Sythesizing isopentyl acetate by the fischer esterification essay

Abstract: The purpose of this experiment was to synthesize isopentyl acetate via an esterification reaction between acetic acid and isopentyl alcohol, using concentrated sulfuric acid as a catalyst.

The product was washed with sodium hydrogen carbonate, as well as with water, then dried with anhydrous sodium sulfate. The product was then distilled using a Hickman still and characterized using infrared spectroscopy. The percent yield of isopentyl acetate was 61. 52%.

This may have been low due to not all of the condensed product being removed from the Hickman still, some product being lost during transfer of the product from the reaction tube into the Hickman still, or the loss of some product due to evaporation during distillation. Infrared spectrum analysis of the product indicated that the product was isopentyl acetate, as expected, and thus that the reaction was successful. Preparing Isopentyl Acetate by the Fischer EsterificationIntroduction: The purpose of this experiment is to synthesize isopentyl acetate via an esterification reaction between acetic acid and isopentyl alcohol, using concentrated sulfuric acid as a catalyst. The product will be washed, distilled, then characterized using infrared spectroscopy.

Materials Used: Paraffin sand bath test tube clamp 50-mL Erlenmeyer flask Hickman still cork Pasteur pipettes with bent ends microspatula Kim-wipes sand bath vial Pasteur pipettes Rubber bulbs Procedure: Part 1 – Refluxing Reaction Mixture Weigh a reaction tube while it is in a 50-mL beaker. Record the mass of the beaker and the tube. Place 0. 809 g isopentyl alcohol in a

test tube using a Pasteur pipette. Then, add 2 mL acetic acid and 3 drops concentrated sulfuric acid to the tube.

Add a boiling chip, then wrap a wet Kim-wipe around the top of the test tube. Place the tube in a sand bath on a setting of 2-3. Heat to boiling, then reflux solution for 1 hour. Part 2 – Separating and Washing Product Layer Remove the test tube from the sand bath and allow to cool to room temperature. Remove the boiling chip from the tube using a microspatula.

Slowly add 1 mL of 5% NaHCO3 to the reaction mixture in the tube. Swirl tube gently to mix. Then put a cork in the tube, and shake gently with venting until bubbles are no longer produced. Label a test tube “ Aqueous Layers”.

Use a Pasteur pipette to remove the lower aqueous layer from the vial. Place this aqueous layer into the labeled test tube. Repeat the extraction twice using new 1 mL portions of 5% NaHCO3 each time. Then, wash the organic layer with 1 mL of distilled water. Again, remove the lower aqueous layer and place in the labeled test tube.

Finally, add 0. 3 g anhydrous sodium sulfate to the test tube to dry the product. Wrap a film of paraffin around the top of the tube, cork the tube, and place in the refrigerator for a couple days. Part 3 – Distilling the Product Transfer liquid from test tube into the bottom of a Hickman still using a Pasteur pipette.

Add a boiling chip to the still, and wrap a wet Kim-wipe around the top of the still. Using a clamp to hold the still in place, put the still into a sand bath and clamp into place. Set the sand bath on a setting of 2 – 3. Heat to boiling.

As the liquid evaporates and condenses, use a Pasteur pipette with a bent tip to remove the condensed liquid from the upper ring of the Hickman still. Transfer the condensed liquid into a clean, dry, vial. Make sure you weigh and record the mass of the vial before transferring any liquid into it. Continue until all of the liquid from the bottom of the still has evaporated and all the distilled product collected. Measure and record the mass of the product.

Part 4 – Characterizing the Product Place one drop of the distilled product on an infrared spectrum card. Place card in spectrometer and run an infrared spectrum on the product. Part 5 – Cleaning Up The aqueous layers from the washings performed in Part 2 may be put down the sink with a lot of water. Place all other materials in their appropriate waste containers. Data and Calculations: Mass isopentyl alcohol: 0.

820 g Mass product (isopentyl acetate): 0. 745 g Theoretical Yield: 1. 211 g Percent Yield: 61. 52% Finding Limiting Reagent Acetic Acid (2 mL AA) (1. 049 g AA) (1 mol AA) (1 mol product) (130. 19 g product) (1 mL AA) (60.

05 g AA) (1 mol AA) (1 mol product) = 4. 549 g isopentyl acetate Isopentyl Alcohol (0. 820 g IA) (1 mol IA) (1 mol product) (130. 19 g product) (88. 15 g IA) (1 mol IA) (1 mol product) = 1. 211 g isopentyl acetate The limiting reagent for this esterification reaction is isopentyl alcohol.

It yields the least amount of isopentyl acetate in this reaction, and therefore is the limiting reagent. Preparing Isopentyl Acetate by the Fischer Esterification Theoretical Yield Isopentyl Alcohol (0. 820 g IA) (1 mol IA) (1 mol product) (130. 19 g product) (88. 15 g IA) (1 mol IA) (1 mol product) = 1.

211 g isopentyl acetate Percent Yield (mass of isopentyl acetate) (0. 745 g isopentyl acetate) x (100) = 61. 52% yield (theoretical yield) (1. 211 g isopentyl acetate) Observed Properties and IR Data and Interpretation: An infrared spectrum of the product revealed that it was isopentyl acetate. A peak at 1743. 5 cm-1 indicated the presence of a carbonyl group.

The peak at 1056. 08 cm-1 indicated a C-O-C bond, and the peak at 2960. 55 cm-1 was indicative of alkane –CH2- groups. Also, the peak at 1387. 85 cm-1 indicated alkane bonds which include an isopropyl split. As can be seen in the structure of the product, isopentyl acetate contains an isopropyl group at one end.

It also contains a carbonyl group, a C-O-C bond, and alkane –CH2- groups. Results and Conclusions: The esterification reaction between acetic acid and isopentyl alcohol, using concentrated sulfuric acid as a catalyst, was successful and yielded isopentyl acetate. The percent yield of this reaction was 61. 52%. This may have been low due to the fact that not all of the condensed product was able to be removed from the Hickman still.

Although most of it was able to be removed using the bent Pasteur pipette, some may still have been stuck inside the still. Also, some product was lost when the liquid was transferred from the test tube into the Hickman still.

Some of the product may have also evaporated during the distillation. The product was proven to be isopentyl acetate via infrared spectroscopy.

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It also contains a carbonyl group, a C-O-C bond, and alkane –CH2- groups. Together, all these peaks indicated that the product was indeed isopentyl acetate and that the esterification reaction was successful.