

16 Distillation of Nail-Polish Removers

Purpose: Distillation is used to separate acetone from a nail polish remover product.

Introduction

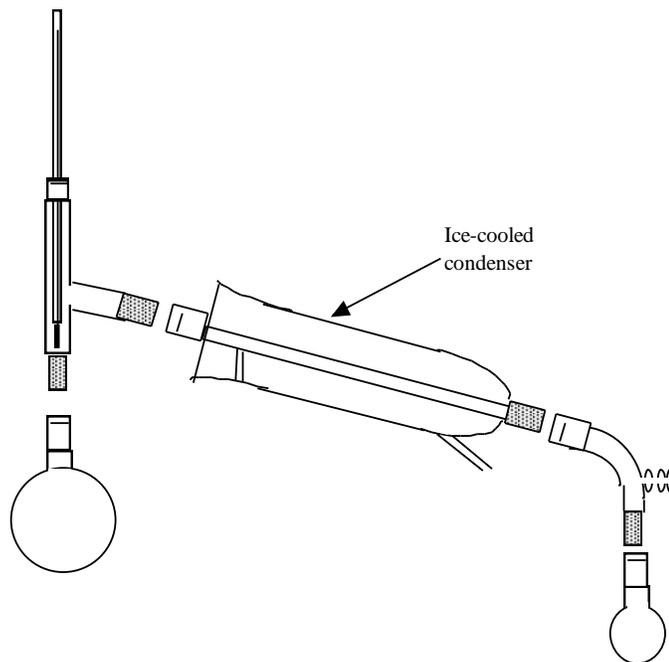
Nail polish remover is distilled to remove acetone using a hot water bath as the heat source.

The formula for acetone is:
$$\begin{array}{c} \text{O} \\ || \\ \text{CH}_3\text{-C-CH}_3 \end{array}$$

The nail polish remover product also contains water, yellow dye, gelatin, fragrance, propylene carbonate, glycerol and the dimethyl esters of adipic, succinic and glutaric acids. Low boiling acetone (56 - 57°C) is readily separated from those by distillation. The apparatus shown below includes an ice-cooled condenser rather than a water-cooled condenser.

Apparatus

The distillation setup is shown on the right. The heating is done by immersing the 25mL round bottom flask in a beaker of water on a hot plate (not shown). The ice-cooled condenser replaces the standard water-cooled condenser.



Procedure

1. Assemble the distillation apparatus as shown in the figure. Use ring stands and clamps to support the apparatus. If necessary, place a glass extender (adapter with one end male and one end a female joint) between condenser and distillation head to prevent the condenser from hitting the water-bath beaker. Use the plastic clamps (small yellow rings) to secure the joint connections. You should have five of these.

CAUTION: The thermometer is in a holder with a rubber tube. It should be already assembled. If not, be sure to insert the thermometer into the holder slowly and carefully to avoid breakage.

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2. Pour 5 mL nail polish remover into the 25mL round bottom flask. To do this, remove the thermometer assembly and use a funnel.
3. Fill the jacket around the condenser with ice (doesn't need to be filled to the top) and place a beaker below to collect runoff.
Note: One filling with ice is enough to perform this experiment.
4. Place water in the 250 mL beaker for the heating bath and lower the set up so that when the 25 mL round bottom flask is immersed the beaker is about 2/3 full.
5. Heat the hot water bath using the highest setting on the hot plate until water is near boiling, then turn it down a little. The water need not be at a full boil.
6. Record boiling temperature of acetone.
Note: The boiling point is the same temperature at which the vapor condenses. If it is difficult to tell exactly when this condensation occurs watch for the thermometer to quickly rise and then settle. The degree on which the thermometer rests will be the boiling point.
7. Record the volume of acetone that is obtained.

Data and Results (Distillation of nail polish remover)

Name(s) _____

Brand Name of Nail Polish Remover Product _____

Volume Nail Polish Remover distilled _____ mL

Volume acetone recovered _____ mL

% Acetone recovered (of the volume of nail polish remover) _____ %

Temperature range (during condensing of acetone) _____ °C

Questions:

1. Compare distillation to the use of the MelTemp apparatus for determination of boiling points (if you have used the MelTemp for boiling points.)
2. Why does the temperature stay constant while the acetone evaporates? Why does the the temperature begin to rise again once all of the acetone has evaporated?
3. Can you think of any examples in everyday life where distillation is used?

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Instructor's Guide *#16 Distillation*

Brand Name of Nail Polish Remover Product cutex

Volume Nail Polish Remover distilled 5.0 mL

Volume acetone recovered 2-3 mL

% Acetone recovered (of the volume of nail polish remover) 40-60 %

Temperature range (during condensing of acetone) 56-57 °C

Questions:

1. Compare distillation to the use of the MelTemp apparatus for determination of boiling points (if you have used the MelTemp for boiling points.)
2. Why does the temperature stay constant while the acetone evaporates? Why does it then begin to rise again?
3. Can you think of any examples in everyday life where distillation is used?

1. The boiling temperature using the distillation apparatus is very easy to see. The temperature range is narrow. Using the MelTemp, only an approximate boiling point or range can be found and it is more difficult to see.

2. The temperature will remain constant at the boiling point. It will begin to rise again once all the acetone has evaporated. When the temperature reaches the next lowest boiling point of one of its components it will plateau again.

3. Gasoline from petroleum, bottled water from water with high mineral content, alcoholic beverages from fermented fruits and grains.

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Instructor's Guide *Distillation (cont'd)*

Time: 45 min—can be done in one class period if some set-up is done beforehand

Equipment and Materials: per group

| Items | Number | Comment |
|---------------------------|-----------------|---|
| Stir/hot plates | 1 | |
| Ice-cooled condensers | 1 | |
| 25-mL round bottom flask | 1 | |
| 10-mL round bottom flask | 1 | |
| Adapter vacumes | 1 | |
| Three-way adapters | 1 | |
| Extender adapters | 2 per class | to prevent condenser from hitting water bath beaker if using smaller condensers |
| 250-mL Beakers | 1 | for water heating bath |
| 100/150-mL Beakers | 1 | For collecting runoff |
| Nail polish remover | 50 mL | different brands |
| Thermometers | 1 | With adapter |
| Ring stands | 1 | |
| Clamps | 1 | |
| Funnels | 1 | |
| 10-mL Graduated cylinders | 1 | |
| Plastic clamps (yellow) | 40 per class | 5 per setup |
| ice | | |
| Safety glasses | 1 per student | |
| Rubber gloves | 1 box per class | |

Ideas/ Information

Compare the acetone with the remaining ingredients in the nail polish remover. Have the students notice the color and texture difference and if the teacher deems appropriate and the class has been versed in appropriate lab behavior they may compare the smells.