

Tension in the Surfactants Market



by Cynthia Challener
JCT CoatingsTech
Contributing Writer

Many properties of paints are determined by interactions that take place at surfaces. Control of surface interactions is achieved through the use of surfactants, or surface active agents. Because they are a key additive in coatings, surfactants have been affected strongly by the changing regulatory environment and the globalization and consolidation the industry has been experiencing. Producers are responding with increasingly specialized, "greener" chemistries that provide improved performance attributes that enable paint formulators to differentiate themselves.

Surfactants act as wetting agents in aqueous formulations, stabilize pigment dispersions, and control foam formation. More generally, the main function of surfactants is to reduce the surface tension of a solution. These properties are important during both the production and application of the coating. Their importance has increased with the growing interest in water-based formulations.

Various different surfactant chemistries have been developed over the years to provide highly specialized performance parameters. The structure is typically comprised of a hydrophobic and hydrophilic portion. Cationic, anionic, and zwitterionic surfactants are charged species and obviously can only be used in formulations where the charge can be tolerated. Anionic surfactants include alkyl sulfates, alcohol sulfates, fatty alcohol ether sulfates, sulfonates and sulfosuccinates, and various blends. Alcohol sulfates account for the largest volume due to their lower price. However, as demand for higher performance increases, interest in more complex anionic surfactants is growing.

Nonionic compounds are neutral and therefore have wider applications. They offer effective performance characteristics for wetting, emulsification, and dispersing applications. Typical products include fatty alcohol ethoxylates, alkyl phenol ethoxylates (APEO), alkyl polyglycosides, and various

nonionic blends. Currently, APEOs are the largest class of nonionic surfactants, but their use is diminishing as they become more widely regulated.

Defoamers are typically either polysiloxanes or mineral and paraffin oils. Polysiloxanes offer better compatibility and lower surface tension, while mineral and paraffin oils have a lower price. Fluorosurfactants, fluorocarbon modified polyacrylates, along with polysiloxanes, are gaining increasing interest due to their enhanced performance capabilities.

In coating formulations, the surfactants form micelles when the critical micelle concentration (CMC) is reached. In these spherical aggregates, the hydrophobic groups are in the center, while the polar groups face outward and are present at the liquid-air or solid-liquid interface and affect the conditions there. In pigment dispersions, the surfactants coat the pigment particles and cause them to repel one another, providing increased stability to the dispersion. The surfactants also help determine the size of the particles, which affects color intensity, shade, and light fastness.

The global market for surfactants is valued at \$800 million dollars, according to The ChemQuest Group, Inc., and accounts for 6% of the total global market for additives that are used in paints and coatings. In the United States, the surfactant market (dispersants, wetting agents, and foam control agents) in 2006 was valued at \$264-\$270 million by consulting firm Kusumgar, Nerlfi & Gowney (KNC). Dispersants account for the largest dollar and volume share (\$115-\$120 million; 60-63 million lb), followed by defoamers and anti-foaming agents

(\$64-\$65 million, 57-58 million lb) and wetting agents (\$85 million, 35-36 million lb). The growth rate for surfactants ranges from 1% to 3% per year.

While there are numerous surfactant manufacturers, several key players dominate the market and account for a good percentage of the sales. "This segment is based on fine chemistry and requires knowledge of sophisticated synthetic chemistry," notes Steven Nerlfi of KNC. "Customers demand very high levels of customer service and technical support. For many industrial and military applications, extensive testing is required to demonstrate the performance and benefits of new additives. All together, these factors create a very high barrier to entry to the surfactant market."

Those producers involved in the surfactant market have been responding to changing market conditions. The shift to waterborne, high solids, and energy cured coating formulations in response to increasing environmental regulations is a key driver in the surfactant sector. Higher energy and raw materials costs are also factors. "Overall, the trend is to higher performance at the equivalent or even lower price," Nerlfi says. "Paint and coatings manufacturers want a cost differential or a performance differential, or, in some cases, both. The successful surfactant suppliers have established good relationships with their customers and work to anticipate their technology needs," he adds.

JCI COATINGSTECH spoke with several different surfactant manufacturers to learn about the key issues they face today. Input was provided by Kelly Boyer, global market manager, Performance Solutions at Air Products; Ronald Lee, industry manager for BASF's Industrial Specialties in North America; Peter Manshausen, managing director of Borchers, a LANXESS company; Andre Bendo,

industry manager - Industrial Coatings for Ciba Specialty Chemicals; Michael Hoppe, Cognis' NAFTA market manager, Coatings, Construction, and Packaging; Christopher J. Martin, global market segment leader, Zonyl® Fluoroadditives with DuPont Chemical Solutions Enterprise; Frank Fusiak, International Specialty Products' (ISP) director of marketing and business development, North America Performance Chemicals business; Martin Wusik, global market manager, Coatings, with Momentive Performance Materials (formerly GE-Advanced Materials, Silicones); John Foley, vice president, Industrial Formulations, for Rhodia's Novecare enterprise; and Robert Miller, product manager for Troy Performance Additives and Defoamers.

JCI: *What are the main issues/challenges facing surfactant producers in 2007?*

K. Boyer, Air Products: One of the toughest challenges facing our business is managing the opportunities and threats resulting from a global economy. Maturation of North American and European markets is being offset by high growth potential in Eastern European and Asian emerging markets. Existing customers in the mature geographies are expanding into high growth regions with existing formulations, thereby creating a pull-through effect for additive suppliers. However, local additive suppliers are emerging in these high growth markets, offering low-cost alternatives, which results in a more intense competitive environment. Creating and sustaining a competitive advantage is becoming more difficult.

R. Miller, Troy: The rising price of raw materials and energy has provided us with the challenge of demonstrating to the customer how our products can promote value for them. We have been forced to raise prices as have all suppliers so it has

been necessary to work closely with our customers to optimize the use of surfactants/dispersants for improved performance and, often, reduced price of the final coating.

R. Lee, BASF: The main challenges facing surfactant producers will be with managing costs as well as addressing the changing environmental climate. This includes regulations to reduce volatile organic compound (VOC) emissions as well as market initiatives to promote environmentally friendly technologies.

M. Wusik, Momentive: The need and desire to meet increasingly stringent VOC limits in many coatings applications, while maintaining or improving final product performance, is one of the biggest current challenges in the coatings industry.

P. Manshausen, Borchers: For basic, low molecular weight surfactants, increasing raw material and energy costs will have a major impact. Additionally, new regulations such as "REACH" in Europe or VOC limitations in different parts of the world will lead to a change of coatings systems with new requirements for all additives used therein.

C. Martin, DuPont: The industry must keep pace with new government regulations—or better yet, stay ahead of them. It is an ongoing and important challenge. For example, DuPont recently announced that we have successfully commercialized a new, patented manufacturing process to remove greater than 97% of trace levels of perfluorooctanoic acid (PFOA) and its homologues and direct precursors from our fluorotelomer products. This milestone meets key commitments of the U.S. EPA voluntary stewardship program for product content three years ahead of schedule.

E. Fusiak, ISP: The primary driver will be environmental issues (biodegradability, endocrine disruption) and the recent Wal-Mart initiative to eliminate NPE from products.

J. Foley, Rhodia: Our top priorities are centered around understanding customer needs and then developing new solutions that help to lower their costs while delivering unique characteristics and overall reliable product performance. To do so, we need to navigate the raw material and energy landscape, changing regulations, and customer needs, large and small. We also work to stay close to customers wherever they are and to provide them with consistently high quality products that are easy to use, with improved ecotoxicity profiles, under economical terms.

JCT: *What are the key trends in this segment?*

A. Benda, Ciba: There are two key trends in this segment. The first involves the move towards lower VOC formulations, which will create reformulation opportunities. Surfactant producers are modifying their product offerings to capitalize. The second is commoditization. To offset commoditization, product differentiation and confirmation of value is critical.

M. Hoppe, Cognis: Increasing end user awareness (Wal-Mart initiative, etc.) will accelerate the phase out of alkyl phenol ethoxylates (APEOs) and drive up the overall demand for high performance and ultimately biodegradable "green surfactants." At the same time, formulators are driving raw material suppliers to develop higher performance surfactants that address market needs such as improved scrub resistance.

P. Manshausen, Borchers: Customers are demanding "tailor-made solutions" for their specific coatings systems in order to differentiate their products from the competition. More and more new developments are either focused on cost-cutting processes and/or searching for new solutions like highly effective, environmentally

friendly dispersants with universal compatibility, or highly specialized materials which satisfy, for example, the needs of new organic pigments in low-VOC systems. Due to this ongoing specialization, suppliers of additives need to have a good understanding of customers' needs and general trends—or maybe even set new trends.

C. Martin, DuPont: As the use of solvents in coatings is reduced, a number of coating performance issues are arising. They include blocking, shorter open time, cratering, dirt pickup, and foaming. Formulators solve these problems by adding a variety of different additives to their water-based coatings. At DuPont, we have found Zonyl® useful to address many formulation problems and eliminate the need for many of these additives.

JCT: *Where do the opportunities lie?*

J. Foley, Rhodia: We still see significant opportunities in the United States. The U.S. is still the global leader in manufacturing, innovation, and engineering, and this leadership helps to propel the double-digit growth that we're experiencing in our industrial markets.

R. Lee, BASF: The opportunities lie in promoting sustainable solutions that address both environmental and performance requirements while maintaining or improving cost/performance requirements.

P. Manshausen, Borchers: In an environment of increased competition, differentiation through products and services becomes essential. Under these conditions, innovation is the key to success. One basic factor for a successful innovation process is a close proximity to markets and customers, resulting in a good understanding of customer needs and expectations. If this proximity is aligned with technical expertise and strong R&D, high-end, customer based solutions, even

niche markets will offer new opportunities.

M. Wusik, Momentive: Some of the best opportunities lie in improving coating quality in the shrunken design space left by reduced coalescent solvent levels employed as a result of new VOC limits.

K. Boyer, Air Products: A key opportunity is being able to provide products that meet an extensive list of environmental requirements, such as VOC limitations, risk phrase-free, negative/positive lists, etc., across the globe without sacrificing performance. In many cases, the target seems nothing short of the Holy Grail. Also, as key markets mature and global competition intensifies, delivering performance at optimal cost will be imperative. This objective may be met through multi-functional or higher efficiency products.

M. Hoppe, Cognis: Continued need for productivity improvements combined with a market need for more environmental friendly solutions will open up new doors for ultimate biodegradable "green surfactants." This trend will be accelerated by the continued volatility in crude oil pricing and increasing costs for petrochemical derived surfactants, plus potential greenhouse cost emissions.

A. Bendo, Ciba: As always, the changing landscape in legislation, such as more stringent VOC regulations, will create opportunities. In this case, a premium will be placed on 100% solids surfactants and surfactants that enable less VOC in formulations.

R. Miller, Troy: The pressures on the customer for improved coatings coupled with the demands of regulatory change offer an opportunity for the company that can provide surfactant products with demonstrated value that are environmentally friendly. Resins developed for low- and no-VOC coatings have inherent shortcomings that can be

dramatically improved with the proper optimized surfactant.

JCT: *What new technologies are on the horizon and what benefits will they bring?*

M. Hoppe, Cognis: We are expecting to see increasing development work target "multi-functional" surfactants. The objective here is to combine properties in order to provide formulators with the ability to operate within a wider formulation window, and at the same time minimize the number of surfactants that they need to include in their formulations.

P. Manshausen, Borchers: There is a demand for materials that combine best emulsification with lowest foaming tendency during manufacturing and application of a coating. Additionally, dispersants controlling rheology or non migrating materials without negative impact on water or chemical resistance of a coating are needed. In contrast to low-performance coatings, where classic dispersants will mostly prevail because of cost factors, high quality industrial coatings will use more and more specific polymeric alternatives. Recent developments are focusing on special functionalities of dispersants that make them "similar" to commonly used pigments. Another approach is introducing reactive groups into polymeric dispersants so that they might be crosslinked into the coatings system. The latter technology significantly reduces water sensitivity of a coating after the drying process. There are different routes to these polymers and they all result in materials which offer the highest efficiency, color acceptance, stability, and pigment load.

R. Miller, Troy: We see the optimization of existing chemistries as a primary focus of product development and introduction. This is primarily due to the costs associated with the testing and registration of

new chemistries. There is a lot of publicity surrounding nanoparticle technology. As the cost of nanoparticles comes down, there will be a large opportunity for the dispersant supplier that can provide optimum dispersion and stabilization of these additives.

F. Fustak, ISP: Super wetting agents that are effective at low-use levels and are non-foaming will be an important technology in the future.

C. Martin, DuPont: We continue to develop DuPont Zonyl fluorosurfactants to allow coating formulators to reduce solvent content, meet VOC requirements, and reduce environmental footprint without sacrificing performance, and all at equivalent cost.

Selected Surfactant Producers

Air Products
Ashland
BASF
Borchers/LANXESS
BYK-Chemie
Ciba Specialty Chemicals
Cognis
Cytec Surface Specialties
Dexter
Dow Chemical Company
Dow Corning
DuPont
Elementis
International Specialty Products
Momentive Performance Materials
Noveon
Rhodia
Rohm and Haas Company
Tego
Troy Corporation

JCT: *What new products have you introduced recently that you would like to highlight? What are their properties and advantages?*

K. Boyer, Air Products: Air Products has recently introduced a new line of dispersants under the ZetaSpense trade name. They function to disperse and stabilize pigments and are specifically designed for use in waterborne coating and ink systems. These environmentally friendly additives are APE-free and offer increased color development properties with reduced dispersant demand, resulting in better cost in use. Developed for all pigment types—organic, inorganic, and carbon black—these products can provide higher pigment loading without the increased viscosity seen with conventional dispersant technology.

Carbowet surfactants are a new family of additives that enable formulation flexibility and enhance performance with budget in mind. By contributing effective pigment and substrate wetting without contributing to foam, these products offer optimal value in use. Carbowets are solvent-free and are environmentally preferable alternatives to nonylphenol ethoxylates (NPE) and alkylphenol ethoxylates (APE) surfactants.

R. Lee, BASF: BASF has launched PLURACOAT™, a portfolio of specialty additives that can help paint, coating, ink, adhesive, and sealant manufacturers to address needs that range from environmental compliance to improved cost/performance requirements. BASF's PLURACOAT brand additives are based on novel, proprietary technology focused on functional performance. PLURACOAT consists of three functional platforms addressing environmental compliance (low VOCs, APE-free); pigment dispersing applications; and multipurpose coating applications requiring enhanced performance, such as wetting, de-

foaming, dispersing, and adhesion promotion. These products address environmental/performance requirements, and provide flexibility to the coatings formulator.

P. Manshausen, Borchers: Borchers has recently launched Borchil® Gen 0653, a new acrylic block copolymer that was developed as a versatile dispersant for inorganic and organic pigments in waterborne systems. It exhibits outstanding compatibility with all types of binders and significantly improves gloss and color stability, even extending gloss retention after weathering of a coating.

In 2007, Borchers will celebrate its 200th anniversary. We will celebrate by launching several new products, including a group of new PU-based versatile HAPS and VOC-free materials for higher pigment load in concentrates of selected organic pigments. In contrast to currently known dispersants, pigment concentrates based on the new materials will have improved color strength, low viscosity, and an excellent compatibility with a wide range of binder systems, generating improved stability even in combination with some critical pigments. Our patented Borchil Gen 0451 is the basis of this group of new dispersants. This 100% VOC-free polyurethane has wide compatibility and high efficiency for acidic carbon blacks in high-performance coatings. Due to its excellent compatibility, Borchil Gen 451 improves gloss and shifts the "blacks" to a more bluish tone.

Borchers recently strengthened its Asian involvement, inaugurating a new technical center in Shanghai and hiring new technicians in India. These additional efforts will improve proximity to local customers, thus strengthening the company's regional position.

A. Benda, Ciba: Our Ciba® EFKA® 6225 dispersing agent, which utilizes fatty acid modified emulsifier (FAME) technology, is ideal for uni-

versal colorants. The 100% solids product offers a significant advantage in low-VOC formulations. Through design, the product exhibits excellent compatibility in both water and solventborne-based paints and prevents de-wetting in water-containing basecoats.

M. Hoppe, Cognis: The newest surfactants from Cognis are our Disponil® AFX range of products, which are readily biodegradable, nonionic, high performance surfactants that represent a high performance alternative to environmentally problematic alkylphenol ethoxylates (APEO). They can be used in many industrial processes including during polymerization, or as a post additive. The Federation of German Industries (BDI) has given our Disponil AFX range of surfactants its prestigious "BDI Umweltschutzpreis" environmental award in the "environmentally friendly products" category. Separately, we recently expanded production of our sulfation plant at our manufacturing facility in Kankakee, IL.

C. Martin, DuPont: DuPont recently introduced its LX Platform Products, a superior performing line of fluorotelomer products based on existing DuPont Zonyl chemistry. DuPont's new manufacturing process will remove greater than 97% of all trace levels of PFOA and its homologues and direct precursors. LX Platform Products are expected to be drop-in replacement products that do not require new equipment or investments and will continue to be listed on existing global regulatory clearances, including the U.S. (TSCA), Europe (LINECS), Canada (DSL), and Japan (ENCS).

Zonyl FS-610 is a new surfactant that is a useful formulation tool for low-VOC architectural paints. This Zonyl fluorosurfactant provides defoaming properties; allows the reduction of other surfactants used for color, acceptance, leveling, defoaming and cratering; provides im-

proved block resistance and extended open time; and is cost effective. In addition, Zonyl fluorosurfactants are added at very low levels (100 to 1000 ppm active ingredient), so they have minimal to no impact on other paint properties, such as recoat adhesion and in-can stability. They are also easy to use, and enable the formulator to produce thinner defect-free coatings in both spray-applied, high-speed coating techniques, and traditional application methods.

E. Fusiak, ISP: ISP recently introduced Easy-Wet® 20, which is based on ISP's alkyl pyrrolidones—Surfadone LP-100® and Surfadone LP-300—and provides rapid reduction of dynamic surface tension. Surfadone LP-100 is non-foaming and offers synergistic wetting characteristics with anionic and non-ionic surfactants. Our Surfadone products do not form micelles, but when used in combination with anionic and nonionic surfactants, do form mixed micelles, allowing for significant reduction of surface tension at low-use levels.

M. Wusik, Momentive: Momentive Performance Materials Inc., the new company created by the sale of GE's Advanced Materials business to Apollo Management, L.P., is focused on technology and service excellence in the silicones, quartz, and ceramics industries. The former GE Advanced Materials management team, led by president and CEO Wayne Hewett, will continue in their roles in the new business. In addition, the former joint ventures GE Bayer Silicones and GE Toshiba Silicones, their employees, and their management team, are now part of Momentive Performance Materials.

CoatOSil Y-15790 and Y-15791 wetting agents, developed based on Momentive's knowledge in the area of superspreaders, were introduced late in 2006 and are available for

sampling. These materials show excellent wetting, flow, and leveling properties in many systems, and seem to be especially useful in wetting difficult substrates. The CoatOSil products take advantage of dynamic surface tension gradients to drive the wetting of non-polar substrates, allowing excellent wetting without extremely low surface tension measurements. (CoatOSil is a trademark of Momentive Performance Materials Holdings Inc.)

J. Foley, Rhodia: Our family of phosphate functional monomers (Sipomer PAM series) has been successfully launched over the past few years. They can significantly improve the adhesion properties of polymer resins to a variety of different metal surfaces. Another new product we have just introduced into the market is ABEX 8018, a very versatile APE-free surfactant for use in various different polymer systems such as acrylic, vinyl acrylic, and SB.

Overall, Rhodia launches 10–15 new products per year, and we anticipate maintaining this rate for the next two to three years. Our new products provide our customers with total formula cost reductions, greener or biodegradable product profiles, and low VOCs. Our industrial formulations can provide a one-stop approach for coatings technologies. We are proud of our technology synergies, proud of our sustainable product development, and proud of our customer partnerships. It's a combination that we expect will continue to work very well for all segments of customers, anywhere in the world.

Looking ahead, we see new developments on coalescing agents for low-VOCs and low odor. We recently announced surfactant capacity expansions at our plants in Blue Island, IL. Rhodia has also made a

major commitment to the developing regions of the world, with significant investments in India.

R. Miller, Troy: New products from Troy have focused on providing substrate wetting and surface flow and leveling without contributing VOCs. A prime example is Troysol ZIAC, which utilizes the active component of proven Troysol IAC with no VOCs. Products will be introduced for solvent and solvent free systems in the near future.

JCT: Where do you see the surfactants market in one year? Five years?

R. Lee, BASF: As the coatings segment continues to migrate towards waterborne technologies, surfactants will play a significant role. Surfactant demand will grow to address the needs of the marketplace.

Peter Manshausen, Borchers: As an answer to commoditization, specialization even into niche applications will create new options in a slowly but constantly growing market for dispersants.

M. Hoppe, Cognis: We expect the surfactants market to continue to grow overall at 3.5% over the next five years, with stronger growth in environmental friendly surfactants and emerging countries.

M. Wusik, Momentive: As the industry tries to increase the functionality of coatings, employ new raw materials, and meet stricter environmental standards, the importance of silicone surfactants will only increase.

A. Bendo, Ciba: In the next five years, the market will continue to grow in volume, but grow slightly less in value. Competition in the market will intensify along with commoditization. To maintain market share, the market leaders will have to develop differentiated products. ■