Milk of magnesia extemporaneous preparation

Student worksheet

Health and safety note

Wear eye protection, 1 mol dm^{-3} sulfuric acid is an irritant. Take care when handling hot apparatus.

Background

Magnesium hydroxide, $Mg(OH)_2$, may be used as a laxative and as an antacid.

Indigestion and heartburn are caused when acid in the stomach flows back up the oesophagus (called reflux). Antacids neutralise some of this acid giving relief from the discomfort.

Milk of Magnesia is an antacid that consists of a suspension of magnesium hydroxide in water. It may be bought in pharmacists and supermarkets.

Medicines are usually supplied to the pharmacist already prepared. Occasionally, a pharmacist formulates one or two medicines on the premises. These are called extemporaneous preparations. Instructions are given in pharmacopoeias such as the British Pharmacopoeia (BP). Here are the instructions in the British Pharmacopoeia for 'Magnesium Hydroxide Mixture'.

DO NOT USE chloroform in the preparation – omit it from the formulation. Carry out a risk assessment and check with your teacher before carrying out the preparation.

Professional preparation of magnesium hydroxide mixture. DO NOT follow.

Magnesium Hydroxide Mixture

(Magnesium Hydroxide Oral Suspension; Cream of Magnesia)

Definition

Magnesium Hydroxide Mixture is an aqueous suspension of hydrated magnesium oxide. It may be prepared from a suitable grade of Light Magnesium Oxide.

Content of hydrated magnesium oxide, calculated as $Mg(OH)_2$ 7.45 to 8.35% w/w.

Extemporaneous preparation

The following formula and directions apply

Magnesium sulfate, 47.5 g

Sodium hydroxide, 15 g

Light magnesium oxide, 52.5 g

Chloroform, 2.5 cm^3

Purified water, freshly boiled and cooled; sufficient to produce, 1 dm^3 (1000 cm^3)

Dissolve the sodium hydroxide in 150 cm^3 of purified water, add the light magnesium oxide, mix to form a smooth cream and then add sufficient purified water to produce 2500 cm^3. Pour this suspension in a thin stream into a solution of the magnesium sulfate in 2500 cm^3 of purified water, stirring continuously during the mixing. Allow the precipitate to subside, remove the clear liquid, transfer the residue to a calico strainer, allow to drain and wash the precipitate with purified water until the washings give only a slight reaction for sulfate. Mix the washed precipitate with purified water, dissolve the chloroform in the mixture and add sufficient purified water to produce 1000 cm^3.

Assay

Mix 10 g with 50 cm^3 of water, add 50 cm^3 of 0.5 mol dm^{-3} sulfuric acid and titrate the excess acid with 1 mol dm^{-3} sodium hydroxide using methyl orange as indicator. Each cm^3 of 0.5 mol dm^{-3} sulfuric acid is equivalent to 29.16 mg of hydrated magnesium oxide calculated as $Mg(OH)_2$.

In this activity you will make 100 cm^3 of magnesium hydroxide mixture and analyse it.

Step 1: Preparing magnesium sulfate-7-water

Equipment and materials

- 25 cm^3 measuring cylinder
- Tripod and gauze
- Bunsen burner
- Stirring rod
- 250 cm^3 beaker
- Evaporating basin
- Balance
- 1 mol dm^{-3} sulfuric acid − Irritant
- Magnesium oxide

Method

1. Use a measuring cylinder to measure 20 cm^3 of 1 mol dm^{-3} sulfuric acid into a beaker. Stand a stirring rod in the acid to prevent the solution from 'bumping' when it is heated later.
2. Heat on a tripod and gauze using a Bunsen burner until the acid just boils. Turn the Bunsen off and add magnesium oxide one spatula measure little at a time, stirring after each addition, until no more dissolves.
3. Filter the hot mixture into a pre-weighed evaporating basin. Place the basin on the tripod and gauze and gently heat it until crystals begin to appear. Put the dish to one side and allow it to cool.
4. Leave until all the water has evaporated and a crystalline solid, $MgSO_4.7H_2O$, remains.
5. Weight basin and crystals and calculate the yield of $MgSO_4.7H_2O$. Record this mass.

Calculating percentage yield

Write a balanced equation for the reaction between magnesium oxide and sulfuric acid.

Magnesium oxide was in excess, so the theoretical yield depends on the amount of sulfuric acid. Calculate:

- the number of moles of sulfuric acid that were used;
- the theoretical yield of $MgSO_4.7H_2O$.

From the mass of $MgSO_4.7H_2O$ obtained (actual yield), calculate the percentage yield of a reaction from the theoretical yield and actual mass of product obtained.

Step 2: Preparing magnesium hydroxide mixture

Method

Rewrite the method given in the British Pharmacopoeia as a series of steps, adapting it where necessary to make 100 cm^3 of magnesium hydroxide mixture and taking into account any limitations you have on chemicals and equipment. List the equipment and materials needed.

You might want to consider, for example, how to:

- avoid using solid sodium hydroxide or concentrated sodium hydroxide solution (both are extremely corrosive);
- produce a thin steam of the magnesium oxide suspension;
- stir the mixture continuously;
- remove the clear liquid;
- obtain the residue if you do not have a calico strainer;
- test for sulfate ions in the washings.

Once it has been checked, use the method to make 100 cm^3 of magnesium hydroxide mixture.

Step 3: Magnesium hydroxide mixture assay

Method

You are provided with 0.10 mol dm^{-3} sulfuric acid and 0.20 mol dm^{-3} sodium hydroxide solution. These are not the concentrations used in the BP assay. Adapt the BP assay to use these more dilute solutions for the assay. List the equipment and materials needed.

You might want to consider:

- what mass magnesium hydroxide mixture to take;
- how to take sample of magnesium hydroxide mixture bearing in mind that the mixture is a suspension that settles over time;
- how many titrations you need to carry out;
- what mass of hydrated magnesium oxide calculated as $Mg(OH)_2$ each cm^3 of 0.100 mol dm^{-3} sulfuric acid is equivalent to.

Carry out a risk assessment and check with your teacher before carrying out the assay.

Once it has been checked, use the method to assay your magnesium hydroxide mixture.