Experiment

AIM: To prepare and submit phenytoin from benzil and urea and calculate its percentage yield.

REFERENCES:

1. Vogel's Textbook of Practical Organic Chemistry by Brian S. Furniss, Antony J. Hannaford, Peter W. G. Smith & Austin R. Tatchell; Fifth Edition; Page No. 1153.
2. Practical in organic chemistry, by Hitesh G. Raval, Sunil L. Baldania and Dimal A. Shah, Nirav Prakashan, Page No. 313.

REQUIREMENTS:

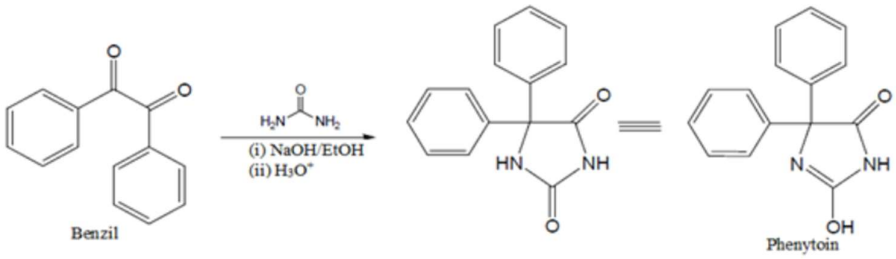
Chemicals: Benzil, Urea, Sodium hydroxide, Ethanol, Concentrated hydrochloric acid etc.

Apparatus: Round-bottom flask, Reflux condenser, Crystallizing dish, Heating mantle, Stirrer, Beaker, Filtering flask with Büchner funnel, Graduated cylinders, Petri dish etc.

PRINCIPLE:

The base-catalyzed reaction between benzil and urea is used to synthesize phenytoin. The reaction proceeds via intramolecular cyclization to form an intermediate heterocyclic pinacol. Upon acidification, the pinacol undergoes a rearrangement reaction resulting in the formation of hydantoin (phenytoin) due to a 1,2-diphenyl shift.

Reaction:



Use:

It is a common antiepileptic drug.

PROCEDURE:

1. Place 5.3 g (0.025 mol) of benzil and 3.0 g (0.05 mol) of urea in a 100 ml round-bottomed flask. Add 15 ml of 30% aqueous sodium hydroxide solution and 75 ml of ethanol. Set up a reflux condenser with the flask and boil the mixture using an electric heating mantle for at least 2 hours.

2. Allow the reaction mixture to cool to room temperature, then pour it into 125 ml of water and mix carefully. Let the reaction mixture stand for 15 minutes, then filter the product under suction to remove any insoluble by-products.

3. Add concentrated hydrochloric acid to make the filtrate strongly acidic. Cool the solution in ice water and immediately filter off the precipitated product.

4. Recrystallize the resulting product at least once from industrial spirit to obtain about 2.8 g (44%) of pure 5,5-diphenylhydantoin with a melting point of 297-298°C.

CALCULATION:

Here, the limiting reagent is benzil; hence, yield should be calculated from the amount taken.

Molecular formula of benzil = $C_{14}H_{10}O_2$

The molecular formula of phenytoin = $C_{15}H_{12}N_2O_2$

The molecular weight of benzil = 210 g/mole

Molecular weight of phenytoin = 252 g/mole

Theoretical Yield:

210 g benzil forms 252 g of phenytoin

Therefore, 5.3 g benzil will form …….? (X) g of phenytoin

X = (252 ×5.3)/210 = 6.36 g

Theoretical yield = 6.36 g

Practical yield = ————- g

% Yield = (Practical Yield)/(Theoretical Yield) × 100

Result:

Phenytoin was synthesized and the percentage yield was found to be……..%.