Introduction

Have you ever noticed that spilt petrol is colourless, but that the oil you see squirting out of the ground in movies is black? Why is this? Crude oil, also known as petroleum, is the raw product that is found in underground reservoirs. It’s pumped out of the ground and then transported to refineries where it’s processed. A whole range of products are made from this oil, including petrol. Crude oil is a complex mixture of different compounds that need to be separated to maximise their use. In this experiment you will explore the process of fractional distillation, which is one of the major steps in refining crude oil.

The main components of petroleum are hydrocarbons. They are chemical compounds composed of hydrogen and carbon. The diagram below shows just a few of the complex molecules present in crude oil.

Safety precautions

• wear safety glasses at all times
• crude oil is flammable, so care must be taken to keep it and its fractions away from naked flames. Do not use Bunsen burners. Use of a heating mantle reduces the risk of flammable liquids catching alight.
• ensure Material Safety Data Sheet (MSDS) has been read

Materials (per group)

| safety glasses (per person) | 3 x medium test tubes |
| heating mantle | quickfit round-bottom flask (100 ml) |
| retort stand with clamp | quickfit apparatus to connect flask and test tube |
| crude oil (15 mL) | test tube rack |
| boiling chip | 25 mL measuring cylinder |
| matches | cotton wool |
| ice | 4 x metal spoons |
| heat mat | salt |
**Procedure**

1. **Ensure you have your safety glasses on.**

2. **Collect equipment and set up the experiment as shown in the diagram.**

3. **Place 15 mL of crude oil and a boiling chip into the quickfit round-bottom flask (try not to run oil down the side of the flask).** CAUTION: Do not turn on the heat source until step 9.

4. **Place a loose plug of cotton wool in the neck of the flask above the crude oil.**

5. **Attach the quickfit connector and return to the heating mantle.**

6. **Combine salt, water and ice in the 500 mL beaker.** This will be used to cool the fraction and cause condensation.

7. **Label the three small test tubes #1, #2 and #3.** Place them in the test tube rack in order.

8. **While keeping the test tube rack away from the heating mantle, place the quickfit connecting apparatus into test tube #1.** Put this test tube into the ice bath.

9. **Heat the bottom of the quickfit round-bottom flask gently with the heating mantle set to low.**

10. **Collect the liquid being produced in test tube #1. It may take a while for the crude oil to heat up. This collection is called the first fraction. Continue to collect the first fraction as the oil boils.**

11. **When the boiling subsides, switch test tubes, putting test tube #2 into the ice bath.**

12. **Increase the heat on heating mantle.** You are now collecting the second fraction.

13. **Change test tubes again to collect the third fraction in test tube #3.** Heat the oil with the heating mantle set to its hottest setting.

14. **Return test tube #3 to the test tube rack and turn off the heating mantle.**
• You have completed the fractional distillation of the crude oil mixture. You have three fractions, or parts, of the original mixture. Let’s see how the fractions differ from each other and from the remains of the original crude oil mixture. Record your results on your worksheet.

• If you prepared some biodiesel in a previous experiment, you may like to test and compare this too.

15. Look at test tubes #1, #2, #3 and the round-bottom flask. What is the colour variation between each of the three fractions and the remains of the original mixture?

16. Swirl the liquid in each test tube and the flask around to observe any differences in the thickness (or viscosity).

17. Using your hand, waft any odour from each test tube and flask toward your nose. Carefully smell each fraction to determine any difference in odour of each fluid.

18. Test each fraction to see how easily it burns: pour a few drops of each fraction on a metal spoon then carefully ignite the liquid with a match. Describe how easily each fraction ignites, how clean the flame is when burnt and what the residue on each spoon looks like.