

Procedure:

1. Set up a 400 mL hot water bath. Allow the water to come to a boil.
2. Obtain the mass of an empty, dry reaction vial. Add 1.2 mL of n-propyl alcohol and obtain the total mass. Then add 2.5 mL of glacial acetic acid to a small reaction vial and obtain the final mass. Add the masses to a data table and calculate the masses of each reactant
3. Using a Beral-type pipet, add 5 drops of concentrated sulfuric acid to the reaction vial.
4. Seal the vial with a Teflon-coated cap. Make sure the cap is on tight. Invert the mixture several times to mix the reactants
5. Place the vial into the hot bath using a wire hanger. Watch for a small stream of bubbles. If bubbles are present, remove the vial and tighten the cap.
6. Heat the vial for 20 to 25 minutes in the hot bath
7. Remove the vial and place on a ceramic gauze pad. Allow the vial to cool then place the vial in a ice-water bath for 3 minutes.
8. Add 10 mL of ice water in a small test tube for step. Carefully open the reaction vial and pour the contents into the test tube containing the ice-water. Rinse the reaction vial with additional distilled water. Transfer the upper organic layer containing the ester product back to the reaction vial using a Pasteur pipet.
9. Wash the crude ester product twice with 2 mL of 10% sodium carbonate solution and once with distilled water. Add the sodium carbonate solution slowly to prevent the mixture from bubbling out of the vial from the generation of CO_2 .
10. Remove as much of the lower aqueous layer as possible from the solution using a pipet. Dry the ester with a small amount of anhydrous sodium sulfate. Transfer the organic layer to a clean, massed vial and obtain the mass of the ester and vial. Calculate the mass of the ester.
11. n-Propyl acetate has a strong banana- or pear-like odor and is called banana oil. The boiling point of n-propyl acetate is 101 °C. Confirm the presence of the ester by properly smelling the product.

Calculations

1. Calculate the mass of original products used.
2. Write a balanced chemical equation for the production of n-propyl acetate
3. Calculate the theoretical yield for n-propyl acetate.
4. Calculate the percent yield for n-propyl acetate.

Questions:

1. Why do you think that artificial flavors and aromas less expensive than natural flavors?
2. The lab introduction showed a general mechanism for a Fischer Esterification. Draw out the complete mechanism using appropriate reactants. Remember that alcohols act as bases in strong acids and carboxyl groups are protonated at low pH values (with strong acids).
3. Predict the products from the following pairs of reactants by drawing and naming each ester
 - a. ethanol and formic acid
 - b. isopentanol and acetic acid
 - c. methanol and butanoate
 - d. methanol and 2-aminobenzoic acid

Extension: Other esters can be made. If you are interested in synthesizing these, see your Instructor.