

Competition – Lab from 5 OTC Products

By Volanschemia

Preface

My focus for this OTC lab is organic chemistry. I decided on this avenue because I have found that OTC organic chemistry is not nearly as common or documented as its inorganic counterpart. All five of my ingredients are available within an hour's drive from my home. Because this venture is focused towards organic, the equipment and glassware requirements are not ideal for a beginner, but I hope that this is countered by the number of extremely useful reagents that have been prepared from this lab.

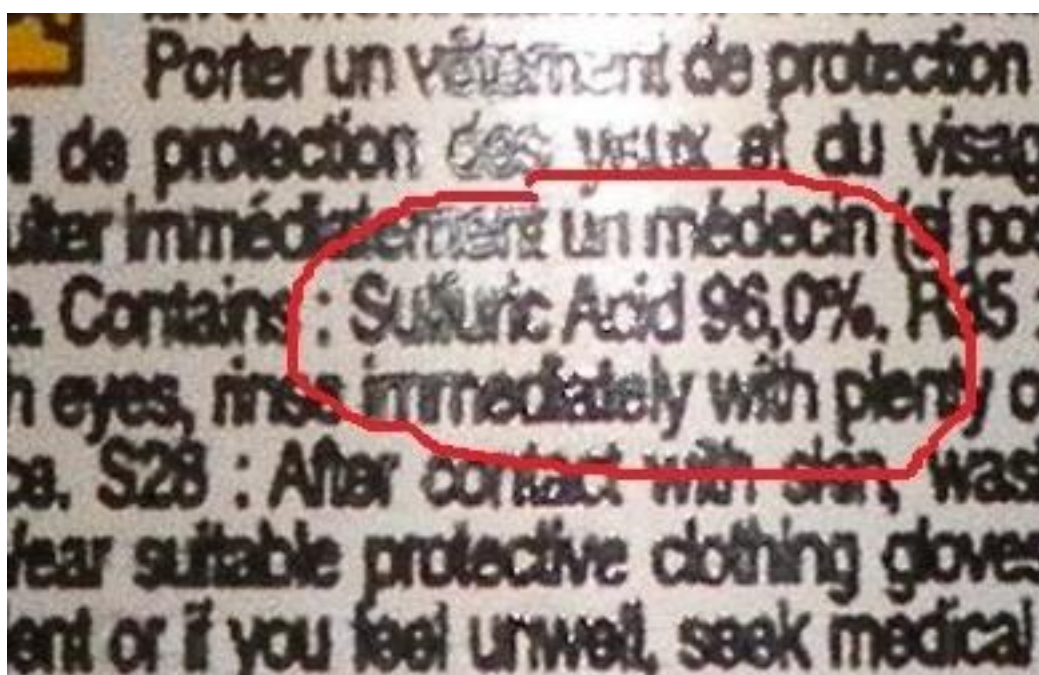
Safety

- Potassium Permanganate reacts violently with some organic solvents, is capable of oxidizing skin and staining everything brown.
- Xylenes are extremely flammable and vapours can cause headaches and dizziness if inhaled in large quantities.
- Ethanol is extremely flammable.
- 2-(acetyloxy)benzoic Acid is toxic if ingested in moderate amounts.
- Ethyl 2-Hydroxybenzoate is toxic if ingested in moderate amounts.
- Sulphuric Acid is very corrosive and reacts violently with water.
- Phthalic Anhydride can cause respiratory irritation and asthma when sublimated.
- Phenol is moderately toxic and corrosive.
- Ethoxyethane is extremely flammable and causes headaches and dizziness if inhaled.
- Ethanal is extremely flammable and causes headaches and dizziness if inhaled. It has been identified as a potential human carcinogen.
- Ethanoic Acid is corrosive.
- Manganese(VII) Oxide is an extremely powerful oxidizing agent. It is capable of igniting human skin on contact and reacts explosively with many organic compounds. When it reacts, it gives off Manganese fumes which are toxic with acute and chronic effects.

Full PPE is highly recommended when working with the above.

Products Chosen

- **Potassium Permanganate** – [Sold as disinfectant by Chemist Warehouse](#), contains 1g/g Potassium Permanganate.
- **Xylenes** – [Sold as Xylene by Bunnings Warehouse](#), [MSDS](#). Contains mixed isomers of Dimethylbenzene, with small amounts of Ethylbenzene and Benzene.
- **Ethanol** – [Sold as Methylated Spirits by Bunnings Warehouse](#), [MSDS](#). Contains 95% Ethanol, 5% Water with small amounts of denaturant.
- **2-(acetyloxy)benzoic Acid** – [Sold as Aspirin by Coles Supermarkets](#). Contains 300mg 2-(acetyloxy)benzoic Acid with gluten, starch and other binders per tablet.
- **Sulphuric Acid** – Sold by Home Hardware as Dynatherm by Orapi (link not available as business does not have an online store, see photo below). Contains 96% Sulphuric Acid with a small amount of contaminant that colours the acid lightly amber, has no effect on reactions specified here.



Reagents Synthesised/Extracted & Recovered From Products

Those highlighted in Red have a particular importance/usefulness in an organic lab.

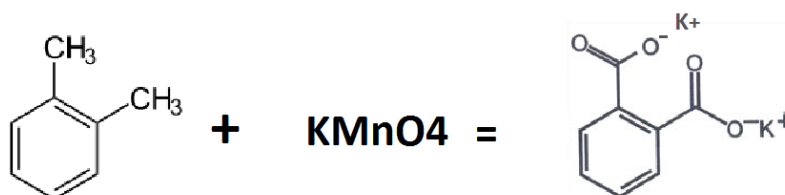
- Potassium Phthalate
- Phthalic Acid
- Phthalic Anhydride (Precursor to many other organic molecules)
- Manganese(IV) Oxide (Good oxidizer, not as aggressive as permanganate)
- 2-(acetyloxy)benzoic Acid
- 2-Hydroxybenzoic Acid
- Phenol (Precursor to many other organic molecules)
- Phenolphthalein (Highly useful pH indicator)
- Ethyl 2-Hydroxybenzoate
- Ethyl Ethanoate (Non-polar solvent)
- Ethoxyethane (Very useful solvent and reactant)
- Ethanal (Extremely useful reactant for condensation reactions etc.)
- Ethanoic Acid (Commonly used carboxylic acid)
- Manganese(VII) Oxide (Not recovered from the Sulphuric Acid, I'm not that brave)

Procedures

Double Benzylic Oxidation of Xylenes

Overview:

This is a standard double oxidation by Potassium Permanganate, which oxidized both methyl groups on the Benzene ring to convert them to carboxylic acid groups. The Potassium Permanganate is in turn reduced to Manganese(IV) Oxide.



Reagents:

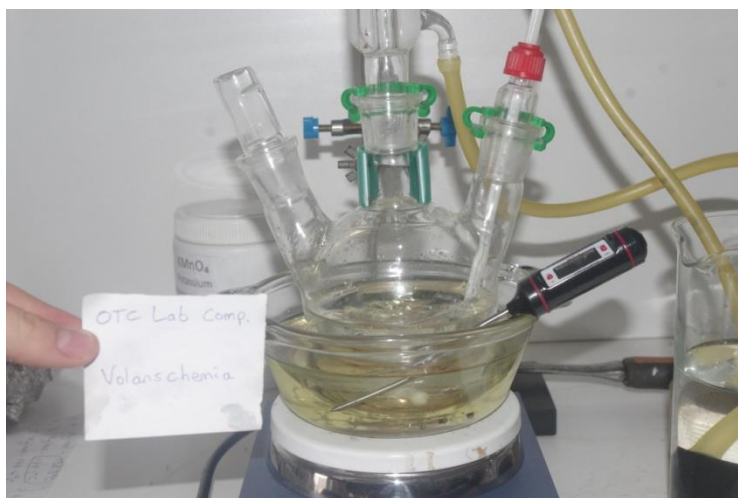
- 10.6g Xylenes (containing ~75% 1,3-Dimethylbenzene, 20% 1,2-Dimethylbenzene, 5% 1,4-Dimethylbenzene)
- 63.2g Potassium Permanganate
- 200mL Distilled Water

Equipment:

- Hotplate/Stirrer and Stir Bar
- Oil Bath
- 3-necked 500mL Round Bottomed Flask
- Thermometer with Adapter
- Reflux Condenser
- Condenser Water Setup
- Ground Glass Stopper
- Powder Funnel
- Vacuum Filtration System

Procedure:

The 3-necked flask was charged with a stir bar, 200mL of distilled water and 10.6g of Xylenes. The thermometer was fitted to one of the side necks and lowered into the solution and the condenser was fitted to the middle neck. The stopper was placed in the last neck and the setup was clamped in place in an oil bath.

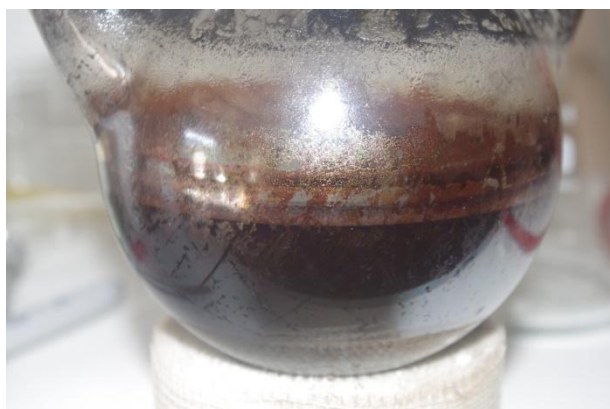


The hotplate was turned on and the oil bath was heated to approximately 85 degrees Celsius and maintained there for the remainder of the reaction. When the Xylene solution had reached 80 degrees, the stopper was removed and approximately one tenth of the Potassium Permanganate was added through the powder funnel. This resulted in an instant intensely purple solution.



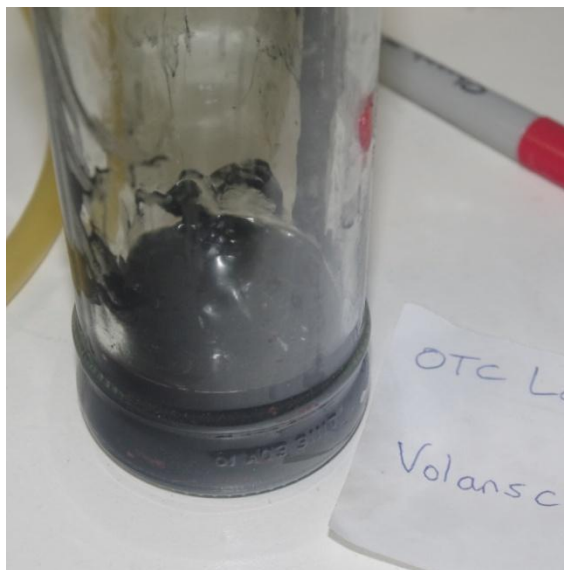
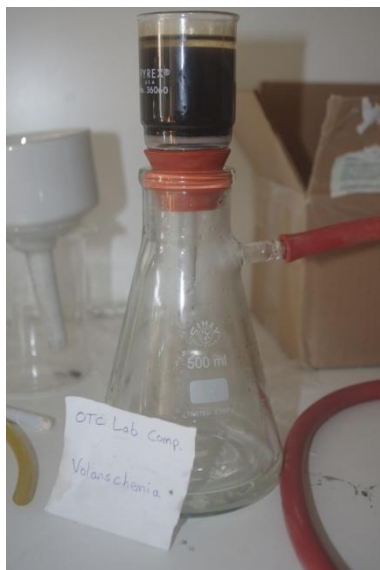
After a short time the purple became brown as the permanganate oxidizes the Xylenes and is in turn reduced to Manganese(IV) Oxide.

Whenever the solution became brown, another tenth of the Potassium Permanganate was added with the powder funnel until it was all added.



The mixture was then stirred very fast for about 5 minutes to lift up any Potassium Permanganate that may have settled on the bottom. The solution was still slightly purple at this stage, so a small amount of Sodium Thiosulphate was added to neutralise the remaining Potassium Permanganate. None of the Sodium Thiosulphate makes up the product of the reaction; it is acting as an extraction reagent.

The mixture in the round bottomed flask was allowed to cool to room temperature and was then filtered through a fritted funnel on vacuum to remove the Manganese(IV) Oxide.



The Manganese(IV) Oxide in the filter funnel was washed with Ethanol to remove the Xylenes, and then water to remove the Ethanol and other soluble impurities. It was then placed in a jar where I dried it by heating it while under an airstream. This took a considerable amount of time.

Cleanup of the Manganese(IV) Oxide in the flask and in the funnel was done using 32% Hydrochloric Acid. Be aware that this produces small amounts of Chlorine gas.

Yield and Experimenter's Notes:

Yields are not available for this step as the Potassium Phthalates were not crystallised.

This reaction is not an excellent way to get the Phthalates, as the commercially available Xylenes only contain about 20% 1,2-Dimethylbenzene and you expend a large amount of Potassium Permanganate oxidizing the other isomers. It is however the only really viable method to getting Phthalates OTC in Australia, due to Bis(2-Ethylhexyl)phthalate being banned in gloves here.

Xylene isomers are almost impossible to separate via distillation, but it may be possible to greatly increase the concentration of 1,2-Dimethylbenzene by freezing, as each isomer has a large difference in freezing point. I did not have access to dry ice or liquid nitrogen at the time so could not attempt this.

Potassium Phthalates to Phthalic Acids

Overview:

This step is simply acidifying the solution and restoring the Phthalic Acid from its salt form. The free acid is sparingly soluble in water, whereas Potassium Phthalate is very soluble in water.

Reagents:

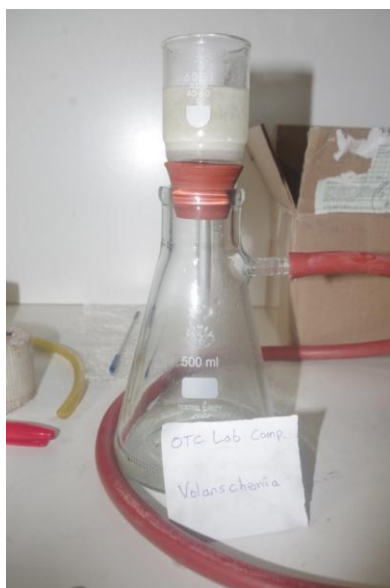
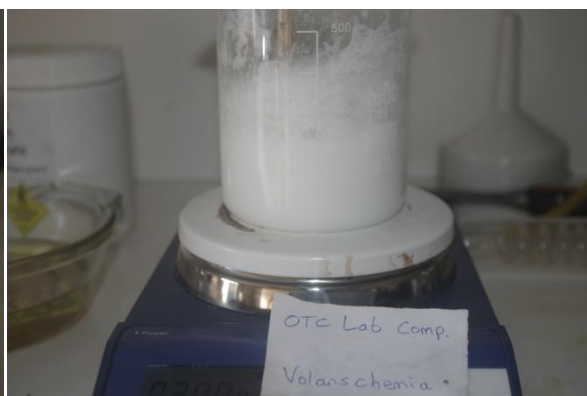
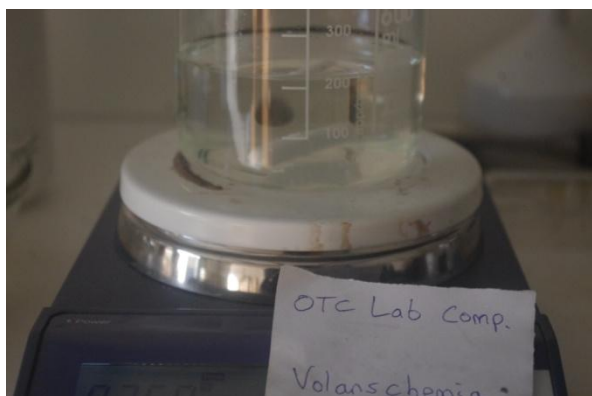
- Potassium Phthalate + Impurities Solution
- 10g 96% Sulphuric Acid

Equipment:

- Magnetic Stirrer and Stir Bar
- 600mL Beaker
- Vacuum Filtration System

Procedure:

The solution of Phthalic Acids was added to a 600mL beaker and a stir bar followed. Fast stirring was started and 10g of 96% Sulphuric Acid was very slowly added. A white precipitate instantly crashes out of solution and some foaming of Carbon Dioxide occurs due to break down of products.



The mixture was stirred for a further five minutes to ensure everything had reacted and was then placed in the lab freezer to chill.

When it was at zero degrees, it was vacuum filtered through a fritted funnel and dried as much as possible under vacuum.

Yield and Experimenter's Notes:

Yields not available as I did not completely dry the Phthalic Acids.

Separation of the isomers may be possible here by differences in solubility, but I opted to just heat them all together knowing that only the o-Phthalic Acid will decompose to Phthalic Anhydride.

Decomposing to Phthalic Anhydride

Overview:

This is a very interesting reaction, because it is rather unique. Here Phthalic Acid is decomposed to its anhydride, Phthalic Anhydride, by heating. It is very unusual for an anhydride to be formed from an acid in this way.



Reagents:

- Phthalic Acids

Equipment:

- Hotplate
- Small Beaker (it will likely be destroyed by carbon stains)
- Round Bottomed Flask

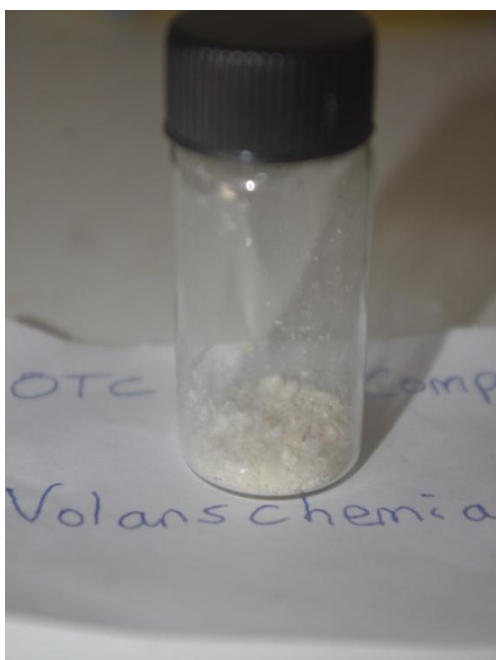
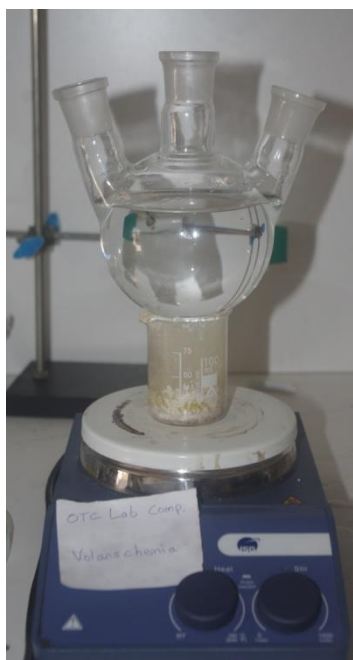
Procedure:

The mixture of Phthalic Acids was placed into an already worse-for-wear 100mL beaker and was placed on the hotplate. The heat was turned on moderately high until all the excess water had boiled off. In the meantime a round bottomed flask was filled with cold water to act as a crude condenser.



When all the water had been boiled off the heat was turned onto maximum.

The o-Phthalic Acid melts, whereas the other isomers start to burn. When it was noticed that Phthalic Anhydride was starting to sublime off (the vapours become much whiter), the round bottomed flask was placed on top of the beaker to condenser the vapours.



When there were a sizeable amount of crystals on the flask, the heat was turned off and the beaker was allowed to cool. Cooling is important to allow the Phthalic Anhydride vapours to condense, otherwise when you remove the flask, they will all shoot out of the beaker.

The crystals were scraped off into a vial for storage.

Yield and Experimenter's Notes:

Yield of Phthalic Anhydride was 1.29g, which corresponds to a 30% yield assuming the Xylenes contained 20% 1,2-Dimethylbenzene. Major losses could have been attributed to:

- There was less than 20% 1,2-Dimethylbenzene in the Xylenes.
- Phthalic Acid left in solution.
- Destruction of product due to over oxidation.
- o-Phthalic Acid trapped by charred isomers and unable to decompose.
- Mechanical losses in the filter funnel and beaker.

Yield could possibly be improved by separating the Xylene isomers by freezing (see above), slower addition of Potassium Permanganate to Xylenes and grinding up the powder in the beaker to allow all the o-Phthalic Acid to decompose.

Extracting 2-(acetyloxy)benzoic Acid from Aspirin Tablets

Overview:

There is no synthesis in this step, merely an extraction. 2-(acetyloxy)benzoic Acid is not soluble in water, but it is soluble in Ethanol. The impurities in the Aspirin tablets are not soluble in Ethanol, so this allows for an effective separation.

Reagents:

- 192 300mg Aspirin Tablets
- 760mL Ethanol (95%)

Equipment:

- Hotplate/Stirrer
- 1000mL Beaker
- Stir Bar
- Vacuum Filtration Setup
- Mortar & Pestle

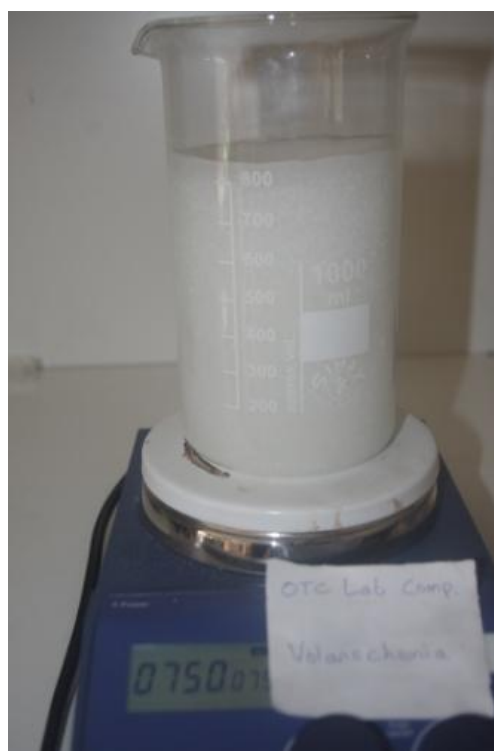
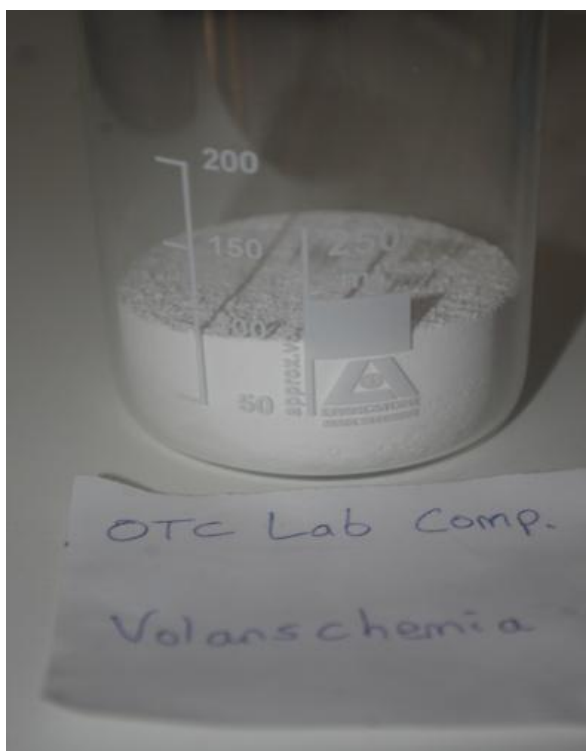
Procedure:

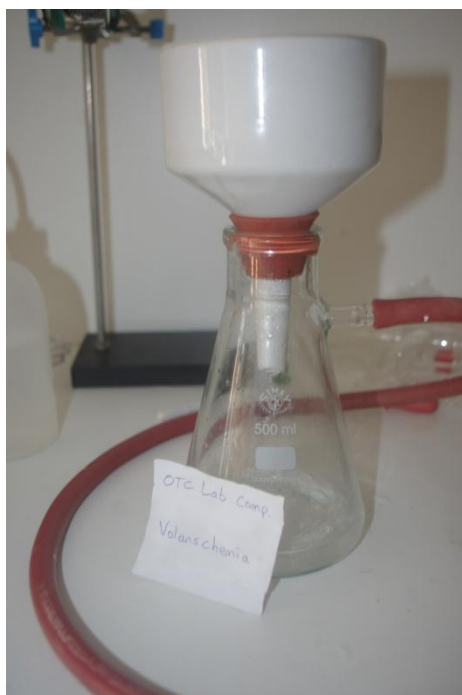
192 300mg Aspirin tablets were placed into a mortar and pestle and ground into a fine powder.



The Ethanol was added to a 1000mL beaker and a stir bar was added. It was stirred at medium speed while the crushed tablets were added slowly so as not to jam the stir bar.

The solution was stirred for 30 minutes while heating slowly until it was at about 45 degrees Celsius. It was then taken off heat and stirring and allowed to settle for 15 minutes.

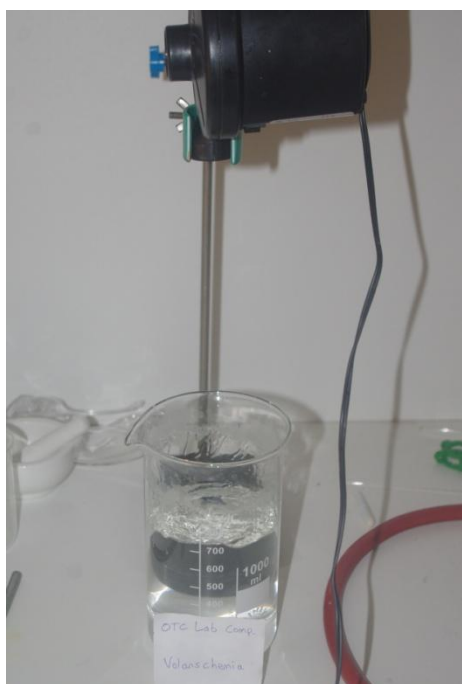




In the meantime a vacuum filtration system was set up, and the solution was filtered through a Buchner funnel to remove the insoluble gluten, starch and other binders. Alternatively, a gravity filter could be used, however it would be much slower.

The binders in the funnel were discarded and the filtered solution was poured back into the washed 1000mL beaker and most of the Ethanol was evaporated off under an airstream. The wet crystals were then placed in a Petri dish to dry over a steam bath.

The crystals of 2-(acetyloxy)benzoic Acid were harvested ready for the next step.



Yield and Experimenter's Notes:

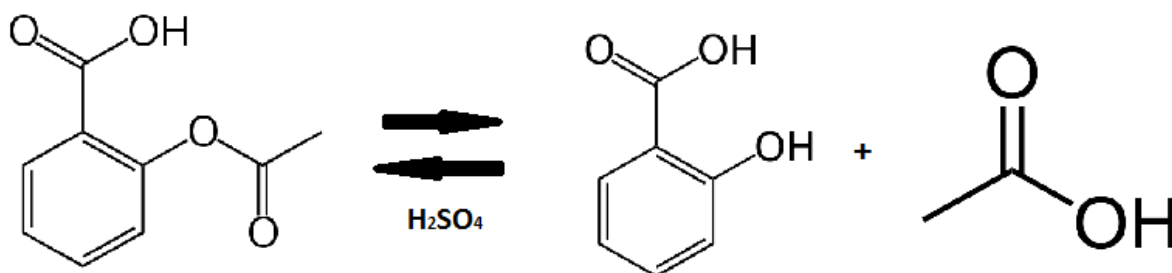
Yield was 54g based on 300mg of 2-(acetyloxy)benzoic Acid per tablet. This represents a 94% yield. The main loss can be attributed to the fact that my Petri dish exploded on the hotplate while I was drying the crystals. Turns out it wasn't borosilicate after all. This extraction can generally be expected to give near quantitative yields.

I think that I used way too much Ethanol to dissolve the Aspirin, because the crystals did not start to precipitate out of the Ethanol until over half of it had been evaporated. You can likely use a lot less.

Acid Catalysed Hydrolysis of 2-(acetyloxy)benzoic Acid

Overview:

In this step 2-(acetyloxy)benzoic Acid is hydrolysed to 2-Hydroxybenzoic Acid and Ethanoic Acid. This hydrolysis is catalysed by a strong acid, in this case Sulphuric Acid.



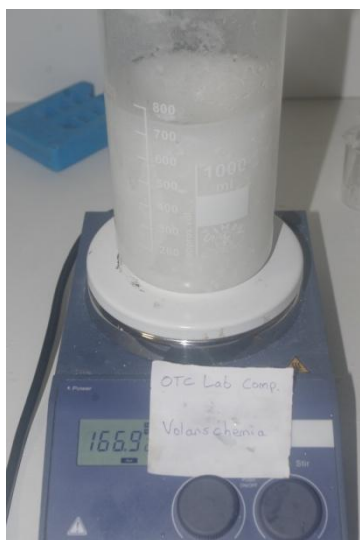
Reagents:

- 54g 2-(acetyloxy)benzoic Acid
- 650mL Distilled Water
- 60g 96% Sulphuric Acid

Equipment:

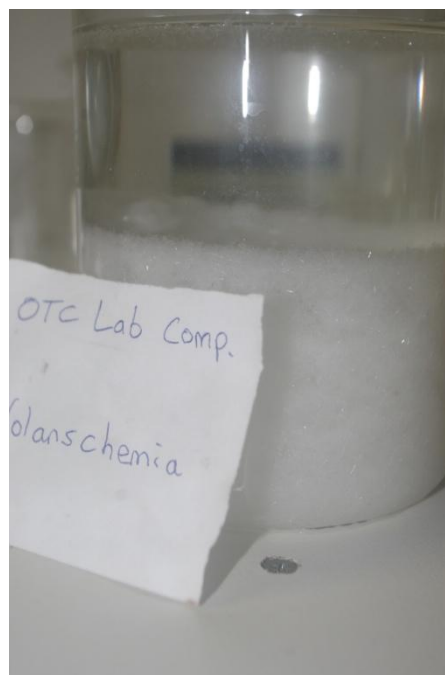
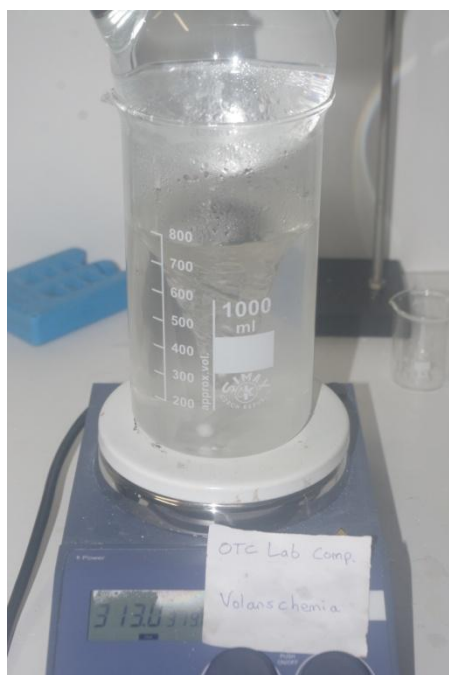
- Hotplate/Stirrer & Stir Bar
- 1000mL Beaker
- Distillation Setup

Procedure:



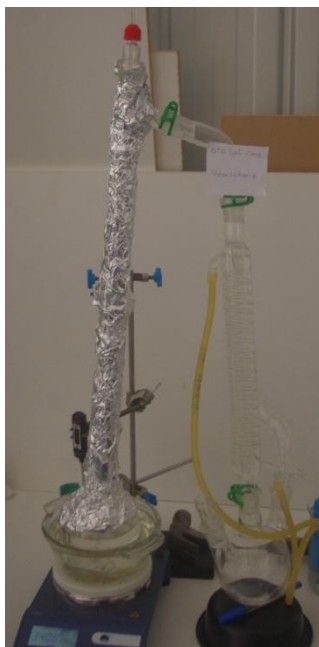
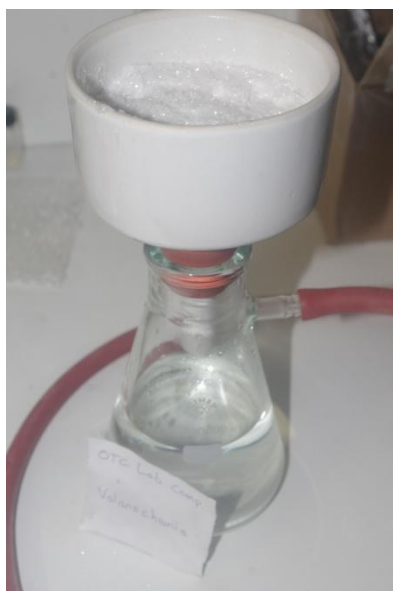
650mL of distilled water and 60g of 96% Sulphuric Acid were added to a 1000mL beaker and stirred until they were homogeneous. Be sure to add the acid to the water and not the other way around.

The 2-(acetyloxy)benzoic Acid was then added slowly to the solution. When it was all added the heat was turned on and the mixture was brought to the boil. When it began to boil a round bottomed flask filled with cold water was placed on top to condense the water vapours. When the solution reaches boiling point, all the powder should be dissolved. If it doesn't you may have to add more water until it does.



The mixture was refluxed for an hour and was then taken off heat and allowed to cool. The solution now smells strongly of Ethanoic Acid.

Very soon after removing the heat, crystals of 2-Hydroxybenzoic Acid began to precipitate out. When it had reached room temperature it was placed in the lab freezer until it was at zero degrees Celsius.



The crystals were broken up with a glass stir rod and the solution was filtered through a Buchner funnel.

The crystals of 2-Hydroxybenzoic Acid were removed from the funnel and placed on a crystallising dish to dry.

The solution in the vacuum flask contains Ethanoic Acid, Sulphuric Acid and a small amount of 2-Hydroxybenzoic Acid. It was placed in a round bottomed flask and the Acetic Acid was separated by fractional distillation.

Yield and Experimenter's Notes:

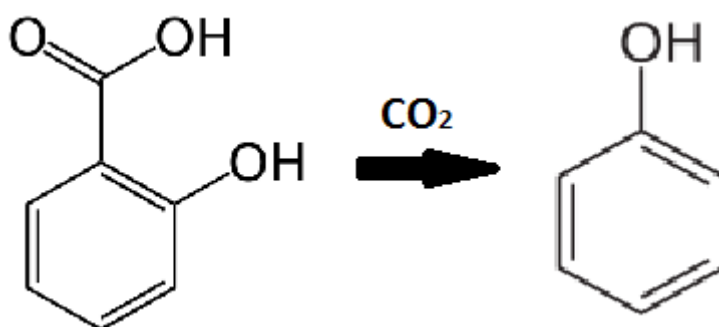
Yield of 2-Hydroxybenzoic Acid was 40g, which corresponds to a 96% yield based on 2-(acetyloxy)benzoic Acid. Yield of Ethanoic Acid was 16.2g, which represents a 90% yield.

No further notes.

Decarboxylation of 2-Hydroxybenzoic Acid

Overview:

In this step, 2-Hydroxybenzoic Acid is thermally decarboxylated to Phenol.



Reagents:

- 36g 2-Hydroxybenzoic Acid

Equipment:

- Hotplate/Stirrer & Stir Bar
- Distillation Setup (minus condenser)

Procedure:

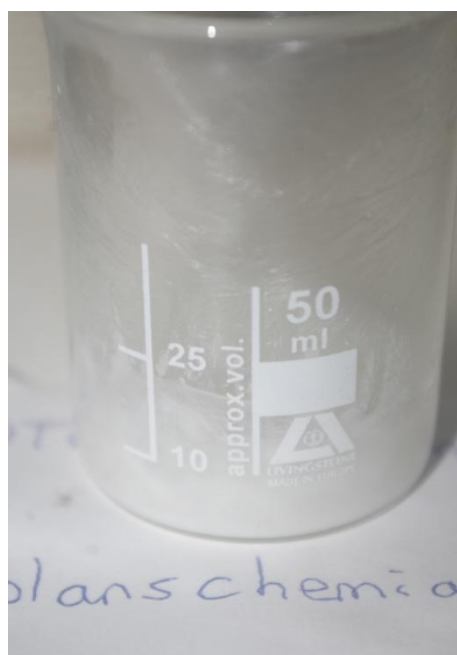
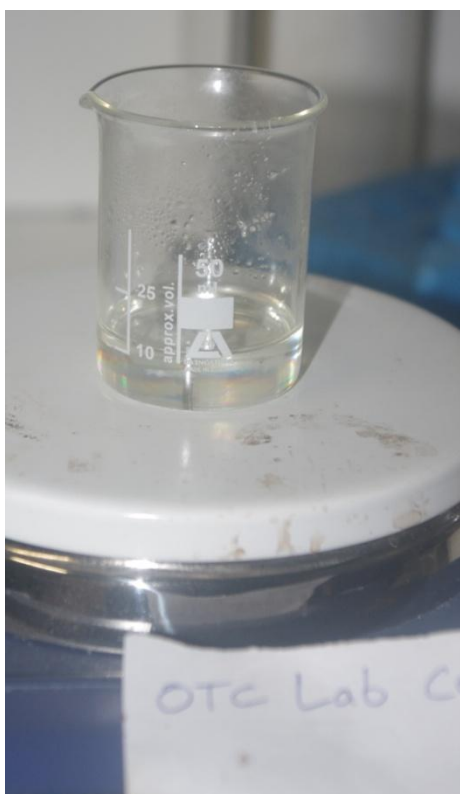
A 250mL Round Bottomed Flask was charged with 36g of 2-Hydroxybenzoic Acid and a stir bar. It was attached to the distillation apparatus which was insulated with foil and cotton.



The heat was turned on and the 2-Hydroxybenzoic Acid first melted and then started to decompose. Some of the acid will sublime onto the walls of the flask until the whole thing heats up enough to prevent this. The temperature was controlled so as to keep the still head temperature between 180C and 188C, so as to prevent distilling over impurities.

The Phenol at this point contained some water and would not freeze, so it was transferred to a small beaker and was heated so as to boil off the water.

After no more water vapour was coming off the mixture, it was removed from heat and upon dropping below 40C, froze into some nice crystals of solid Phenol. There was no 2-Hydroxybenzoic Acid in the product, as evidenced by no solids when all the water had been boiled off, so a re-distillation was unnecessary.



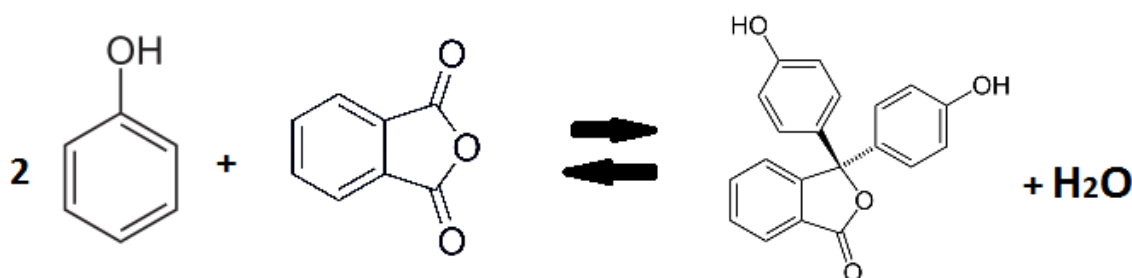
Yield and Experimenter's Notes:

Final yield of Phenol was 11.13g, which represents a 45% yield. The largest loss is likely to be due to the formation of Phenyl 2-Hydroxybenzoate, which may have been catalysed by a tiny amount of residual Sulphuric Acid in the 2-Hydroxybenzoic Acid. I would recommend washing the crystals more to prevent this.

Esterification of Phenol and Phthalic Anhydride to Phenolphthalein

Overview:

In this step a Fischer esterification is carried out to synthesise Phenolphthalein from Phenol and Phthalic Anhydride. A small amount of Sulphuric Acid is added to catalyse the reaction and the reaction is carried out above the boiling point of water, which drives the reaction forward in accordance with *Le Chatelier's* principle.



Reagents:

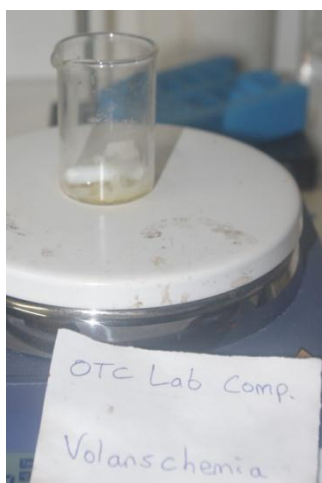
- 1.29g Phthalic Anhydride
- 1.7g Phenol
- Small amount of Sulphuric Acid
- 4g Sodium Hydroxide
- 50mL Ethanol

Equipment:

- Hotplate/Stirrer & Stir Bar
- 50mL Beaker

Procedure:

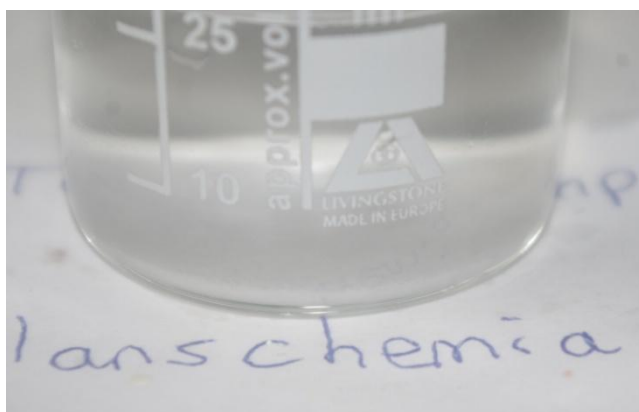
1.29g of Phthalic Anhydride and 1.7g of Phenol were added to a 50mL beaker along with a stir bar. On top of this a few drops of Sulphuric Acid was added.



The heat was turned on and the Phenol and the Phthalic Anhydride melted. The stirring was then switched on and the solution began to go darker and darker orange. The Phenolphthalein is orange, not pink, because I used a little too much Sulphuric Acid, which caused the Phenolphthalein to be highly protonated into its orange form.



After an hour, the heat was turned off and 4g of Sodium Hydroxide in 20mL of water was added. The Sodium Hydroxide is acting here as an extraction reagent, nothing of it makes it into the product. The excess Sulphuric Acid is neutralised and the Phenolphthalein is deprotonated to its characteristic pink colour.



The solution was then poured into a small amount of dilute Sulphuric Acid, which neutralises the NaOH and crashes out the Phenolphthalein.

This mixture was added to a fritted funnel and vacuum filtered. The receiving vessel was swapped out and 50mL of Ethanol was added to the funnel and stirred. It was then pulled through. The filtrate is a ready-to-use Phenolphthalein solution.



The photo on the left shows one drop added to a Sodium Hydroxide solution.

Yield and Experimenter's Notes:

Yield is unavailable as I did not dry the Phenolphthalein, however it is a sufficient amount to make 50mL of Phenolphthalein solution.

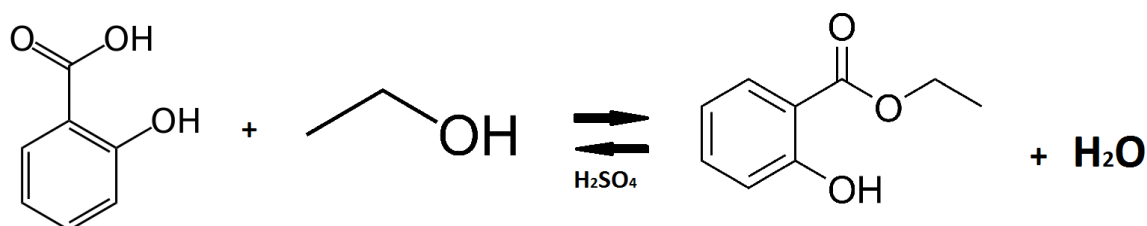
The only other note I have is to only add a drop or two of Sulphuric Acid, this will cut down on the amount of NaOH and subsequently more Sulphuric Acid needed for the workup.

Esterification of Ethanol and 2-Hydroxybenzoic Acid

Overview:

This is another Fischer esterification reaction, this time between Ethanol and 2-Hydroxybenzoic Acid to form Ethyl 2-Hydroxybenzoate, an ester that smells very similar to Wintergreen.

A small amount of Sulphuric Acid is used as a catalyst and also to collect water, driving the reaction forwards.



Reagents:

- 2g Ethanol
- 4.3g 2-Hydroxybenzoic Acid
- 1g Sulphuric Acid
- Sodium Hydrogen Carbonate Solution

Equipment:

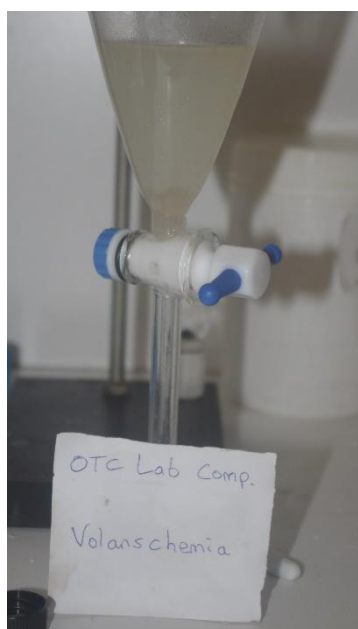
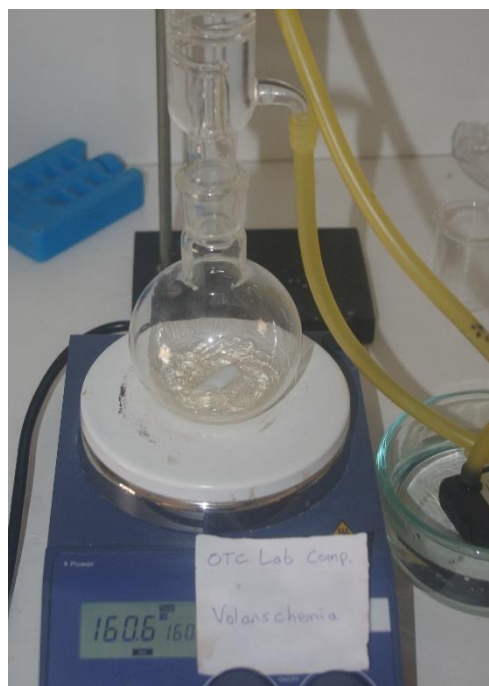
- Hotplate/Stirrer & Stir Bar
- 250mL Round Bottomed Flask
- Reflux Condenser
- Separation Funnel

Procedure:

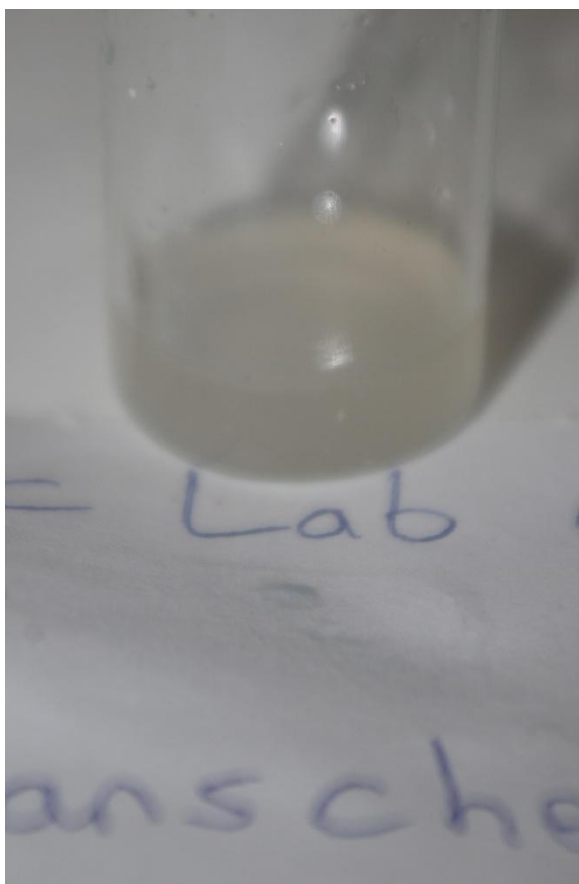
A 250mL round bottomed flask was charged with 2g of Ethanol and 4.3g of 2-Hydroxybenzoic Acid.

A couple of drops of Sulphuric Acid was added and the reflux condenser was placed on top of the flask.

The heat was turned on and mixture liquefied and became homogeneous. It was brought to the boil and refluxed for an hour and a half.



After the mixture had cooled to room temperature, it was added to a separation funnel and 50% Sodium Hydrogen Carbonate solution was added slowly until no more Carbon Dioxide was evolved. The funnel was then stoppered and shaken, while venting frequently to neutralise the last of the acids. The separation funnel now contains a mixture of water, Sodium Hydrogen Carbonate, Sodium Sulphate, Sodium 2-Hydroxybenzoate, Ethanol and Ethyl 2-Hydroxybenzoate, the desired product. All of these compounds are soluble in water except for the Ethyl 2-Hydroxybenzoate, which falls out as an oil that sinks to the bottom and forms a layer.



The mixture was left to separate for an hour and then the lower layer was drained into a vial for storage.

It is likely not very pure and could be redistilled to purify it further, but I mainly made it for the smell, so was happy to keep it as it was.

Yield and Experimenter's Notes:

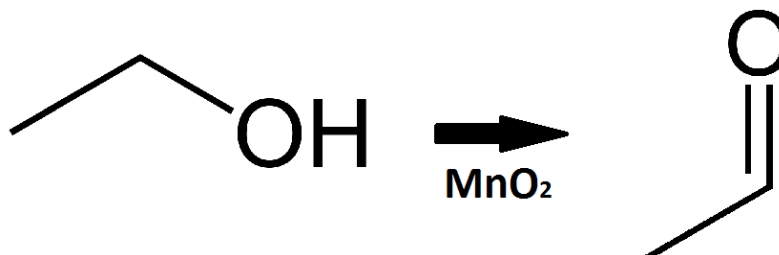
The yield of crude Ethyl 2-Hydroxybenzoate was 2.17g, which represents about a 50% yield. With Fischer esterifications you can generally expect about a 60-70% yield, and I attribute my loss to the fact that I did not dissolve my 2-Hydroxybenzoic Acid in the Ethanol before heating, likely losing some through sublimation or decomposition to Phenol.

If I were to carry out the reaction again I would first dissolve the acid in the Ethanol.

Mild Oxidation of Ethanol to Ethanal by Manganese(IV) Oxide

Overview:

This reaction is similar to the oxidation of Xylene, the difference being that a primary alcohol is being oxidized, and the alcohol is only oxidized once. This partial oxidation can be achieved with varying results with Manganese(IV) Oxide and Sulphuric Acid.



Reagents:

- 50g Ethanol
- 50g Manganese(IV) Oxide
- 50mL 35% v/v Sulphuric Acid

Equipment:

- Hotplate/Stirrer & Stir Bar
- 500mL Round Bottomed Flask
- Distillation & Reflux Setup with 2 Condensers

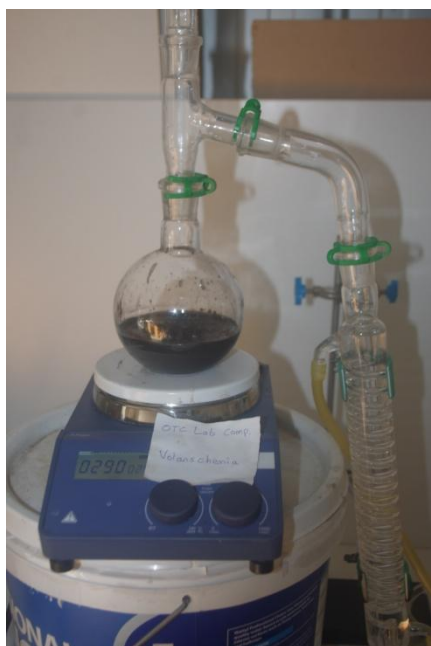
Procedure:

A 500mL Round Bottomed Flask was charged with 50mL of Ethanol. 50g of Manganese(IV) Oxide was added all at once followed by the Sulphuric Acid solution. The flask was attached to an already assembled reflux setup. It is important to do these steps quickly as unless you live somewhere very cold, some Ethanal will start to boil off right away.



Low heat and reasonably strong stirring was switched on and the solution was refluxed for an hour. A second reflux condenser was placed on top of the first shortly after starting the reflux, as the smell of Ethanal could still be detected at the top of the first.

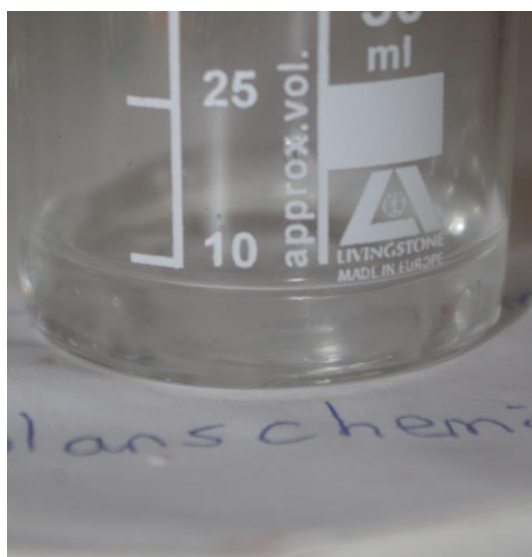
After an hour, the heat was removed and the flask was allowed to return to room temperature. Then, while still attached to the condenser, it was placed in an ice bath. When the solution was at approximately 5°C, the condensers were removed and the flask was hooked up to a distil rig.



The mixture was heated to roughly 30C to boil off the Ethanal. Note that extremely cold condenser water is required for the reflux and the distillation to be able to condense the Ethanal.

When the boiling died down the heat was turned off and the remaining stuff in the boiling flask was washed out and the MnO_2 was cleaned out with 32% Hydrochloric Acid.

A small amount of the distillate was mixed with some diamminesilver(I) complex in the classic Tollens' Test for aldehydes. The walls of the test tube were plated with silver metal, confirming the presence of Ethanal.



Yield and Experimenter's Notes:

Yield of Ethanal was 7.06g, which represents a 15% yield based on Ethanol. This is a pretty bad yield, and you can expect very varying results with this reaction. It has been known to give yields between 10 and 50%. The amount produced here could still be very useful and the reactants are reasonably cheap.

If I were to carry out the reaction again, I would skip the reflux step all together and simply attach the flask directly to the distillation setup. This will prevent any losses of Ethanal through the condensers, but the reaction may be a lot slower due to the heat limit.

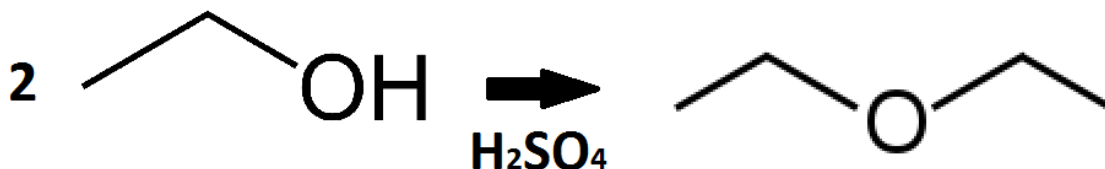
Procedures I Did Not Perform

The procedures listed here were not undertaken by myself for this competition as I was running short on time. They are however well documented and have been proven to work in practice. I have provided links to instructions on how to perform these procedures.

Ethoxyethane from Ethanol and Sulphuric Acid

Overview:

This reaction is an acid catalysed alcohol condensation that forms Ethoxyethane. The concentrated Sulphuric Acid catalyses a reaction where two Ethanol molecules combine to form the desired product.



Reagents:

- 340mL Ethanol
- 80mL Sulphuric Acid

Equipment:

- 3-Necked Round Bottomed Flask
- Distillation Setup

Procedure:

[This YouTube video](#) by Nile Red illustrates the procedure excellently.

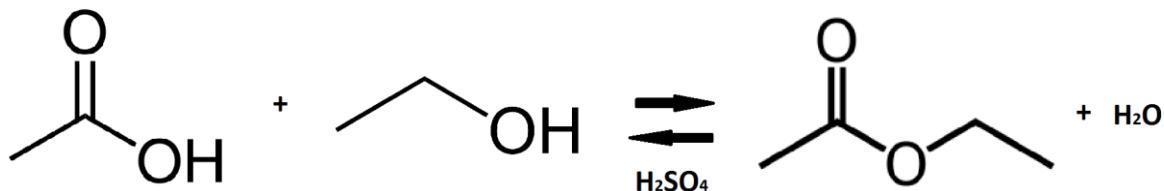
Yield and Experimenter's Notes:

Not applicable.

Esterification of Ethanol and Ethanoic Acid

Overview:

Yet another Fischer esterification, this one is the reaction of Ethanol and Ethanoic Acid to form Ethyl Ethanoate, a useful solvent in the lab.



Reagents:

- 30mL Ethanol
- 30mL Acetic Acid
- A few drops of Sulphuric Acid
- Sodium Carbonate

Equipment:

- Hotplate/Stirrer & Stir Bar
- 250mL Round Bottomed Flask
- Distillation & Reflux Setup
- Separation Funnel

Procedure:

[This YouTube video](#) by ParadoxChem126 documents the procedure excellently.

Yield and Experimenter's Notes:

Not applicable.

Manganese(VII) Oxide from Potassium Permanganate and Sulphuric Acid

Overview:

Manganese(VII) Oxide does not really have any practical uses in the lab, however it is an impressive demonstration of the power of oxidizing agents. It is very simply made in very crude form by adding concentrated Sulphuric Acid to Potassium Permanganate. The acid acidifies the Potassium Permanganate to Permanganic Acid, and then dehydrates it to its anhydride, Manganese(VII) Oxide. This procedure is extremely well documented and has been attempted by most amateur chemists. [This YouTube video](#) by Nile Red does an excellent job at explaining the risks and showing how to make it.

Conclusion

Overall, the procedures described above succeeded to some degree. There were some setbacks (exploding Petri dishes!) and some improvement could be made. The fact remains however that all of these procedures can be carried out with only the five OTC ingredients listed above.

I hope that I have done OTC organic chemistry justice with this submission, and that at least someone learns something from it (I definitely learnt a heap).

External Reading on Reaction Mechanisms

[https://en.wikipedia.org/wiki/Tollens' reagent](https://en.wikipedia.org/wiki/Tollens%27_reagent)

[https://en.wikipedia.org/wiki/Alcohol oxidation](https://en.wikipedia.org/wiki/Alcohol_oxidation)

[https://en.wikipedia.org/wiki/Fischer%20%93Speier esterification](https://en.wikipedia.org/wiki/Fischer%20%93Speier_esterification)

<https://en.wikipedia.org/wiki/Hydrolysis>