used as a combination in medecines for the treatment of low blood calcium levels.
•Used as leavening agent in the production of self-raising flowers.

Uses of Calcium Sulphate ($CaSO_4$)

•Used as food additives.
•Used in the industry i.e Adhesives and sealant chemicals, agricultural chemicals.

Uses of Calcium Nitrate ($Ca(NO_3)_2$)

•Used as a source of fertilizers.
•Used as plant food.

THANK YOU