How to Measure Interfacial Tension

with ramé-hart DROPimage Advanced

This knol walks through the steps involved in measuring interfacial tension using any current-generation ramé-hart contact angle goniometer or tensiometer with DROPimage Advanced software. Interfacial tension is measured between a drop and an external phase which consist of immiscible liquids.

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Interfacial Tension with DROPimage Advanced

Interfacial tension is measured using a pendant drop of liquid while the external phase consists of an immiscible liquid. For example, the drop may be oil while the surrounding liquid may be water. Interfacial tension is similar to surface tension except with the latter the external phase is a gas (such as air).

When the drop phase is denser than the external phase, a hanging pendant drop is used. In the example below, however, the drop phase is less dense than the external phase – therefore, an inverted pendant drop is used.

The following products are used with this experiment:

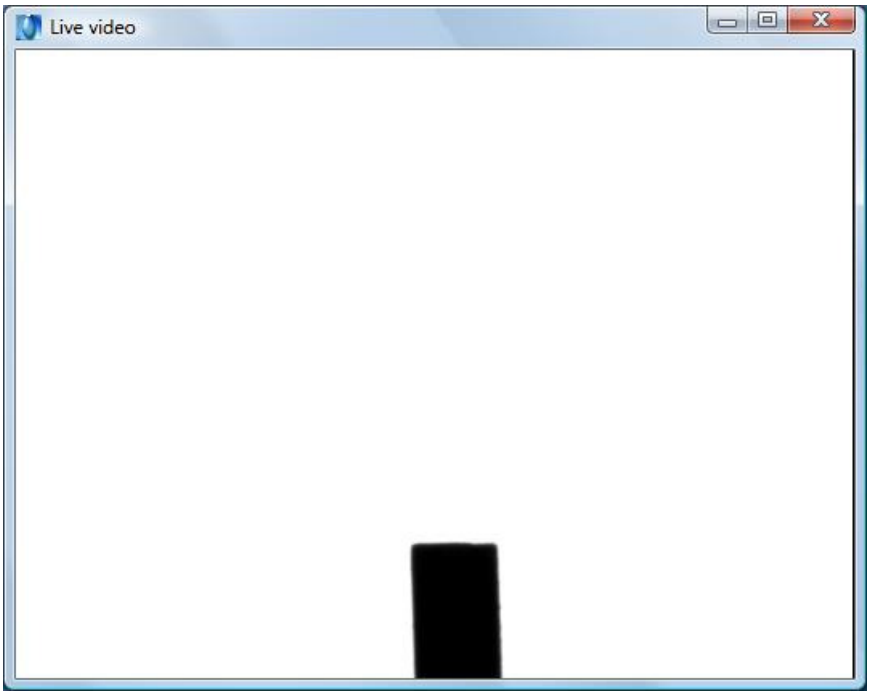
- ramé-hart Model 250 Standard Goniometer with DROPimage Advanced (p/n 250-F1)
- Quartz Cell (p/n 100-07-50)
- Inverted Stainless Steel 22g Needle (p/n 100-10-13-22)
- Manual Microsyringe (p/n 100-10-20; note one is included with Model 250)

Goal

The goal of this experiment is to take ten measurements of interfacial tension of an oil sample in water at ambient temperature and pressure.

Procedure

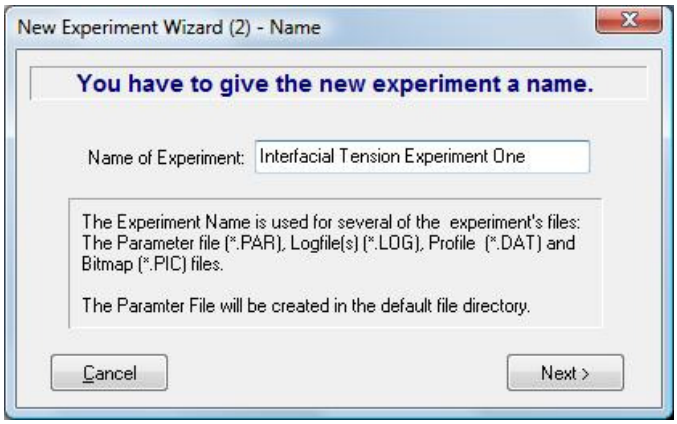
1. Verify that the instrument is setup according to the instructions provided and has been calibrated.
2. Fill the quartz cell with deionized water.
3. Fill the microsyringe with the test oil.
4. Attach the inverted needle to the syringe firmly.
5. Turn the dispensing knob on the microsyringe to remove air from the needle.
6. Start the DROPimage Advanced software.
7. Install the microsyringe in the fixture and adjust it so that the tip of the needle is visible in the center bottom of the DROPimage live image window as shown below.



8. Next, let's begin a new experiment using the Experiment Wizard. Click on File > New Experiment Wizard. Or simply hit Ctrl-T on the keyboard.

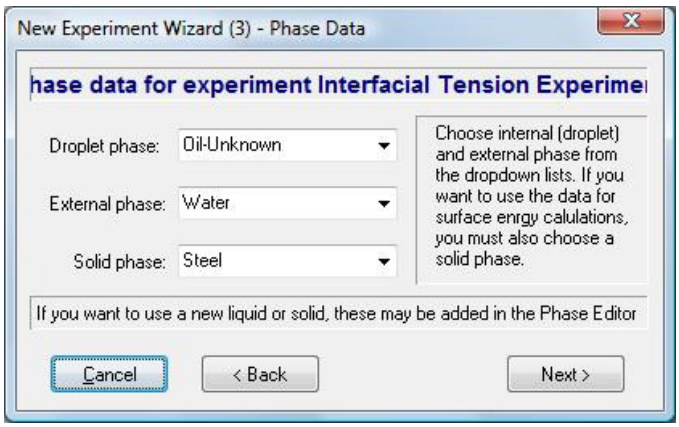
9. We will use the first choice "Surface Tension – Pendant". Note that this is the appropriate method for both hanging as well as inverted pendant drops. Click Next.

10. On the next screen, enter an experiment name. We will use "Interfacial Tension Experiment One".

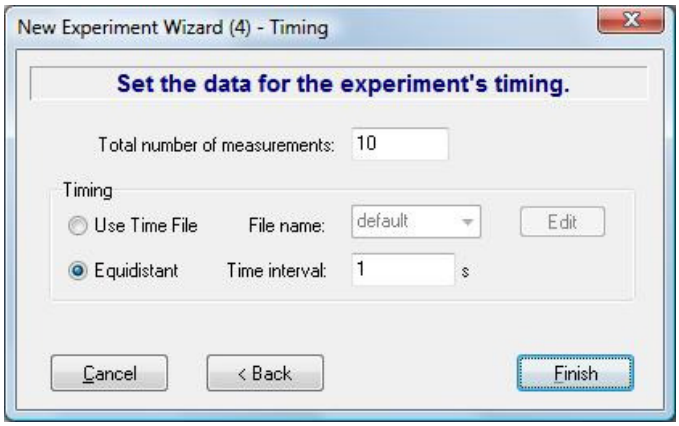


11. Click Next.

12. On the next screen we will enter the phase data. For the droplet phase, select the liquid you are using from the list. Note that if the liquid is not in the list, you will first need to add it using the Phase Editor. Select the External phase – in this case, water. And then the solid phase which is steel (the needle).

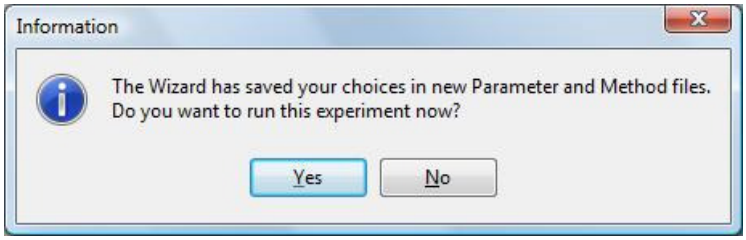


13. Click Next.



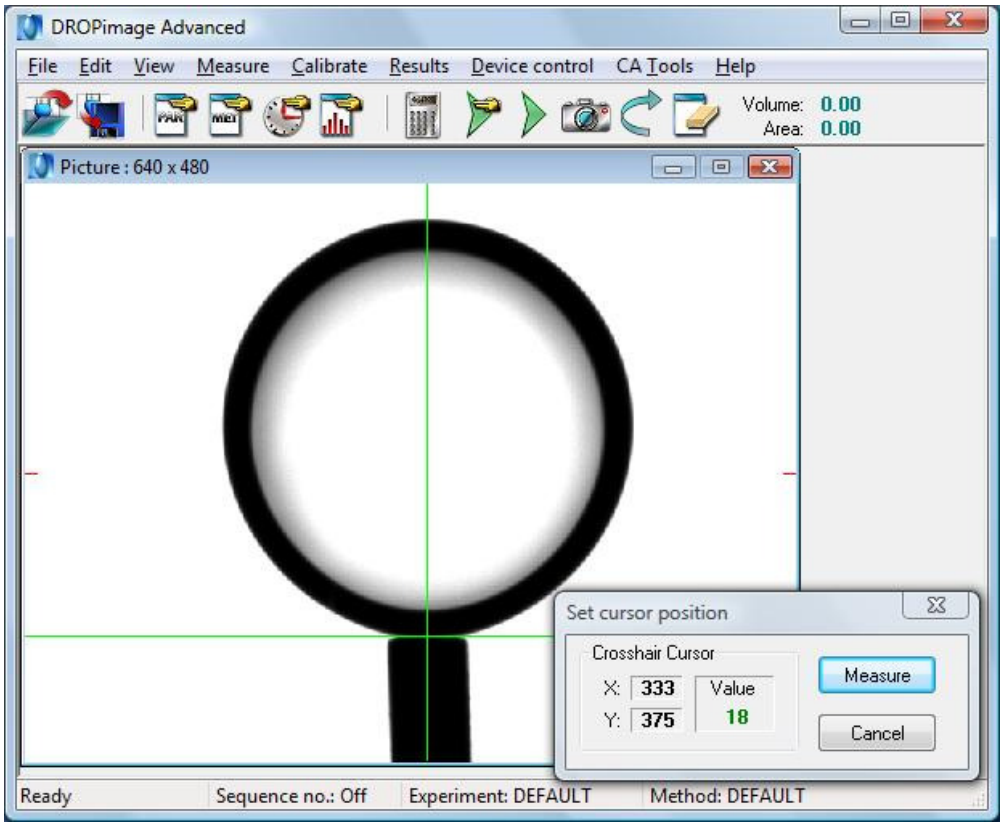
14. Now enter "10" for the number of measurements. For the timing, you can use an existing time file – or create a new one – we will use the Equidistant option and set the "Time Interval" to "1" which means that the measurements will be taken one second apart.

15. Click Finish.



16. At this point, DROPimage has created a Parameter and Method file for your experiment. Click Yes to run it.

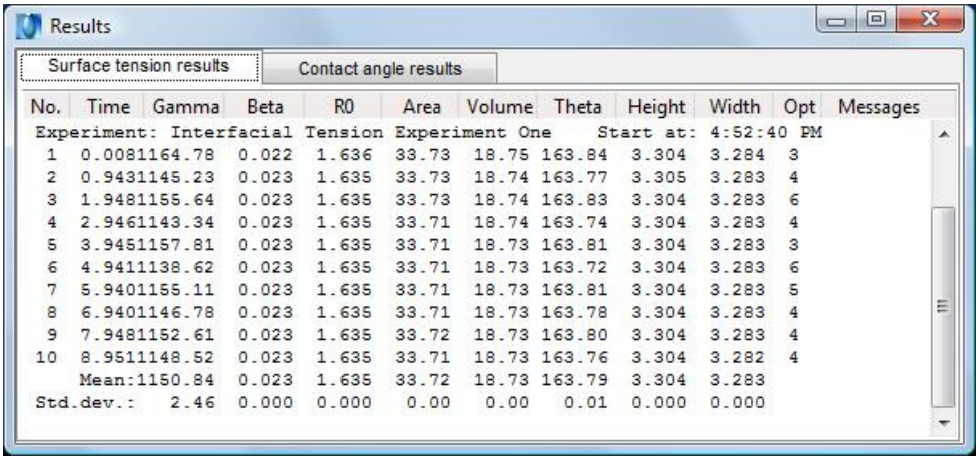
17. Now you will need to dispense your test liquid in order to produce a drop similar to the one shown on the next screen. As a rule of thumb you want to use enough volume to produce a drop that is stable and not so large that it releases itself from the needle. As the interfacial tension decreases, so too will the drop volume.



18. With the drop created, be sure that your lighting is set properly. The background should be white while the needle and perimeter of the drop should be black. The interface between the drop and the external phase should be crisp. If not, focus and take a new picture.

19. Place the crosshairs so that the horizontal line passes through the interface between the needle and the drop and the vertical line passes through the center of the drop and needle as shown above.

20. When you ready, click Measure on the "Set cursor position" dialog box. The experiment will now begin.



21. The results window will now appear if it's not already on your desktop and look similar to the one shown above.

22. The results for surface tension and interfacial tension are the same. Here is some information on each column:

1. No. – run number, e.g., 1,2,3…
2. Time – precise time in seconds of measurement relative to the start of the current run.

3. Gamma – surface or interfacial tension in mN/m.
4. Beta – shape factor; as a rule a number between 0.2 and 0.4 is good.
5. R0 – The radius of curvature at the drop's apex in mm.
6. Area – The drop surface area in mm^2.
7. Volume – The drop volume in mm^3.
8. Theta – The contact angle at the drop limit (horizontal) baseline.
9. Height – The total measured distance from baseline to the drop apex in mm.
10. Width – The dimension in mm at the maximum width.
11. Opt – The number of optimizations performed.
12. Messages – Errors or other messages.

Congratulations. You've now successfully measured interfacial tension. If you want to make changes to your experiment use the Method Editor and Phase Editor to change the settings.

Should you have any problems not covered in this tutorial, please contact us for further assistance at www.ramehart.com.