NITRATION OF ACETANILIDE TLC OF THE REACTION

Introduction
This exercise will follow the course of a nitration reaction using thin layer chromatography, TLC. Nitration is one of the five reactions that aromatic compounds undergo. This reaction replaces a hydrogen on the ring with a nitro group. The compound is called a nitro benzene. Generally nitro compounds have color. This reaction is no exception. The reaction also produces more than one isomer, as both the ortho and para isomer of acetanalide are formed. TLC will be the method used to determine the different isomers produced and to determine the purity of the final product.

Procedure
A. PREPARATION OF THE DEVELOPING CHAMBER AND TLC OF THE ORIGINAL MIXTURE
The compound acetanilide is the reactant in the reaction that will be run. Prepare a TLC of the pure unreacted acetanilide by dissolving a small portion, usually the tip of a small spatula full in some methanol. Spot a TLC plate with this solution by adding a small portion using a capillary tube the bottom of the plate about 1/2 inch from the bottom. Obtain a developing chamber and add a small amount of methylene chloride eluting solvent. The amount of solvent should be to a height in the chamber that when the spotted plate is added the spot will be just above the level of solvent.

Run the TLC of the acetanilide. Allow the solvent to climb the plate until it is almost to the top. Remove the plate from the chamber, allow the solvent to dry (mark the solvent spot with a pencil), and develop the chromatogram. Draw a picture of the developed chromatogram at the end of the laboratory report. This chromatogram shows the condition before reaction has started. It can be compared with additional chromatograms as the reaction proceeds.

B. NITRATION OF ACETANILIDE AND CONVERSION TO ANILINES
Following are the steps in the reaction of acetanilide with nitric acid to form the nitrated products and conversion to the nitro anilines.
1. Weigh out 2.7 grams of acetanilide and add it to a 125 mL Erlenmeyer flask.

2. Add approximately 5 mL of concentrated sulfuric acid to the flask, agitate to dissolve the acetanilide and cool the mixture in an ice bath.

3. In a small beaker add 1.5 mL of concentrated nitric acid to 4.5 mL of concentrated sulfuric acid. Mix these acid thoroughly. CAUTION! NITRIC AND SULFURIC ACIDS ARE CORROSIVE!!

4. Add the acid mixture to the original acetanilide/acid mix in 0.5 mL portions. Do this in the ice bath with mixing and do not allow the temperature of the mixture rise. The Erlenmeyer should remain cool to the touch. This should take about 20 minutes. If you do this too quickly the wrong form will be produced.

5. Add approximately 25 mL of an ice/water mixture to the reaction flask.
6. Take a sample of the reaction mixture with a capillary and spot a TLC plate.
   a. Add 2 ml of dichloromethane to a developing chamber. Cover the chamber.
   b. Prepare a solution of the crude sample dissolved in methanol. This should be about a 5% weight/volume concentration.
   c. Spot three plates with the crude sample and the reference samples of the ortho, meta and para isomers (if room does not allow, only use para and ortho)
   d. Develop these and compare to determine the nature of you’re the reference compounds. (Note: meta and para will have similar R_f values).

7. Place the reaction flask on a hot plate and heat until the color darkens and the solids go into solution. Do not heat excessively! This gentle boil should be maintained for about 20 minutes, after which the reaction vessel should be cooled in an ice bath.

8. Add 25 mL of concentrated ammonia water to the cooled solution in 5 mL portions. The precipitate formed will be the final crude products.
   a. TLC of crude sample. The crystals recovered during the synthesis are a combination of ortho, meta and para nitroaniline.
   b. Add 2 ml of dichloromethane to a developing chamber. Cover the chamber.
   c. Prepare a solution of the crude sample dissolved in methanol. This should be about a 5% weight/volume concentration.
   d. Spot three plates with the crude sample and the reference samples of the ortho, meta and para isomers.
   e. Develop these and compare to determine the nature of your crude sample. (Note: meta and para will have similar R_f values).

This suspension can be stored in the refrigerator until the next laboratory session if needed.

9. Filter the product mixture from the suspension, and wash it with cold water.
   Filter the suspension using filter paper, Buchner funnel and vacuum. Allow the mixture to air dry.

10. Recrystallization of the crude sample. The goal of the laboratory exercise is to synthesize paranitroaniline. The desired product can be recovered by fractional recrystallization. Recrystallize the crude product using approximately 10 mL of ethanol. To do this transfer the solid product to a beaker, add the ethanol and gently heat until all the solids are dissolved. Cool the mixture in an ice bath to promote crystallization and then filter the product.
    a. Transfer the crude sample to a small beaker. Add ethanol. The amount of ethanol required is the volume that will dissolve the entire sample in warm solvent. Heating is done on the surface of a hot plate, do not boil the ethanol.
    b. Heat until the crude sample is dissolved.
    c. Cool the mixture.
    d. Filter the suspension using filter paper, Buchner funnel and vacuum.
    e. Run the TLC of the recrystallized sample following similar steps to the pure materials.

If the results of the activities in step 10 show that the recrystallized sample is pure paranitroaniline proceed to step 11, if not repeat step 10.
11. Characterization of the product (label your vial just in case we need to use it next week).
   a) Determine the actual yield by weight
   b) Determine the melting point
   c) Run the IR spectra (reference spectra are on the next page)
Reference IR Spectrum for o,m,p-nitroaniline