

Lab Report: Synthesis of Tert-Butyl Chloride

5 pages | 1143 words

Abstract

The objective of this laboratory experiment was to synthesize tert-butyl chloride from tert-butyl alcohol and to understand the SN1 and SN2 mechanisms involved in the reaction. The yield percentage of tert-butyl chloride was determined. The experiment successfully produced tert-butyl chloride, and the actual yield was found to be 13.23% of the theoretical yield, resulting in a percentage error of 86.78%. Qualitative chemical tests for reactivity were also performed on the synthesized product.

Introduction

Alkyl halides are compounds that have a halogen atom bonded to a saturated, sp³ hybridized carbon atom, and they can be classified based on the number of alkyl groups attached to the carbon bonded to the halogen. The synthesis of alkyl halides can be achieved through various mechanisms, including nucleophilic substitution. In this experiment, tert-butyl alcohol reacts with concentrated hydrochloric acid (HCl) to produce tert-butyl chloride via an SN1 reaction. The SN1 reaction involves the formation of a carbocation intermediate and is favored by tertiary alcohols. The reaction can be represented as follows: tert-butyl alcohol (R₃COH) + HCl → tert-butyl chloride (R₃CCl) + H₂O. This experiment aims to synthesize tert-butyl chloride, understand the mechanisms involved in the reaction, and determine the yield percentage of tert-butyl chloride.

Methodology

Synthesis of Tert-Butyl Chloride

The following materials and chemicals were used for the experiment: tert-butyl alcohol, concentrated hydrochloric acid (HCl), separatory funnel, sodium bicarbonate solution, anhydrous calcium chloride, vial container, 250mL Erlenmeyer flask, 50mL flask, 50mL beaker, and qualitative chemical reagents (potassium iodide solution and silver nitrate solution). The synthesis of tert-butyl chloride was performed as follows:

1. 5mL of tert-butyl alcohol and 15mL of concentrated HCl were placed in a 125mL separatory funnel.
2. The mixture was gently swirled without shaking, and internal pressure was relieved by slowly opening the stopcock.
3. The separatory funnel was placed on a ring stand to allow the two layers to separate.
4. The lower aqueous layer was drained into a 250mL Erlenmeyer flask.
5. 40mL of saturated sodium bicarbonate solution was added to the remaining organic layer in the funnel, and the previous steps were repeated.
6. The organic layer was transferred into a dry 50mL flask with a small amount of anhydrous calcium chloride to remove water droplets.
7. The liquid was decanted into a preweighed 50mL beaker, and the crude product (tert-butyl chloride) was weighed.

Qualitative Chemical Tests for Reactivity

Qualitative chemical tests were performed on both tert-butyl chloride and chlorobenzene as follows:

1. Four test tubes were labeled properly.
2. 2-5 drops of synthesized tert-butyl chloride were added to two test tubes, and 2-5 drops of chlorobenzene were added to the other two test tubes.
3. One test tube of each compound received 1mL of potassium iodide solution, and the other two test tubes received 1mL of silver nitrate solution.
4. The stoppers were placed in the test tubes, and the contents were vigorously shaken.
5. The time it took for any precipitation to form was noted, and the differences in the results were recorded.

Data and Discussion

Data 1.1. A. Synthesis of Tert-Butyl Chloride

Chemical	Weight (g)	Molecular Weight (g/mol)	Volume (mL)	% Yield
Hydrochloric acid (HCl)	17.7			

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