MEMORANDUM

Date: February 1, 2002

To: John V. Fletcher
   Associate Professor, Lecturing

From: Susan Philyaw
   Chemical Engineering Student

Subject: Results of the Physical Properties Lab

Over the past two weeks Wednesday lab section and I have done a series of simple exercises using several devices commonly available for physical property measurements in the laboratory. These exercises were performed on various liquids, liquid “oils”, and solids. List below are the objectives completed along with the results of the experimental data collected during the exercises in addition to the reference data used in calculations.

The tasks accomplished over the past two weeks:

- measured the density of five oils; Canola, Soybean, Mobile 224H, Mobile 32H, and Arctic 15, using a hydrometer and a pycnometer. SEE TABLE 1.
- measured the viscosity with a viscometer device of the five oils listed above along with a standard used to test the accuracy of the method. SEE TABLE 2.
- measured the refraction index of two reference liquids, isopropanol and ethylene glycol along with two different volume percent mixtures of the reference liquids. SEE TABLE 3.
- measured the weight percent moisture of a dry food sample by obtaining an original weight, then placing it in a drying oven at 105 C for 1 week, allowing cooling for 45 minutes in a decicator, and re-weighing the sample. SEE TABLE 4.
- conducted a balance evaluation by measuring the weight of a standard object of choice on 4 different weighing devices. SEE TABLE 5.
- Conducted a calibration exercise of a volumetric flask and buret by weight method. SEE TABLE 6.

All of these tasks were accomplished in a timely manner over the past two weeks. As shown in TABLE1, there was relatively small error between the two values collected during the experiments. The comparison of the literature values found from various sources also showed error of 2% or less. We can say with some confidence that the two methods are equally accurate with the pycnometer giving more precision with 5 decimal places. The analysis time for the hydrometer is very short compared to the time constraint of the pycnometer, though the time may be worth it if you need more accuracy in your measurements. The hydrometer was of course easy but a large amount of sample is required verses the pycnometer. I would say that overall it comes down to how many places of precision you need as to what method to choose.
The analysis of refractive index shown in TABLE 3 and CHART 1 was based on volume amounts. We measured 2 mL of each of the references and then made mixture of 1mL isopropanol with 1 mL ethylene glycol and 1.3 mL ethylene glycol with 0.7 mL isopropanol. The data appears to be linear with a correlation coefficient of 0.96 telling us that the data agrees with no values that need to be q-tested out or omitted due to random errors. The volume additivity seems to have some errors in that the data is sort of scattered. This may have to do with only having four data points. If we had more data of different mixes the correlation coefficient may be closer to 1.

The viscometer was a very time consuming process. You have to have a large sample in just the right size vessel to be able to use this apparatus. After each sample was tested all parts, which touch the sample, had to be thoroughly cleaned before analyzing the next sample. When testing the standard to measure the accuracy of the device we found it to be 4.5% error in the measurement. All data was recorded in TABLE 2.

The weight percent moisture experiment found that my sample of dog food contained 7.5% moisture, SEE TABLE 4. The actual % moister given by the dog food manufacture on the label is 10% by weight. I concluded that the sample I used was in a bag that was not seal to the atmosphere, which could account for the difference in % moisture. Also the time spent out of the decicator was crucial. From the time the sample was taken out of the decicator it started to absorb moisture. This could also account for the error in the % moisture calculated.

The balance evaluation, SEE TABLE 5, was a fast an easy exercise. I used a standard object of choice and weighed it on 5 scales and calculated the standard deviation to be 0.0078. With this we can say that the accuracy of the scales on a whole are good. The analytical balances will give more precision than the electronic by 5 decimal places.

The flask calibration, SEE TABLE 6, was done on the basis of weights. The vessels were weighed empty and then weigh with water in them. The temperature of the water was recorded and the appropriate density from Perry’s or CRC was obtained to calculate the volume and obtain values of the error in the glassware.

All reference data has been printed and attached to this memo.

cc: Jumpol
    Rietsch
    (Sorry about the spellings)