

Fluorescein ($C_{20}H_{12}O_5$)

By Joeflsts

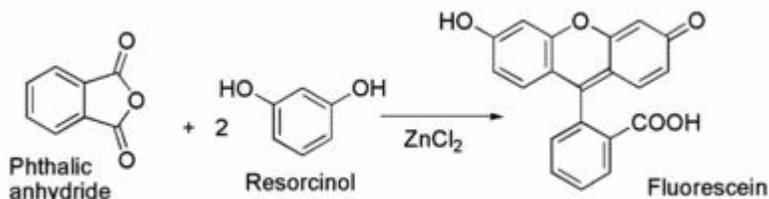


Figure 1: Reaction

Introduction

Fluorescein can be prepared by reacting phthalic anhydride with resorcinol using zinc chloride as a catalyst via the Friedel-Crafts reaction. Resorcinol will act as the solvent for this reaction. Fluorescein was first prepared by Baeyer¹ in 1871.

Procedure

Materials:
Phthalic Anhydride ($C_8H_4O_3$)
Resorcinol ($C_6H_6O_2$)
Zinc Chloride ($ZnCl_2$)
Distilled Water (H_2O)
Hydrochloric Acid (HCl)

Grind in a mortar 7.5g of phthalic anhydride and 11g of resorcinol. This mixture will be placed in a 250mL conical flask and placed in an oil bath. Increase the temperature of the oil bath so that the internal temperature of the reaction mixture reaches $180^{\circ}C$. To the warming mixture add 3.5g of anhydrous zinc chloride. If the stock zinc chloride appears to be moist or wet it must be fused.

Fusing the zinc chloride can be accomplished by heating a slight excess of zinc chloride (approx. 6-8g) in a porcelain dish until all moisture has been given off. The zinc chloride has been properly fused when no bubbles are given off during gentle heating. Fusing will provide about 3.5g of freshly dried zinc chloride.

Using a thermometer to stir the mixture, add the zinc chloride slowly in small portions. A noticeable change in color will take place as the reaction begins.

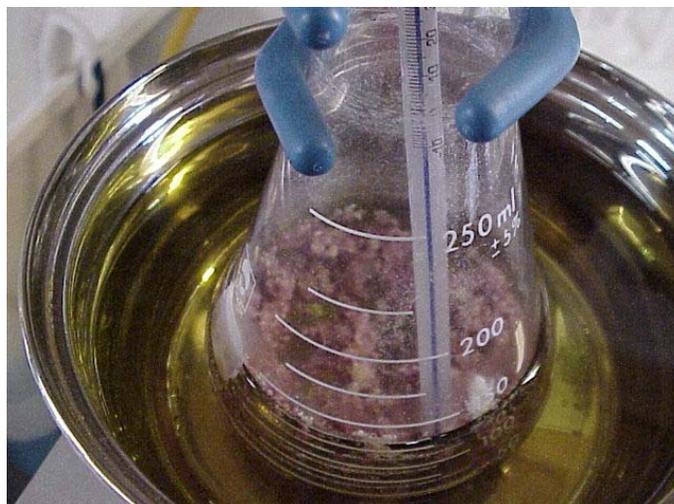


Figure 2: Addition of zinc chloride

As the internal temperature reaches approximately 140°C the mixture will melt. At approximately 180°C with continued heating the mixture will begin become viscous.

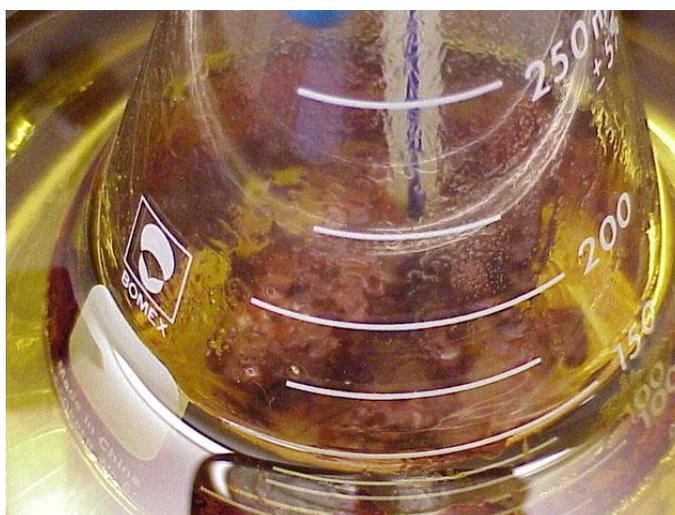


Figure 3: Melting of reaction mixture

Continue heating, stirring every 2 – 3 minutes. After approximately 30 – 90 minutes the mixture will become too viscous to continue stirring.



Figure 4: The reaction mixture solidifies

The resulting dark mass consists primarily of a mixture of fluorescein and zinc chloride along with basic zinc salts.

Allow the oil bath temperature to drop to approximately 90°C and cautiously add a dilute acid solution of 100mL of Distilled Water and 10mL of concentrated Hydrochloric Acid (36.5 – 38%). Using either a glass rod or a thermometer mix the mass with the dilute acid solution and raise the temperature of the oil bath until the mixture boils. Care should be given to prevent the dilute acid from boiling over. Continue boiling until the reaction mixture has disintegrated. Remove from heat and allow to slightly cool.

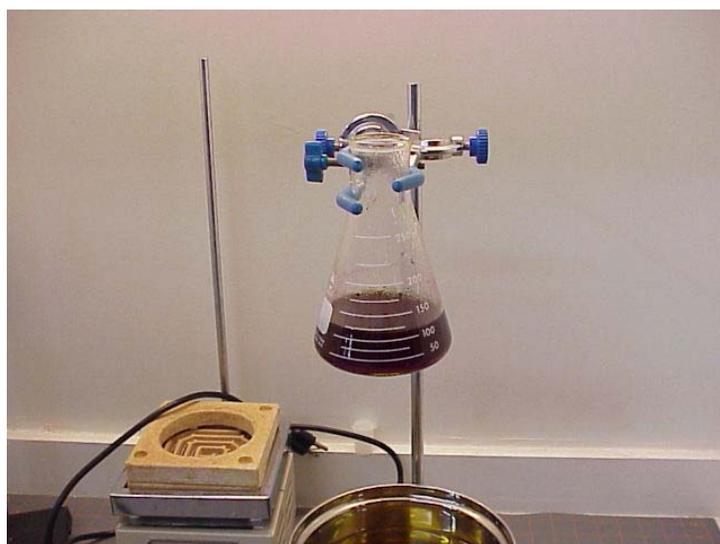


Figure 5: Allow reaction mixture to slightly cool

The insoluble residue of fluorescein is filtered via vacuum filtration. The filtered fluorescein is ground in the mortar with distilled water and filtered again. The fluorescein can be dried at 100°C for approximately 1 hour.



Figure 6: Vacuum filtration



Figure 7: drying at 100°C

The yield was 8.3g, primarily due to poor practices.

Theoretical yield: 16.93g

The fluorescein may be purified by dissolving it in dilute sodium hydroxide solution, filtering if necessary, and precipitating with dilute hydrochloric acid (1:1), filtering, washing, and drying².

Technical Information

The Merck Index	
Chemical Name	Fluorescein
Molecular Formula	$C_{20}H_{12}O_5$
Molecular Weight	332.30
Melting Point	314 - 316°C
% Carbon	72.28%
% Hydrogen	3.64%
% Oxygen	24.07%
Appearance	Yellowish to red powder
Solubility	Insoluble in water

References

¹ Baeyer, Ber., 4, 555 (1871)

² Vogel, Practical Organic Chemistry, 3rd Edition, 1956, page 985