size that surface tension is important in various systems, and that it is a function of geometric shape, temperature, concentration, and electrical charge. Most of the topics build on this.

One of the most important aspects of any course, in my opinion, is to have daily problem assignments. There is no easy source of problems for all of these areas. However, I have compiled a large set of what I call "pseudo-industrial applications" which I assign each time. These problems have come from my experiences and reading, and are, for the most part, designed to put the student in a position of a "trouble-shooter" or development engineer. I am listing two examples of such problems at the end of this article. In addition, I ask each student to write a critical review of one article in the literature (of his choice) toward the end of the course. I think that this is quite valuable in demonstrating to the student that he can now understand much of the literature concerning surface phenomena, at least in a superficial sense.

One of the topics I would like to cover in more detail is that of biomaterials. Last year, while I was on leave, another member of our staff taught this course and added a section concerning this, especially in relationship to thrombus formation on implants. This has now been expanded and next year a course will be offered at the University of Virginia covering just biomaterials. Thus the need for me to add material on this subject no longer exists, and the students will be able to learn this area from teachers much more expert than I. However, I believe that it should be kept in mind when developing any general surface phenomena course. □

ChE problems for teachers

Problems from Professor Gainer's course on "Applied Surface Chemistry."

1. A. As Product Manager of Emulsions, Inc., you are responsible for the new product composition. Your laboratory has given you the following data which was obtained at 25°C:

Compound	Density g/ml	Mol. Wt.	Viscosity cp
For dispersed phase:			
A	0.8	100	0.8
B	1.0	150	0.9
For continuous phase:			
C	0.8	200	3.0
D	0.8	210	5.0

A and B are both relatively insoluble in both C and D.

a. Which system of the four possible systems will make the most stable emulsion at 25°C. without the use of an emulsifier?

b. Will this be the most stable emulsion at 50°C? Do you need more data? If so, what?

c. Name two ways to break the emulsion.

B. It has now been decided to use an emulsifier to stabilize the emulsion picked in problem 1A. You have three (3) emulsifiers to choose from:

Emulsifier	Mol. Wt.	Solubility (g/l) in A	B	C	D
E1	150	0.08	0.15	0.25	0.50
E2	150	0.15	0.15	0.25	0.40
E3	250	0.08	0.10	0.35	0.50

a. List the emulsifiers in order of stabilization (list the emulsifier producing the most stable emulsion first, etc.) Why did you choose this order?

b. Are there other factors to be considered in picking the best emulsifier to be used commercially? If so, what data do you need?

2. You have been hired by the Super Detergent Company. It is a small company, and you are their expert in surface chemistry. The boss has an idea for a new detergent which must be commercially competitive. He calls you in his office, hands you a box of the new detergent (Super X) and tells you that he has the following information about the detergent:

- The organic part of the detergent molecule contains approximately 10 carbon atoms. (Molecular weight is 260).
- A surface tension–concentration curve has been obtained as is shown in Figure 1.
- Other commercial detergents of this type sell for 16 cents per pound with recommended use of 1.2 ounces per gallon at 10°C.
- Super X will sell for 18 cents per pound.

It will be your job to evaluate Super X as follows:

a. What minimum concentration of Super X must be used (in ounces per gallon) for maximum detergency? Is Super X competitive with other detergents? Show comparative costs.

b. Would you recommend this amount to be used for washing at higher temperatures? Explain.

c. Can you make any recommendations about making a new detergent, Super XX, which might be cheaper to use than Super X provided that the manufacturing costs of Super XX are the same as for Super X? □