ChE 529 Polymer Experimental Methods University of Rhode Island
Professor Greenfield Fall 2008

Lab 1, Introduction to Chain Shape and Physical Properties
Lab report information

Make sure that your report addresses the following questions, based on the first lab experiments.

Experiment A: Shape of a polymer chain

Conduct the data analysis as directed in the lab instructions. Here are some guidelines / reminders:

- The average of the squared end-to-end distance is calculated as $\langle r^2 \rangle = \frac{1}{N} \sum_i (r_i)^2$, where r_i is the distance that you measured in experiment i (so i ranges from 1 to 10 or 20). Repeat the calculation for each different kind of distance (end-to-end and maximum extent) and for each string.
- You may need to figure out the distribution of sizes "by hand", such as by picking a width that seems to group multiple r values together (but not too many). The axes on a plot of the distribution will be the size of r (x-axis) and the scaled fraction of attempts that were within that size r (y-axis, see lab instructions for the scaling factors). An example of a distribution is the number of times that a pair of dice add up to a value between 2 and 12, after many rolls. Results for 36 rolls could be (if there was a perfect mix of rolls, which would not be likely to happen, in practice).

sum	number of rolls
2	1
3	2
4	3
5	4
6	5
7	6
8	5
9	4
10	3
11	2
12	1

- The combination of parameters $n\ell^2$ equals the value of $\langle r^2 \rangle = \frac{1}{N} \sum_i (r_i)^2$ that you determined from your experiment. This relationship emerges from the statistical mechanics of polymers. The fully extended length of the string corresponds to $n\ell$. n corresponds to the number of independent bond units along the backbone, and ℓ equals the length of each unit. Note that you can manipulate your results to estimate the values of n and ℓ that are consistent with each string. How do the results differ among the different strings?
- How do the calculation results compare between the end-to-end distance compared to the "maximum extent" distance?

Experiment B: Thermal effects on polymer properties

Answer the questions asked in the lab instructions:

- Rank the "bounciness" of the samples you tested, including temperature effects (see instructions).
  - How would you rank the "bounciness" of these samples?
  - Which bounces the most? Which bounces the least?
  - How do changes in temperature affect the bouncing?
- Rank the effects of heating on mechanical properties (see instructions).
  - What happens (if anything) when the sample is immersed in the boiling water? Describe.
  - How does the modulus (see below) compare for the same material under room temperature and 100°C conditions?
  - How does the modulus compare for these different samples and/or different polymers?

Experiment C: Sorption of liquid water

Answer the questions asked in the lab instructions:

- What did you observe as you added water to the diaper material?
- How much water could the diaper absorb? If you recorded the mass of the dry diaper material, how does the amount of absorbed water compare?
- Plot the expansion of the diaper material (longest length or approximate volume, depending on what you can calculate from your observations) vs. the mass of the added water.
- Describe your observations as you added salt to the hair gel. Compare the effect of adding salt to hair gel and to the polymer from the diaper.