Fractional distillation

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Expermental Theory

Fractional distillation is used:To separate two or more miscible liquids such that the difference between their boiling points is less than 50°C.

Raoult’s law states that:

The vapor pressure of any component in a mixture equals the vapor pressure of the pure component multiplied by its mole fraction in the mixture.

$XA + XB = 1$

$PTOTAL = P^{o}A\ XA + P^{o}B\ XB$

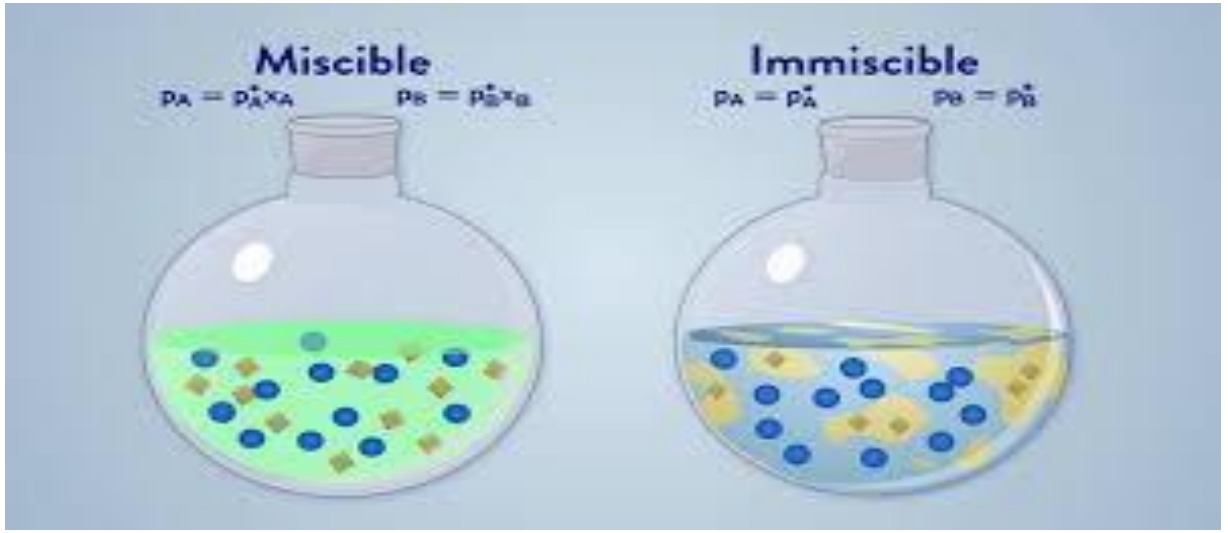
XA = mole fraction of A in the mixture.

XB = mole fraction of B in the mixture.

P total = total vapor pressure of the mixture.

$P^{o}A$ = vapor pressure of pure component A.

$P^{o}B$ = vapor pressure of pure component B.



The fractionation process is carried out by a fractional column which consists of units called **THEORETICAL PLATE**

These are used to increase the cooling surface.

When designing the plates, the following must be considered:

(number of plates in the column, plate inclination, height of the theoretical plate, type of material used such as Pyrex, and the distance between plates) in order to achieve the best heat exchange.

(Fractional Column) Principle of operation

The role of these protrusions can be explained when heating begins for the mixed liquids: The vapor of the two liquids rises and passes through the fractional column. Some vapor condenses when passing over the protrusions due to heat exchange. The less volatile liquid (higher boiling point) falls back into the distillation flask, while the vapor of the more volatile substances (lower boiling point) continues rising. Thus, the mixed liquids are separated

The efficiency of a fractional column depends on:

1- The number of theoretical plates (directly proportional).

2- The column height (the amount of liquid remaining in the column) (inversely proportional).

3- The equivalent height of a single theoretical plate (inversely proportional).

4- The amount of distillate per unit time (inversely proportional).

5- Reflux ratio = amount of distillate / amount of reflux (inversely proportional).

Procedure:

1. Arrange the apparatus as shown in the figure.
2. Place the miscible liquids to be separated in the distillation flask, then add some porcelain pieces (boiling stones). Connect the flask to the fractional column so that the lower end of the column is fixed with a cork stopper. Place the thermometer at the top of the column and fix it with a cork, ensuring that the thermometer bulb faces the side arm of the column slightly downward to measure the temperature of the liquid passing to the condenser. Then connect the condenser, place the receiving flask, and connect the water source.
3. Pass water through the condenser and begin heating slowly بحيث لا يتجاوز ما يتكثف في دورق الاستلام قطرة كل (5–4)seconds, ensuring a drop is suspended on the thermometer bulb.
4. Collect the distilled liquids at specific temperatures, each liquid in a separate flask.
5. Record the temperatures and the volume of distilled liquid at each temperature..

منظومة

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