ChemBam

Fractional distillation (teachers' guide to exercise and experiments)

AIM

- ⇒ For students to recognise that we can separate different liquids in a mixture due to their different boiling points
- ⇒ For students to be made aware of the practical issues related to fractional distillation of crude oil and gain an appreciation for alternative renewable resources
- ⇒ For students to recognise that different vapours condense at different temperatures and each of these can be separated out
- ⇒ For students to understand that larger hydrocarbon chains have higher boiling points that shorter hydrocarbon chains
- ⇒ For students to perform their own fractional distillation and recognise that each distillate is removed at a different temperature due to their different boiling points
- ⇒ For students to recognise why some components (e.g. sugar) are left in the conical flask

EXERCISE 1 – Answer guide for teachers

1. Different boiling points for different liquids (could begin to discuss how differences arise due to changes in molecular weight)
2. High temperatures needed mean a lot of energy is needed – high costs, use of non-renewable energy sources for heating. Also consider environmental implications of using crude oil.
3. Initiate discussion of renewable resources (e.g. solar, wind, hydrothermal) and their advantages/ disadvantages (high cost of equipment, not as effective, noise pollution, ugly, etc.)

EXERCISE 2 – Answer guide for teachers

The shortest carbon chain will be removed at the coolest part of the column (at the top). As you go down the column, the chains increase in size until the largest hydrocarbon chain is removed at the highest temperature (at the bottom). Encourage discussion around why students have chosen this order (different boiling points due to differences in molecular weight).

EXPERIMENT QUESTIONS – Answer guide for teachers

1. The pH of the water decreased (solution should change colour from green to yellow/red). The carbon dioxide released from the fizzy drinks can react with the water to form carbonic acid.
2. The first fraction has the lowest boiling point and the last fraction has the highest boiling point.
3. Sugar remains in the flask after distillation as the boiling point of sugar is far too high to reach under these conditions. In a diet version of this drink we wouldn't see the sugar left over
4. The final density of the drink should be greater than that of the initial density as most of the water will have been removed, meaning the liquid in the conical flask will have a higher sugar content and therefore greater density
5. Fraction 2 should have a sweet fragrance as this contains the flavourings in the fizzy drink. Fraction 3 should have little to no fragrance as it should be mostly water.
6. The first fraction is at the top of the column and the last fraction is at the bottom of the column