Dynamics and Statics

Hare's Apparatus

(Ireland)

Background

Hare's Apparatus allows a reference liquid to be used to find the density of another liquid, by comparing the heights that both liquids reach in a system where they can be drawn up equally through vertical tubes.

Details of how to construct the device can be found at this link bit.ly/SonS2019

You will need:

- ✓ Retort stand
- ✓ 1 m plastic tubing
- ✓ 6 tube clips
- ✓ 1 Mohr clip
- ✓ 1 Pasteur pipette
- ✓ Scissors
- ✓ Screwdriver
- ✓ Glue
- ✓ Laminated paper rulers
- ✓ T-junction
- ✓ 50 cm^3 plastic syringe
- ✓ 2 small beakers
- ✓ Water
- ✓ Cooking oil

Follow these steps:

1. To set up the device for use, make sure the syringe has been removed and the Mohr clip is fully open.
2. Place an equal amount of water in one beaker, A, and a sample of cooking oil in the other, B.

Allow several minutes for the capillary action in each tube to settle.

3. Make sure the piston of the syringe is fully closed, before reattaching to the apparatus.
4. Draw out the syringe piston approximately halfway.
5. Quickly close the Mohr clip to maintain the applied suction.
6. Read the height of each liquid from the graduations behind each tube.
7. Enter the heights into the formula and calculate the density of the cooking oil.

So what happened?

The ratio of the densities of two liquids is equal to the ratio of the column heights of these liquids under equal pressure. If one of the liquids is water we can take its density to be 1.0 g/cm^3. This then changes the formula so that by measuring the height of water and another liquid we can calculate the density of the second liquid.

This means that Hare's Apparatus provides a straightforward method for measuring densities, using water as a reference liquid.

The difference in the column heights can be explained by the fact that both columns of liquid have the same mass and exert the same hydrostatic pressure.

In general, oils have lower density than water and so the oil column would usually be higher than the water column.

What next?

- Hare's Apparatus could be used to explore ratios in addition to students using experimental reading in a formula to quantify relative densities of liquids compared to water
- The experimental results could also be used to predict density layers in a density column and confirming predictions by constructing the density column.

$$\frac{\rho_1}{\rho_2} = \frac{h_1}{h_2}$$

$$\frac{1.0}{\rho_2} = \frac{h_1}{h_2}$$

$$h_2 = \rho_2 h_1$$

$$\rho_2 = \frac{h_2}{h_1}$$