**Nucleophilic Substitution: Synthesis of *tert*-Butyl Chloride**

**Introduction**

The main purpose of this particular lab experiment is to prepare 2-chloro-2-methylpropane from 2-methyl-2-propanol by using HCl as the hydrogen halide.

In order to determine the presence of alkyl halide can be determined by reacting the product with AgNO3(Silver Nitrate) in ethanol. Tertiary alkyl halides will react rapidly via SN1 mechanism through this reaction:

To promote the reaction, ethanol solvent is used to dissolve the alkyl halide.

**Physical Data and Hazards**

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| --- | --- | --- | --- | --- | --- |
| **Chemical Formula & Name** | **Molecular Weight (g/mol)** | **Melting Point (C)** | **Boiling Point (C)** | **Density (g/cm3)** | **Hazards** |
| *2-methyl-2-propanol (tert-butyl alcohol)* | 74.12 | 25-26 | 82-83 | 0.775 | Flammable, Irritant |
| *Hydrochloric Acid* | 36.46 | -114.2 | -85.05 | 1.49 | Poison, Harmful |
| *2-Chloro-2-methylpropane* | 92.57 | -26 | 51 | 0.84 | Flammable |
| *Ethanol* | 46.07 | -114 | 78.37 | 0.789 | Flammable |
| *Silver Nitrate* | 169.87 | 212 | 444 | 5.35 | Explosively reacts with Ethanol. Corrosive |
| *Silver Chloride* | 143.32 | 455 | 1547 | 5.56 |  |

*Sources: Handbook for Organic Chemistry,* ***CRC Handbook of Chemistry and Physics*** *(especially Section C: "Physical Constants of Organic Compounds" ), available at the information desk in the Science Library (in Norlin) and in the Organic Chemistry Stockroom.*

***Safety Precautions***

*Concentrated Hydrochloric acid is a corrosive and a poison; need to wear gloves and protective clothing while handling this substance. Bot the alcohol and the alkyl halide are flammable*

***Wastes***

*Aqueous Waste: HCl layer from first separation, the sodium bicarbonate wash, and the two sodium chloride washes.*

*Solid Chemical Waste: Place used drying agent in the small trash receptacle labeled “Solid Chemical Waste” in the main hood.*

*Recovery Jar: Product, 2-chloro-2-methylpropane*

**Procedure**

1. Put 5 mL of *tert-*butyl alcohol in an Erlenmeyer flask
2. Place the flask over the stir motor
3. Add the magnetic stirrer
4. Add 10mL of concentrated HCl (12.1M)
   1. Be very careful. Extremely concentrated.
5. Stir the reaction mixture for around 15 minutes
   1. Time it
6. Transfer the mixture to a separatory funnel and allow it to stand until there are two separate layers are formed.
7. Remove the aqueous layer
8. Wash the organic layer with 6mL of statured aqueous Sodium Chloride solution
9. Then was the organic layer with 6ml of saturated aqueous sodium bicarbonate.
10. Finally wash it with another 6 mL of saturated aqueous Sodium Chloride.
11. Save the Organic layer.
12. The reaction between the residual HCl and the Sodium Bicarbonate will give a lot of CO2(g) 
    1. DO NOT confine this gas in the funnel.
13. Swirl the mixture initially in the UNSTOPPERED, upright funnel.
14. Stopper your funnel, gently invert it and then vent it IMMEDIATELY
    1. Open the stopcock while pointing it into the student hood.
15. Shake the funnel gently and briefly between periods of venting until the evolution of gas subsides
16. Dry the organic layer over anhydrous sodium sulfate.
17. Weigh or measure the volume of the product to determine the yield
18. Run an IR spectrum of the product
19. Perform a Silver nitrate test for Alkyl Halides
    1. Place a few drops of your product in a vial
    2. Add 2 drops of silver nitrate test solution and mix
    3. The appearance of a white precipitate indicates that a reaction has taken place between alkyl halide and silver nitrate.
    4. Dispose of the test reaction in the small organic waste jar in the main hood.