

**Organic –Chem. 221 Lab**

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**Experiment No: (**6)

**Experiment title:**

The Amylenes Preparation of 2-methyl-2-butene and 2-pentene.

**Submission date:** 29-5-2021

**Abstract: (including objectives, chemical reactions, methods used and main results)**

Main Objectives:

to prepare 2-methyl 2- butene by dehydration reaction of t-Amyl Alcohol, and to understand the mechanism involved in the reaction, and to be able to do the test of unsaturation. The preparation of 2-methyl 2- butene follows the E1 reaction which is elimination to alcohols using strong acid, high temperature, and doing simple distillation of the alkene to remove any impurities. The unsaturation test is a qualitative test for the presence of unsaturation -carbon-to-carbon double or triple bonds- and phenols. Two common qualitative tests for unsaturation are the reaction of the compounds with bromine and with potassium permanganate. If the solution was put with pink KMnO4 it must give a brown precipitate, while if the solution was put with brown bromine, it must give colorless solution.

Methods used: simple distillation.

**Chemicals:**

1. Water

2. Concentrated Sulfuric acid

3. t-Amyl Alcohol

4. Sodium hydroxide

5. Anhydrous calcium chloride

6. Br2 / CCl4

7. KMnO4

8. Ice

**Glassware:**

1. Graduated Cylinder

2. Water bath

3. Round bottomed flask

4. Thermometer

5. Still head

6. Condenser

7. Stand

8. Ring

9. Erlenmeyer flask

10. Clamps

11. Bunsen burner

12. Separatory funnel

13. Curve adapter

14. Beaker

15. Cotton plug

16. Test tubes

**Mechanisms or Reaction:**

* **Dehydration reaction:**

CH3                                               CH3

CH3-C-CH-CH3        H2SO4   CH3-C=CH-CH3

        OH                     **or**                                                 +    H2O

                                                   CH3

                                                    CH2=C-CH2-CH3

* **Bromide test:**

                                                           red

                      CH3                         Br2CCl4                                  CH3

           CH3-C=CH-CH3                               CH3-C-CH-CH3

                  colorless                                              Br   Br

                                                                                         colorless

* **Permanganate test:**

purple

CH3KMnO4 CH3

CH3-C=CH-CH3                               CH3-C-CH-CH3       +    MnO4

colorlessOH   OH                    brown ppt

* **Dehydration mechanisms:**

          CH3                                                CH3                                        CH3

CH3-C-CH-CH3                   CH3-C-CH-CH3              CH3-C-CH-CH3

          : OH                                   O                                      H

                                              H    H

H+, HSO4 -

                                                       CH3

                                            CH3-C=CH-CH3     +   H2O

**Experimental Procedure:**

This procedure was taken from the world of organic chemistry, a laboratory approach, David C. Eaton, 4th edition page 45-47, experiment 6 in the book. But there is a modification instead of using cyclohexanol, t-Amyl Alcohol was used with half of the quantities written in the book.

**Data:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Name and structure** | **Molar mass (g/mol)** | **M.P / B.P. (°C)** | | **Density (g/ml)** | **Milliliter** |
| t-amyl alcohol  C5H10OH | 88.15 | 101-103 | | 0.805 | 27 |
| Sulfuric acid  H2SO4 | 98.079 | 337 | | 1.8302 | 40 |
| Potassium permanganate  KMnO4 | 158.034 | 240 | | 2.703 | Few drops |
| Bromide/carbon tetrachloride  Br/CCl4 | ---- | ---- | | ---- | Few drops |
| **Experimental Results** | | | | | |
| **Product** | **Theoretical Yield (g)** | | **Theoretical B.P (°C)**  39 | | |
| 2-methy-2-butene  C5H10 | **Experimental % Yield** | | **Density (g/ml)**  0.662 | | |

**Calculation and results:**

Percentage yield = (mass of 2-methel-2-butene / 44) \*100%

= (17.64 /44) \*100%

= 0.4009\*100%

= 40.09 %

The main results of the experiments, the % yield of 2-methyl 2- butene was 40.09%

**Discussion & Comments:**

The preparation of 2- Methyl -2- butene from t-Amyl Alcohol, is a dehydration of alcohol. This is considered as an elimination reaction, specifically E1 reaction. This reaction involves the protonation of alcohol by a concentrated acid which then is followed by the loss of water, as dehydration of alcohol needs a strong acid, and for the OH to make a good leaving group. And when Water leaves, we have a carbonium ion which is a carbocation intermediate. Then it loses a proton and the double bond forms with as the 2- Methyl -2- butene final product. As shown above, the volume od 2- Methyl -2- butene was 18 ml using the density equation to get the mass of this product and measure the % yield, which was 40,09%, it is a relatively low yield, which means errors happened while doing the experiment, one of those errors is we probably lost some of the liquid when it was moved between the glassware, as some might have fallen out, also when doing the distillation, the flask that collected the 2- Methyl -2- butene was covered with cotton because it is extremely volatile, so probably it wasn’t covered properly and some of 2- Methyl -2- butene the got to the air. Tests to determine the presence of a double bond can be done, such as adding Br and KMnO4 tests, as if Br we can indicate the double bond if a discharge happens and the solution is colorless, while if added to t-Amyl Alcohol a brownish color will appear, as for the KMnO4 , as if a double bond is present a brown precipitate will show and a colorless solution if it was t-Amyl Alcohol, it will show a purple color. When distilling t-Amyl Alcohol, the melting point reaches 43 °C and then started to drop to 32 °C, this indicates that the t-Amyl Alcohol reaction has finished and the sudden rise is due to the water.

**Questions:**

**Q2. Write equation for the following reaction:**

1. **2-methyl-2-butene plus bromide**

                      CH3                         Br2CCl4                                  CH3

           CH3-C=CH-CH3                               CH3-C-CH-CH3

                                                                             Br   Br

1. **2-methyl-2-butene plus cold, dilute potassium permanganate**

CH3KMnO4 CH3

CH3-C=CH-CH3                               CH3-C-CH-CH3       +    MnO4

               OH   OH

**Q7.**

If the initial distillation is done without taking into account the temperature of the distillation and quickly, the sample will not be distilled properly because all the mixtures will be the result of an uncontrolled temperature. Even moisture will not be separated from the required distilled samples

**Q8.**

If HCl was used instead of H2SO4 then the obtained product will be a chloride derivative instead of its sulphate derivative, And the product is halide alkyl.

**References:**

1. The world of organic chemistry, a laboratory approach, David C. Eaton, 4th edition page 47-50, experiment 5 in the book.
2. https://www.google.ae/search?q=mechanism+of+2+methyl+2+butene&sour ce=lnms&tbm=isch&sa=X&ved=0ahUKEwihn6mrj6DhAhULaFAKHQTyC wcQ\_AUIDigB&biw=1366&bih=576#imgrc=bAbnElCQT8yVSM:
3. <https://www.scbt.com/scbt/product/2-methylbutane-78-78-4>
4. https://www.google.ae/search?ei=ckGiXID-LonIwQL6qZjwAQ&q=methylb utane&oq=methyl+but&gs\_l=psy-ab.1.2.0l2j0i10j0l7.812.13856..16596...7. 0..1.269.4114.0j13j9......0.... 1..gws-wiz.....0..0i71j0i67j0i131.2kSGBEGm35