Name: Date: Class/Hour:

# DISTILLATION OF ETHANOL

## INTRODUCTION

Distillation is a method of purification in which a liquid is vaporized and successively condensed in order to separate its components.

Distillation operates on the property of a substance's volatility, or its ease of vaporization. When a liquid is heated, the more volatile substances vaporize, leaving the less volatile substances behind. Thus, liquids containing substances with different levels of volatility can easily be separated by distillation.

Ethanol is one such substance, capable of being purified from a fermentation broth to 95% purity. A 5% impurity remains from a small portion of co-distilled water.

In industry practice, molecular sieves (materials with small, uniform pores) are used to further distill ethanol into an acceptably purer form.

In this lab you will become familiar with the distillation process using a simple distillation column under the context of ethanol purification.

A fermentation broth will be created or sampled from a previous lab. The broth will then undergo distillation using a simple distillation apparatus. You will then analyze the purity of the product in terms of ethanol concentration.

PROCEDURE

NOTES

STEP 1: PREPARING A FERMENTATION BROTH

1. Prepare a yeast suspension by dissolving 4.67g yeast into 100mL of deionized water.

2. Heat the yeast suspension to 30°C for at least 30 minutes. Stir while heating at about 250rpm.

3. Prepare a 200g/L glucose solution in water by dissolving 200g anhydrous dextrose in 1.0L deionized water.

4. Using a refractometer, measure the dissolved solids contents of the glucose solution. You should measure around 20.0% Brix.

5. Obtain a 250mL Erlenmeyer flask with stopper size #6.

6. Using a graduated cylinder, pour 10.0mL of the yeast suspension into the Erlenmeyer flask.

7. Using a graduated cylinder, add 200mL of the glucose solution into the Erlenmeyer flask with yeast suspension.

8. Seal the Erlenmeyer flask with a one-hole #6 stopper. In the hole place either a bubble trap, or a cotton or glass wool packed column.

STEP 2: MEASURING THE FERMENTED SOLUTION

1. Calibrate the ethanol probe using your ethanol solutions.

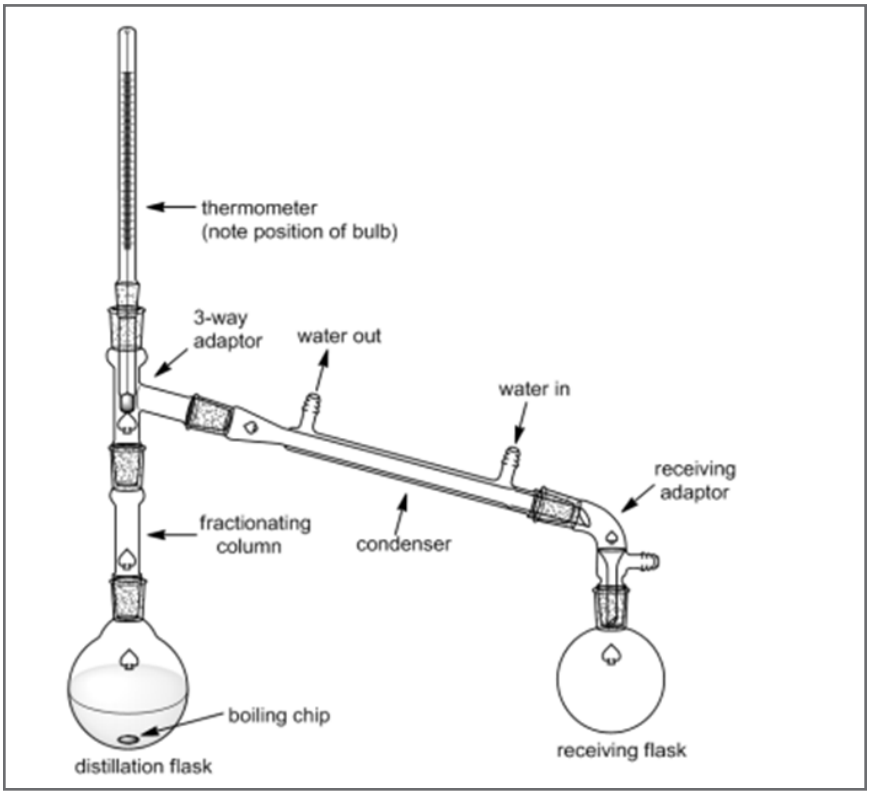
2. Record the ethanol content of the fermented solution as described in the fermentation lab.

STEP 3: CONSTRUCTING THE DISTILLATION APPARATUS

1. Set up your distillation apparatus as shown in the figure on the next page.

PROCEDURE (cont.)

NOTES




STEP 4: DISTILLATION OF ETHANOL

1. Quantitatively transfer the 200mL of fermented solution into the 500mL distillation flask. Make sure when washing you do not overfill the 500mL flask. The flask should ideally be half full.

2. Heat the distillation flask using either a Meker burner (keeping flame at least 2 inches away from flask), a hot plate, or a heating mantle. A heating mantle is recommended as the safest method.

3. Slowly adjust the temperature of your heat source until the temperature within the distillation flask reaches 79°C. At this point you should notice condensation in the condenser.

4. Pay close attention to the temperature within the distillation flask. A lowering temperature is an indicator that ethanol is no longer vaporizing into the condensation tube. When this happens, remove the heat source and let the condensed product cool.

PROCEDURE (cont.)

NOTES

STEP 5: ANALYSIS

1. Measure the mass of ethanol collected by either weighing the sample or measuring the volume in a 25mL graduated cylinder. Record your observation.

2. Measure the concentration of ethanol in both the condensed product and the leftover fermentation broth. You will likely need to dilute the ethanol sample with distilled water by a factor of 10 to 1 to allow the probe to accurately measure its concentration. Record your observations.