|  |
| --- |
| Chemical Investigations |
| Preparation of aspirin |
| Teacher/Technician Guide |

A picture containing room, drawing

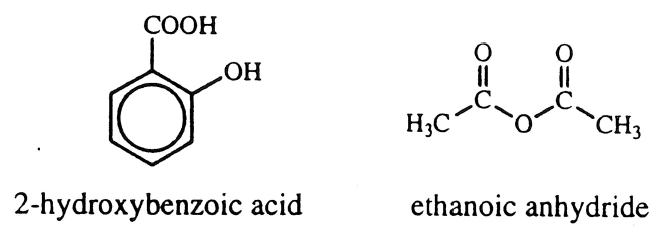
Description automatically generated

Preparation of Aspirin

*UNIT 3 PPA 4*

**Introduction**

Aspirin is an analgesic (pain-killing), anti-inﬂammatory and anti-pyretic (fever-reducing) drug. It is an ester and can be prepared by the condensation reaction between 2-hydroxybenzoic acid (or salicylic acid) and ethanoic anhydride:



After purification by recrystallisation, the product can be weighed and the percentage yield determined. The purity of the ﬁnal sample can be checked by determining its melting point.

**Health & Safety**

Wear eye protection and if any chemical splashes on your skin wash it off immediately.

2-hydroxybenzoic acid is harmful if swallowed, causes serious eye damage and is a reproductive toxin. Wear goggles (BS EN166 3) and consider gloves.

Ethanoic anhydride is flammable, corrosive to skin and eyes and harmful if swallowed or inhaled and is severely lachrymatory. The liquid irritates and burns the eyes and skin severely while the vapour irritates the respiratory system and may cause bronchial and lung injury. Wear goggles (BS EN166 3) and gloves and handle in a fume cupboard.

85 % phosphoric acid is corrosive; it burns and irritates the skin and eyes. It is a systemic irritant if inhaled and if swallowed, causes serious internal injury. Wear goggles (BS EN166 3) and gloves.

Ethanol is volatile, highly flammable, irritating to the eyes and intoxicating if inhaled or ingested.

**Requirements**

|  |  |
| --- | --- |
| 2-hydroxybenzoic acid | ethanoic anhydride |
| 85% phosphoric acid | ethanol |
| deionised water |  |
| 50 cm3 conical ﬂask | 100 cm3 conical ﬂasks |
| measuring cylinders (10 cm3, 50 cm3) | 250 cm3 glass beakers |
| thermometers anti-bumping granules | dropper |
| balance (accurate to 0.01 g) ice | hot plate |
| glass stirring rod | Buchner funnel and ﬂask |
| water pump | ﬁlter papers |
| clock glass | oven |
| melting point apparatus | capillary tube |

**Procedure**

1. Weigh a 50 cm3 conical ﬂask and to it, add about 5 g of 2-hydroxybenzoic acid. Reweigh the ﬂask and its contents.
2. In a fume cupboard, add l0 cm3 of ethanoic anhydride from a measuring cylinder, to the 2-hydroxybenzoic acid. During the addition, swirl the contents of the ﬂask to ensure thorough mixing.
3. Add 5 drops of phosphoric acid to the mixture, again with swirling.
4. Place the ﬂask on a hot plate (in the fume cupboard) and heat the mixture to about 85°C. Hold it at this temperature for about l0 minutes and constantly stir the mixture.
5. Cool the mixture in an ice/water bath and then pour it into approximately 150 cm3 of cold water contained in a 250 cm3 beaker.
6. Filter off the precipitate at the water pump and wash it thoroughly with several portions of cold water.
7. Transfer the crude product to about 15 cm3 of ethanol in a 100 cm3 conical ﬂask. Add a couple of anti-bumping granules and heat the mixture gently on a hot plate until the solid dissolves.
8. Pour this solution into a 100 cm3 conical ﬂask containing about 40 cm3 of water. If an oil forms, re-heat the mixture on the hot plate to dissolve it. If the oil still persists, add a few drops of ethanol and re-heat the mixture.
9. Set aside the mixture and allow it to cool to room temperature.
10. Filter off the crystals of aspirin at the water pump and wash them with a small volume of cold water. Allow air to be drawn through the crystals for a few minutes in order to partially dry them.
11. Weigh a clock glass and transfer the crystals to it. Dry the crystals in an oven at about 100°C and then reweigh the clock glass and crystals.
12. Determine the melting point of the aspirin.
13. Calculate the percentage yield of aspirin.

**Notes**

Ethanoic anhydride hydrolyses quite rapidly and so a fresh sample must be used for the successful preparation of aspirin.

When the reaction mixture is added to the cold water, the crude aspirin may separate as an oil initially, but it will soon solidify as the stirring proceeds.

If crystals of aspirin fail to appear on recrystallisation, then ‘seeding‘ the solution or scratching with a glass rod will rapidly induce crystallisation.

The aspirin crystals could equally well be dried in the open air or in a desiccator with silica gel or anhydrous calcium chloride as desiccant.

TEACHER/TECHNICIAN GUIDE -

Requirements per student (or group)

**Reagents**

|  |  |
| --- | --- |
| 2-hydroxybenzoic acid (~5 g) | ethanoic anhydride (10 cm3) |
| 85 % phosphoric acid (~0.25 cm3) | ethanol (~15 cm3) |
| deionised water | anti-bumping granules |
| ice for ice/water bath |  |

**Apparatus**

|  |  |
| --- | --- |
| 50 cm3 conical ﬂask (1) | access to balance (accurate to 0.01 g) |
| 10 cm3 measuring cylinder (1) | 50 cm3 measuring cylinder (1) |
| access to hot plate | dropper (1) |
| 0 - 100°C thermometer (1) | glass stirring rod (1) |
| Buchner funnel and ﬂask (1) | ﬁlter papers to fit Buchner funnel (2) |
| water pump (1) | 100 cm3 conical ﬂasks (2) |
| clock glass (1) | access to oven |
| 0 - 200°C thermometer (1) | 250 cm3 glass beakers (2) |
| access to melting point apparatus | capillary tube (1) |

**Notes**

Ethanoic anhydride hydrolyses quite rapidly and so a fresh sample must be used for the successful preparation of aspirin.

When the reaction mixture is added to the cold water, the crude aspirin may separate as an oil initially, but it will soon solidify as the stirring proceeds.

If crystals of aspirin fail to appear on recrystallisation, then ‘seeding‘ the solution or scratching with a glass rod will rapidly induce crystallisation.

The aspirin crystals could equally well be dried in the open air or in a desiccator with silica gel or anhydrous calcium chloride as desiccant.