

Figure 1 (upper):
Chris Macosko is the
director of Minnesota's
Short Course on Rheological
Measurements, which he
started in 1975, making this
year's stated 24th Annual
course actually the 25th!



Figure 2:
At the Awards Banquet,
Barnes, Macosko and
Chakrabarti (a special lec-
turer in food rheology from
Pillsbury Technology Center)
amuse themselves and the
class with a demonstration
of the yield stress of ketchup
and mayonnaise.
Howard Barnes received an
honorary doctorate in
"Meta-Rheology".

If longevity is a sign of success, then the Rheology and Polymer Group at the University of Minnesota has cause for celebration. Their 24th annual short course on Rheological Measurements, one of the longest-running of its kind, was held August 2-6 this year.

The course covers a broad range of topics in rheology, and is a combination of lectures and labs. In addition to the regular labs attended by all, some students bring samples to learn how best to obtain measurements on materials of interest to them. The class is structured so that those students interested in particular experiments can spend more time in the labs later in the week, when students opt to attend different special lectures or work with faculty in the lab. Founding director Chris Macosko used the course in writing his popular textbook on rheology (Wiley, 1994). The text follows the course and is provided to each student.

While it officially runs Monday morning through mid-day Friday, the course starts with an optional Sunday evening review of vectors and tensors. This is an easy way to refresh math skills, and is an introduction to the Monday lectures, where stress and strain tensors are presented. The tensor description of stress and strain is not really required to get the most out of the rest of the course, but the faculty believe that it deserves to be included. Students

with greater interest in the mathematical description will be rewarded, and the rest will have seen it presented clearly at least once, and be less intimidated by future encounters in journal articles or books.

The lecture schedule varies slightly from year to year, based partly on the topics covered by the guest lecturer (each year has a different special lecturer from outside the university). The complete lecture schedule is available on the web at <http://www.umn.edu.cems/rheology>. The regular lectures began this year with an introduction to rheology followed by lectures on stress and strain tensors; Newtonian, power law and general viscous liquids (all by Macosko); linear viscoelasticity (by Tim Lodge); and shear rheometry utilizing drag flows (by David Giles). The second day began with lectures on shear rheometry utilizing pressure driven flows, and on extensional rheometry. Having the basics from lectures, the class was then split into smaller groups for labs on capillary rheometry, extension, constant stress, startup shear, and sinusoidal shear.

Students returned to the lecture hall in the latter part of the afternoon to hear the first talk by this year's guest lecturer, Howard Barnes (of Unilever), who spoke on Industrial Applications of Rheology. His lecture brought to focus practical applications of rheology. An optional evening question and answer session finished off the day, where some students came to listen; others brought questions relating to the material presented, or to their own work.





Figure 3 (left): Laboratory sessions feature rheometers with some of the latest in special features, such as the ARES rotational rheometer with the addition of axial squeezing flow capability and dual-view-portal oven (shown with David Giles and Kim Chaffin).

Figure 4 (right): The awards banquet is a light-hearted tradition of the short course (seen in this photo are Eun-Kyung Koss, Srivatsan Srinivas, Sean Kohl, Chuck Extrand and Daphna Weils).

Wednesday's lectures covered applications to polymeric liquids (Matt Tirrell), fluid mechanics (Dan Joseph), food rheology (Sumana Chakrabarti), crosslinking and reactive processing (Macosko), and rheoptics (Lodge). Major rheometer vendors (this year Rheometric Scientific, TA Instruments, Haake, Paar Physica, Dynisco, and Perkin-Elmer were present) were allowed time to briefly introduce themselves and their products. Each had at least one rheometer set up and available for interested students to examine and use. This allowed an opportunity to compare a variety of rheometers on the market today. In the afternoon students could also work with Minnesota faculty using instruments from their labs.

The course ended Friday with lectures on applications of rheology to polymer processing (Macosko), and on block copolymers (Frank Bates). The broad range of topics and coverage of fundamentals make this course a continuing attraction for both novices and experienced rheologists.

David Giles and Daniel Williams
 Department of Chemical Engineering and Materials Science
 University of Minnesota
 421 Washington Avenue, SE
 Minneapolis, MN 5545
 giles@cems.umn.edu, dwilliam@cems.umn.edu
 fax: x1.612.626.1686

Figure 5 (below): In addition to over 30 US students, there were 5 internationals. Emilio Ortiz, Juan Luis Camacho, Lene Mikkelsen, Daphna Weils, and Jan Nell show their flags.

The fourth day began with two lectures by Howard Barnes, on rheology of colloidal dispersions, and on the yield stress, entitled "Everything flows, the measurement of and mechanism for the yield stress." Other lectures that day covered non-linear viscoelastic models for non-Newtonian liquids (by Matteo Pasquali), adhesion and surface forces (Tirrell), and coating flows (Skip Scriven). The Awards Banquet that evening followed a Minnesota tradition of food, awards and fun.

