kosmetikos*

By Steve Herman

BACK TO SCHOOL NIGHT

A surfactant concentrate consists of Sodium Lauryl Sulfate, Cocamide DEA and Cocamidopropyl Betaine. The total solids level is 37 percent. The anionic concentration is 0.74 meq/g, and it contains 0.6 percent NaCl. A mixture of 33 percent concentrate and 0.5 percent NaCl in water has a viscosity of 8000 cps. What is the quantitative formula for the concentrate?[1]

Solve the problem yet? Oh yeah, you need a pencil! It is Back to School Night, and we trudge off again to the majestic banks of the Immortal Mother of Waters, the Hackensack River...

The Cosmetic Science Program at Fairleigh Dickinson University alternates years concentrating on skin and hair care. January's Kosmetikos considered the laboratory course in skincare. The next series of required courses include Hair Care Raw Materials in the Fall Semester, Hair Care Formulation and Hair Care Laboratory in the Spring Semester. We join the students returning for the laboratory course.

Since there is more to cosmetic science than a sharp divide between skin and hair, the hair care lab deals with a broad range of surfactant systems. Thus bar and liquid soap and bath products are subsumed under haircare. Some subjects are fairly specialized, such as hair dyes and ethnic products. This is a chance for the students to be exposed to at least the basics of these areas. A typical semester schedule is shown in Figure 1.

Figure 1 Haircare laboratory schedule

WEEK 1	Raw materials, viscosity, salt curve
WEEK 2	Duplication, % solids, foam height, wetting
WEEK 3	Anionic shampoos, pearling
WEEK 4	Nonionics, AOS, medicated shampoos
WEEK 5	Amphoterics, baby products
WEEK 6	Silicones, 2-in-1 products, conditioners
WEEK 7	Bath products
WEEK 8	Hair fixatives
WEEK 9	Bar and liquid soap
WEEK 10	Ethnic products
WEEK 11	Perms, depilatories, shaving products
WEEK 12	Hair dyes
WEEK 13	Oral reports
WEEK 14	Final exam

One important project for each student during the semester is the duplication of a commercial product. The product label contains the initial information. At an early stage of the duplication process, the INCI names must be converted into trade names and the necessary raw materials procured.

The student here confronts a basic fact of cosmetic life: the INCI name is not the whole story. Cocamide DEA, a common shampoo ingredient, has 96 trade names in the CTFA Dictionary.[2] Looking at just two suppliers, we find Rhone-Poulenc has six versions, Albright & Wilson has five. The Cocamide DEA can also enter the product through one of the trade name mixtures, of which there are 59.

Two Henkel products can serve as an illustration of how obstensibly identical materials can differ. Standamid SD and KD are both Cocamide DEAs, but they differ in several significant ways. The fatty chain distribution is C12-18 for KD, C8-18 for SD. Of profound importance is the source of fatty material, KD coming from the stripped coco methyl ester, SD from coconut oil. When the fatty chain is separated from the triglyceride, the SD is left with nine percent glycerin, whereas the KD has no glycerin. Consequently, key properties such as foam height

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Steve Herman is Director R&D of AFF International. He has 28 years experience in the industry, primarily in fragrance application. He serves as an Adjunct Professor in the FDU Masters in Cosmetic Science program, and has been active in numerous capacities with the SCC. He may be reached by phone, (973) 244-5880, or by e-mail at GCISteve@aol.com.

***Greek kosmEtikos, skilled in adornment or decorating.**

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and viscosity building are affected.

Students can easily perform a number of measurements to characterize the target product: viscosity, foam height and retention, percent solids and pH. The question at the beginning of this column illustrates the mental analysis that can be brought to bear on the duplication problem.

The only anionic in the blend is Sodium Lauryl Sulfate (SLS). In real life, it is reacted with a known cationic to the neutralization point to establish the anionic concentration. We have conveniently been provided with the result. Since the molecular weight of SLS is 302, we calculate:

$$\frac{0.74 \text{ meq}}{\text{g conc}} \times \frac{302 \text{ mg SLS}}{\text{meq}} = \frac{223 \text{ mg SLS}}{\text{g conc}}$$

$$\frac{0.223 \text{ g}}{\text{g conc}} \times 100\% = 22.3\%$$

SLS is typically provided as a 29 percent active solution, so

$$\frac{22.3\%}{.29} = 77\% \text{ SLS as provided}$$

The SLS contains 0.25 percent NaCl and is 77 percent of the blend, so the SLS provides about 0.2 percent of the total salt. The remaining 0.4 percent salt comes from the Cocamidopropyl Betaine (CPB). CBP is usually provided with five percent salt content. We can thus conclude that

$$0.4\% \text{ NaCl} \times \frac{100\% \text{ CB}}{5\% \text{ NaCl}} = 8\% \text{ CPB}$$

CPB is commercially available as 35 percent solids, so

$$0.35 \times 8\% = 2.8\% \text{ solids from CPB.}$$

For CPB, the percent active and percent solids are not the same because of the five percent NaCl present. CPB has 35 percent solids but is only 30 percent active.

Cocamide DEA is 100 percent solids and provides the remaining solids content of the blend, so we have:

37% solids total - 25.1% solids from (SLS + CPB) = 11.9% solids from CDEA

We can round off the CDEA to 12%, and our total formula becomes:

SLS	77%
CPB	8%
CDEA	12%

The formula totals only 96 percent because all the calculations were based on approximate values. To refine the formulation of the blend, a viscosity should be taken and compared to the target. Our calculated blend gives 12,000 cps, compared to 8,000 cps for the target. Since the CPB builds viscosity rapidly, adjust by using a little less betaine and a little more Cocamide DEA.

We have seen that the duplication involves chemical calculations, a knowledge of the properties of commercially available raw materials, and adjustment based on understanding the properties of the materials. It thus provides a perfect introduction to the science and art of surfactant formulation.

We have examined one aspect of one night of school, just enough to see a little of the discipline required to learn the science of cosmetics. The soul of formulation must be learned with one's hands and through interaction with colleagues. SCC meetings, seminars, and continuing education programs are invaluable. Yet nothing quite pulls the entire subject together in a systematic way, combining theory with practice, like a comprehensive degree curriculum.

Those interested in the Cosmetic Science Program can contact the FDU School of Natural Sciences (SONS) in Hackensack, NJ at 201-692-2330. Dr. Salvatore Gimelli administers the program, and can be reached at 201-692-2337. ■

References

1. Barry Salka of Henkel. His lecture notes from several years of guest lecturing at FDU on "Duplicating Surfactant Systems" contributed the core technical material for this column.

2. Wenninger, John A. and McEwen, G.N., eds., International Cosmetic Ingredient Dictionary and Handbook, Seventh Edition, CTFA, 1997.