Fatty Acid registration deadline: May 1

Registration deadline for the 1979 AOCS Short Course on Industrial Fatty Acids is May 1, 1979. Registrations received after that date will be accepted on a space available basis.

The short course is being held June 10-13, 1979, at Tamiment Resort and Country Club in Tamiment, PA. Registration fee is $285, including double occupancy room and meals from dinner on Sunday, June 10, through breakfast on Wednesday, June 13. Information about the course and registration forms are available from: AOCS Short Course on Industrial Fatty Acids, 508 S. Sixth St., Champaign, IL 61820 USA.

Approximately three dozen top specialists will present talks during the session ranging from raw materials through processing to end applications from fatty acids. Technical program chairman is Dr. Norman O.V. Sonntag, technical director for Southland Chemical Division, Dallas; local chairman is Dr. Gerhard Maerker, head of the Animal Fat Laboratory at the USDA's Eastern Regional Research Center, Philadelphia.

Approximately half the abstracts for the course were published in the February JAOCS. Abstracts for the other talks follow this article.

Fat-Based Food Emulsifiers. J.L. Van Haften, C.J. Patterson Co.

Emulsifiers are widely used in foods to achieve the texture, taste, appearance and shelf-life characteristics desired by today's consumers. A relatively limited number of fat-based emulsifiers are used alone and in various combinations to provide these characteristics. Bakery products are one of the more important food areas utilizing emulsifiers, and bread is the most important food within this class. Because of the almost universal consumption of bread, the number of emulsifiers permitted to be used is somewhat more limited than in other foods. In spite of this, the use of dough conditioners and softeners in bread represents one of the largest markets for fat-based emulsifiers. The several dough emulsifiers such as monoglycerides, succinylated monoglycerides, ethoxylated monoglycerides, lactylated fatty acids, and monoglycerides and others will be discussed with respect to structure, functionality, method of production, and function in use. Trends in the field, the influence of the FDA and economic developments pertinent to this application area will be covered.

Fat-Based Dibasic Acids. R.G. Kadesch, American Technical Service.

Aside from "dimer" acids, the best known fat-based dibasic acids consist of six product types, of which only three are commercially important: (1) azelaic acid from oleic acid by either chrome oxidation or ozonolysis (possibly also a "brassylic" acid from mixed 55% erucic acid-containing crambe oil fatty acids); (2) sebacic acid from castor oil (possibly dodecanedioic acid from lesquerolic acid) by caustic fusion; (3) C-21 dibasic acid, by Diels-Alder reaction between isomerized tall oil fatty acids and acrylic acid; (4) C-19 dibasic acid (carboxystearic acid) from oleic acid by carboxylation; (5) mixed C-11/C-12 dibasic acid by several routes; and (6) dibasic acid mixture by nitric acid oxidation. Azelaic, sebasic, and C-21 dibasic acids from (1) to (3) inclusive are the only "commercial" examples; chemistry, production, properties of acids and derivatives and uses will be outlined. The potentials for acids from groups (4) to (6) inclusive will also be treated.

Fat-Based Synthetic Lubricants. D.M. Matthews, PVO International, Inc.

The fat-based synthetic lubricants are almost exclusively esters, and those that have some utility usually are produced from the fat-based dibasic acids (azelaic, sebasic, possibly carboxystearic acids), some fatty alcohols, the lower homolog fatty acids containing C_5 to C_9 carbon atoms, as polyol esters of certain saturated fatty acids, from dimer acids and others. The characteristics in the esters for optimum performance as synthetic lubricants, including lubricity, pour point, low acidity, ASTM slope, thermal stability, and oxidation stability, will be outlined. Structural considerations in ester materials required for optimum thermal stability will be pinpointed. The economic and market potential for aircraft and automotive synthetic lubricants will be discussed.

Fatty Alcohols. J.A. Monick, Colgate Palmolive Co.

"Fatty" or higher alcohols are mostly C_{11} to C_{20} monohydric compounds. In probably no other homologous aliphatic series is the current balance between natural and synthetic products so vividly evident. Natural sources, such as plant or animal esters, can be made to yield straight chain (normal) alcohols with a terminal (primary) hydroxyl, along with varying degrees of unsaturation. Synthetic or petroleum sources afford normal (Ziegler), branched (Oxo), or secondary (paraffin oxidation) alcohols by virtue of the starting materials and method of manufacture. Typical chemical reactions are primarily a function of the hydroxyl group and its position in the molecule. Examples include sulfation, oxidation, ethoxylation, ester interchange, dehydration, alkylation and others. Physical properties will be discussed for the most common saturated and unsaturated alcohols, and additional chemical manufacturing and market information will be covered. Manufacturing methods and capacity estimates will be given for current processes, both natural and synthetic. Major markets for higher alcohols will be outlined.

The Importance of Glycerol in the Fatty Acid Industry. Godfrey B. D'Souza, Canada Packers Ltd.

Historically, glycerol, a valuable by-product of the fatty acid industry, is priced higher on the market place than any of the common fatty acids. In times of economic stress, glycerol "credit" from fat splitting frequently makes the difference between a profitable stearic acid operation and an economically unsound one. The various methods of converting sweetwaters into, ultimately, a 99.8% grade of glycerol will be reviewed, including ion exchange. Tailor-making new triglycerides by esterification of "natural" glycerol from the fatty acid industry with certain fractionated fatty acids will be pinpointed.

Isostearic Acid and Other Branched Chain Acids. D.V. Kinsman, Emery Industries, Inc.

The generalized effects of chemical structure and isomer distribution on the physical properties of branched acids will be discussed. Using isostearic acid as a model, comparisons of typical physical properties of branched acids and corresponding straight chain acids will be presented. Similarily, a comparison of the properties of selected derivatives of branched and straight chain acids will also be presented. Selected applications based on the literature will be presented, and the importance of the branched structure to these applications will be discussed.

Marine-Derived Fatty Acids. M. Stansby, National Marine Fisheries Service, U.S. Department of Commerce.

This presentation will consists of three types of information. Background material will first be given concerning the availability and types of fish oils in U.S. and world markets together with data on fatty acid distribution of fish oil triglycerides. Following this background, the special problems encountered in utilization of fish oils for production of saturated fatty acids will be discussed. In the third part, utilization of fish oils as a source of polyunsaturated fatty acids will be considered. In the background discussion, information will be presented on both the magnitude of fish oil production from different species in this country and on a world wide basis and upon the fatty acid distribution of fish oils from major species. The probable stability of production over a period of years will also be considered, since some fisheries result in very wide fluctuations in supply, and the fish may even disappear completely. Likewise, fluctuations in fatty acid of oils will be discussed. In the section on problems relating directly to utilization of marine oils for production of saturated fatty acids, aspects of marine oils from different species which might make for best choice for saturated fatty acids production will be brought out. In the final section on marine oils for polyunsaturated fatty acid production, promising new applications for highly polyunsaturated fatty acids will be indicated. The need for special mild conditions in fat splitting to preserve unsaturated structures will be pointed out. Needed research to overcome difficulties presently preventing production of polyunsaturates from fish oils will be discussed.

New Applications for Fatty Acids and Derivatives. Speaker unassigned.

The early development of the American fatty acid industry during 1900-1920 is usually associated with the use of stearic acid in candles for lighting purposes. Today, the use of stearic acid in candle manufacture continues; the volume consumed for this application is not small, but the use is for ornamental, decorative or festival purposes, only incidentally for emergency lighting purposes. From this single use, the "as-is" applications of commercial stearic acid have grown to literally hundreds of other interesting and diverse present uses. The new and unique "as is" uses for commercial stearic and other common fatty acids will be summarized. A group of unanticipated application areas for several fatty acid derivatives will be treated.

New Developments in the Fatty Acid Industry. N.O.V. Sonntag, Southland Corp. Chemical Div.

The changes in name, management and ownership of many of the traditional American fatty acid organizations may appear to the general public to be only significant changes that have occurred within the fatty acid industry. In an unusual industry already noted for substantial dynamic change, many other important developments are underway. In this presentation we will summarize and review the new developments that have already been pinpointed in some of the 37 previous presentations of this Short Course. Emphasis will be placed upon the important changes in technology, in analytical chemistry, in availability of new and improved raw materials, upon the advent of synthetics including synthetic fatty acids, and upon impending economic factors destined to mold the future of the fatty acid industry.

Nitrogen Derivatives, (Amides, Diamides, Nitriles, Primary Amines and Amine Oxides). R.A. Reck, Armak Industrial Chemical Division.

With the possible exception of the fatty acid esters, no fatty acid derivative group exhibits such a wide diversity of usefulness as the nitrogen derivatives of the fatty acids. This group of five will be treated in some detail with respect to industrial and laboratory preparation, properties and application.

Nitrogen Derivatives (Secondary and Tertiary Amines, Quaternary Salts, Diamines, Imidazolines). C.W. Glankler, Humko-Sheffield Chemical.

Coverage of these five important nitrogen derivatives of the fatty acids will be carried out in detail with respect to industrial and laboratory preparation, properties and applications.

Pollution Control in the Fatty Acid Industry. G.N. McDermott, The Procter & Gamble Co.

Because like fats and oils, fatty acids are lighter than water and almost insoluble in it, they present serious contamination problems if they are permitted to escape from fatty acid plants in effluent streams. Notwithstanding the losses in yield, the effects on lakes and streams can be even more deleterious. The major emphasis for pollution control in the fatty acid industry is to restrict the loss of fat products or treatment materials across all of the unit operations involved in any plant. Other waste materials, however, can generate equally serious problems. A few are mineral acids, fatty acid soaps, spent bleaching clays, inorganic salts like sodium sulfate, magnesium sulfate and the like, and other water soluble or water dispersible products, such as wastewaters. Techniques and methods for the minimization of pollution from fatty acid installations will be reviewed generally. Attention to air emissions and odors will also be given.

Polyglycerol Esters. R.T. McIntyre, Capital City Products Co.

Glycerol may be polymerized to yield a complex series of ether-linked polyhydroxy compounds generally called "polyglycerols," which are capable of esterification with many fatty acids to afford a family of polyglycerol esters. The preparation of polyglycerols and of several polyglycerol esters will be outlined. Unusual properties and applications for the latter family of compounds will be illustrated.

Polymerization – Dimer Acids. Edward C. Leonard, Humko Sheffield Chemical.

In this presentation we will describe the possible reaction mechanisms for polymerization of unsaturated fatty acids; commercial routes for the manufacture of dimer acids; the physical and chemical properties of the products,; the chemical reactions of dimer acids, with particular emphasis on polycondensation reactions; and finally the applications of the products. Toxicology, handling, and analysis will be mentioned. There will also be some commentary on energy usage and economics for dimer acids manufacture. Commercial applications discussion will give a fairly detailed breakdown of the markets, producers of value-added products, and possible future markets that have some growth possibilities.

Product Forms and Packaging in the Fatty Acid Industry. James R. Hickey, C.H. Kline & Co.

Sophistication in product form specifically designed for end use and a variety of convenience packaging has characterized the new look in the fatty acid industry. Certain solid saturated fatty acids are now available in a number of product forms: flaked, molded (bars), beaded, powdered, ground powdered, "atomized," or chunklets. Aside from the traditional 100 lb fatty acid bag, the new packages consist of a variety of containers: various sized lined or unlined cartons, drums and different shaped boxes. Unsaturated or liquid fatty acids are available in standard or jumbo tank cars and a variety of cartons, pails, jars or drums. A comprehensive treatment of the situation will be given. Some emphasis will be given to beading towers and flaking equipment.

Recent Advances in the Analysis of Industrial Fatty Acids and Their Derivatives. L.D. Metcalfe, Armak Industrial Chemicals Division.

Recent advances in the analysis of industrial fatty acids and their derivatives almost always involve complex instrumentation. An important development in the analysis of fatty acids and their derivatives was the application of gas chromatography (GC) to this problem. Even though GC has been used for almost 20 years to analyze fatty acids and their derivatives, new advances still continue to be made in this area and will be discussed. Included will be some review of recent gas chromatography-mass spectrometry (GC-MS) developments. Other chromatographic methods to be discussed will include thin layer chromatography (TLC) and high performance liquid chromatography (HPLC). This latter method is now beginning to have the impact on fatty acid analysis that GC had in its early years. Instrumentation techniques such as NMR, IR and others also will be explored. Applicability, scope, precision, and reliability of the various methods will be evaluated with respect to both fatty acids and the nitrogen derivatives.

Soap and Fat-Based Detergents. E. Jungermann, Jungermann Associates.

Historically, soap was the first surfactant used by man, and until World War II it was virtually the universal cleaning agent for both personal care and laundry usage. Since 1950, soap has been replaced to a large extent by petrochemical or fat-based derivatives for reasons of economics and performance. The only areas where soap has maintained its position is in toilet bar soaps. Some of the newer processes for manufacturing bar soaps will be covered. Fat-based surfactants derive their surface active properties from balancing the hydrophobic fatty acid with a variety of hydrophilic functional groups introducted into the molecule via different chemical processes. Surfactants fall into four distinct categories: (1) Anionic Surfactants: the fatty hydrophobic chain is attached to a negatively charged hydrophilic group:

$$\wedge\wedge\wedge\wedge\wedge\wedge X^-, \text{ where } X^- = COO^-, OSO_3^-, SO_3^-$$

(2) Cationic Surfactants: the fatty hydrophobic group is attached to a positively charged hydrophilic group:

$$\wedge\wedge\wedge\wedge\wedge\wedge\wedge X^+, \text{ where } X^+ = -\overset{|}{\underset{|}{N}}{}^+-$$

(3) Nonionic Surfactants: the hydrophobic chain is attached to an uncharged hydrophilic group or chain.

$$\wedge\wedge\wedge\wedge\wedge\wedge\wedge X, \text{ where } X = [OCH_2CH_2]OH, -CONHCH_2CH_2OH,$$

(4) Amphoteric Surfactants: the hydrophobic fatty chain is attached to a hydrophilic group containing both positive and negative charges:

$$\wedge\wedge\wedge\wedge\wedge\wedge/X, \text{ where } X = N^+\text{-}CH_2COO^-,\ N^+(CH_2)_3SO_3^-$$

The most important fat-derived anionic surfactants are the sulfates and sulfonates. The cationic surfactants are primarily nitrogen derivatives, i.e., amines, and quaternary ammonium compounds. The most important examples of nonionics are esters, such as monoglycerides, or products obtained by ethoxylating various fatty moities. The most important classes of these surfactants, their manufacture, and application will be reviewed.

Synthetic Fatty Acids. H. Fineberg, Ashland Chemical Company.

The manufacture of fatty acids from petroleum and natural gas is a very large industry worldwide and has important implications in the U.S. Eastern Europe produces more than one billion pounds per year. The markets are very large and diversified. Applications for the synthetic acids parallel those of natural fat and oil-derived acids and exceed the latter in some important uses. The competitive economics and technologies for the synthetic fatty acids will be reviewed and potential in the U.S. will be addressed.

Tall Oil Fatty Acids. Roger L. Logan, Union Camp Chemical Division

Originally viewed by the "natural" fatty acid industry as a potential threat to stearic and oleic acid production, the production of tall oil fatty acids is today a very large, stable and important part of the overall fatty acid industry. The importance, chemistry, technology, economics and production volumes of the manufacture of tall oil fatty acids from the Kraft papermaking industry will be outlined. New developments, such as the FDA approval of a low rosin tall oil fatty acid for certain edible purpose and the possibilities of a high linoleic fatty acid will be pinpointed.

Traditional Analysis of Fatty Acids and Their Derivatives. L.D. Metcalfe, Armak Industrial Chemicals Division.

Industrial fatty acids and their derivatives are generally manufactured under strict quality control and sold under rigid specifications. The purchase specifications are normally prescribed by a series of standard wet analytical methods. These methods include acid value, saponification value, iodine value, hydroxyl value, and others. The most common methods and the chemistry behind them will be discussed. Information concerning the calculations and how these can be used by persons other than analytical chemists will also be covered. The most common derivatives of the industrial fatty acids are anionic and nonionic surfactants and the nitrogen derivatives such as amines and quaternary ammonium compounds. Though far more complex than fatty acid manufacture, rigid quality control is also applied to these compounds. The methods used for setting purchase specification on these products are accordingly complex. The amine value, the determination of primary, secondary and tertiary amines, will be discussed. The determination of quaternary ammonium compounds and the problems involved will be reviewed. Thorough emphasis will be made on chemical determinations; application test methods will be reviewed. These latter methods, though usually simple physical tests, are often the most difficult to meet in purchase specifications.

Vegetable Oil Raw Materials. E.H. Pryde, USDA Northern Regional Research Center.

Vegetable oils, edible and industrial, contribute 20% and 23%, respectively (compared to 55% for tallow), to the preparation of surfactants, coatings, plasticizers, and other products based on fats and oils. The oils and the fatty acids recovered from soapstock formed as a result of alkali refining represent a several billion pound resource. Coconut oil is imported to the extent of 700-1,000 million pounds per year. Its uses are divided about equally between edible and industrial applications. Safflower oil has a relatively small production, but about 26% of the oil goes into industrial products. Soybean oil is produced in the U.S. at the rate of 9,000 million pounds per year, with more than 500 million pounds going into industrial uses, representing 5-6% of the total production. Castor oil is imported to the extent of about 100 million pounds per year. Linseed oil production has declined drastically over the last 25 years but still amounts to about 100 million pounds per year. Oiticica and tung oils are imported in lesser amounts than castor and linseed oils. New crops that have industrial potential include seed oils from crambe, *Limnanthes, Lesquerella, Dimorphotheca, Vernonia,* and *Cuphea* plants. Crambe oil contains up to 65% erucic acid. Oil from *Limnanthes* contains more than 95% of fatty acids above C_{18}. *Lesquerella* oil contains hydroxy unsaturated acids resembling ricinoleic acid from cator oil. *Dimorphotheca* oil contains a conjugated dienol system. *Vernonia* oils contain as much as 80% epoxy acids. The *Cuphea* oils contain a number of short-chain fatty acids. Of these, crambe, *Limnanthes,* and *Vernonia* are probably the most developed agronomically. Competition between vegetable oils and petrochemicals for the traditional fats and oil markets has been marked over the past 25 years, but prices for petrochemicals have accelerated at a greater rate than those for vegetable oils, and it is now appropriate to re-examine the old as well as new markets for fatty acids. ●