Viscosity Measurement: A Virtual Experiment

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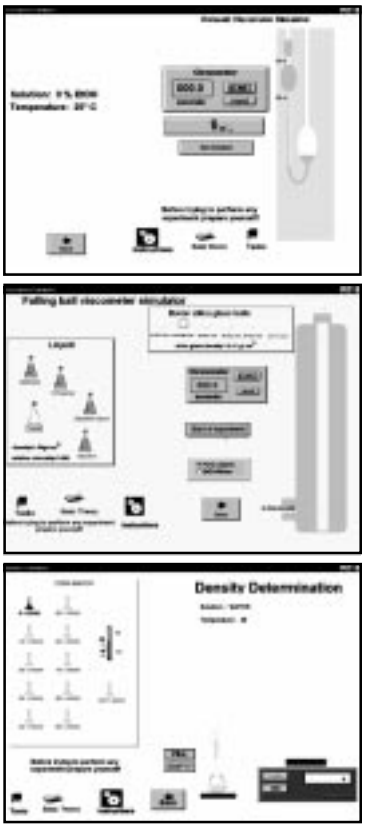
Abstract

Viscosity Measurement: A Virtual Experiment simulates a series of viscosity experiments. Viscosity is a very important subject in both chemistry and chemical engineering because of its relevance in dealing with internal forces in liquids and gases, which has an impact in all technical aspects of the equipment. Most university-level chemistry courses include viscosity to some extent.

Viscosity Measurement includes three virtual experiments: an Ostwald viscometer simulator, a falling-ball viscometer simulator, and a balance simulator for a simple determination of the density of a liquid. The Ostwald viscometer simulator and the balance simulator allow the student to find out how composition and temperature influence the density and viscosity of an ethanol–water mixture. The falling-ball viscometer simulator allows the student to determine experimentally the size and density of the ball required to measure viscosity of various liquids.



Top, the Ostwald viscometer. Center, the falling-ball viscometer. Bottom, the balance simulator.

Each virtual experiment includes a corresponding theoretical section. Support from the program is sufficient to enable the students to carry out a virtual experiment sensibly and on their own. Preparation is not essential. Students can use the program unsupervised, thus saving staff time and allowing more flexibility in the students' time.

The design of the program interface plays a key role in the success of a simulated experiment. Direct manipulation has greater intuitive appeal than alternative interface forms, such as menus, and has been observed to provide performance and learning advantages (*1*). We tried to design an interface that is visually attractive, is user-friendly with simple and intuitive navigation, and provides appropriate schematic animations to clarify the principles of the laboratory procedures. The opening screen presents the virtual experiments that can be selected. Clicking an icon takes the student to the appropriate section.

Viscosity Measurement allows the student to concentrate on the experiments at hand and not on learning how to use the program. It communicates its ideas visually with pictures and diagrams, relegating on-screen text to the minimum required for the student to understand the presentation. A full presentation of viscosity is reserved for the textbook, which the computer cannot replace. It is well established (*2*) that people read text on a computer screen more slowly and

with greater strain than text in a book. Moreover, relatively open-ended exploration does not appear to be a successful method of practice because it is not well conceived and well integrated in the students' learning path (*3*). For every virtual experiment, we suggest a set of coherent exercises that highlight what we want students to know before they enter the real laboratory.

Instructor Notes

Tasks

Each module includes a set of tasks that the students can perform using the simulator. The tasks are listed below.

Ostwald Viscometer

- Try to find out how the composition and the temperature affect the viscosity of the ethanol–water mixture.

Falling Ball Viscometer

- Try to find out experimentally which is the suitable ball to determine the viscosity of methanol, glycerol, ethylene glycol, propanol, and water.
- Calibrate the viscometer.
- Try to find out how the composition and the temperature affect the viscosity of the ethanol–water mixture.

Balance Simulator

- Try to find out how the composition and the temperature affect the density of the ethanol–water mixture.

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Citations

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