Challenges to a Mature Industry: Marketing and Economics of Oleochemicals in the United States

E. CHARLES LEONARD and **S L KOPALD JR.**, Witco Chemical Corporation,
PO Box 125, Memphis, TN 38101

ABSTRACT

Fatty acids, accounting for more than half of oleochemicals discussed, grew at an annual rate of ca. 3% during the 1970s, with no growth since 1979. As competition intensified, the number of companies in the industry declined or ownership changed. Challenges are covered under five major headings–markets, raw materials, competition, research and profitability. Oleochemical markets are extremely diverse but usually involve surface modification. Fatty acid disposition and real consumer personal income correlate closely. Growth of consumer income in the 1980s will be the most important factor in determining growth of fatty chemicals. Fatty chemicals compete with petroleum-derived products; and, therefore, price relationship of natural fats versus petroleum will affect market share. Tallow and other natural fats and oils are approximately the same price as 15 years ago, whereas ethylene has about doubled. Interchangeability of natural fats tends to moderate price fluctuations. Competition remains intense with market shares divided among many companies. Neither imports nor exports have played a significant role in the US fatty chemical industry. There are large exports of fatty acid derivatives, particularly to South America. Research will concentrate on energy reduction as oleochemical production is highly energy-intensive. Enzymatic splitting is a potential commercial process for this purpose. Improved hydrogenation catalysts and development of new specialty oilseeds are additional research objectives. Success of researchers will probably play the biggest role of all in future marketing and economics of fatty chemical companies. The belief is that the fatty chemical industry has had difficulty in consistently maintaining acceptable levels of profitability. To avoid extinction and achieve reasonable rates of return, business strategies must (a) identify, create and exploit growth segments; (b) emphasize product quality and innovative product improvement; and (c) systematically improve production and distribution efficiencies.

INTRODUCTION

In this paper, the terms fatty chemicals and oleochemicals will be used interchangeably. Humko Chemical has been in the fatty acid business since 1948 and a member of our industry association, The Fatty Acid Producers' Council (FAPC), since its formation. Several years ago, the FAPC decided that "fatty acids" was a name that should be changed in order to improve our image. After long debate, representatives of the member companies were not able to agree on a new name, even though we came close to agreeing on oleochemicals. Because of this background, "fatty chemicals" will probably be used more often than "oleochemicals", although they mean exactly the same thing in this paper.

DESCRIPTION OF THE FATTY CHEMICAL INDUSTRY

Fatty chemicals in this discussion include: fatty acids (including tall oil fatty acids), fatty esters, fatty amines and their derivatives (including quaternaries and amine oxides), "natural" fatty alcohols, "natural" glycerine, and fatty amides (including alkanolamides).

Estimates of US production of these products are shown in Table I. The largest oleochemical component, by far, is fatty acids, which serve as feedstock for most of the other product groups in the table. Table II shows consumption of fatty acids in the noncommunist world.

The beginnings of the fatty acid industry in the United States lie in the use of natural drying oils, such as linseed and tung oils, in the manufacture of varnishes and paints; and in the use of meat processing byproducts (tallows and greases) in lamps, as lubricants, and in the manufacture of soap and candles. Until World War II, soap manufacture consumed 75% of the inedible tallow produced in the USA.

TABLE I

US Production of Oleochemicals, 1968-1982 (In millions)

	Pounds			Dollars
	1968	1977	1982	1982
Fatty acids	916	1279	1300	455
Natural fatty alcohols	120	140	150	97
Natural crude glycerine	213	178	125	79
Surfactant esters	164	226	250	228
Fatty amines and amine oxides	155	261	307	255
Fatty alkanolamides	57	81	60	46
Other fatty amides	15	23	23	24
Total	1640	2188	2215	1184

Sources: Humko Chemical Estimates; Charles Kline, "Fatty Chemicals"; US International Trade Commision Reports.

TABLE II

Noncommunist Consumption of Fatty Acids, 1980

Country	Consumption (MM lb)
Canada	120
Japan	316
Latin America	400
USA	1190
Western Europe	1437
Other	300
Total	3763

Source: Humko Chemical Estimates.

Fatty acid production grew at an annual rate of ca. 3% during the 1970s. Since 1979, however, as best as can be determined from available statistics, there has been no growth in fatty acid tonnage produced in the USA. 1982 probably showed a decrease compared to 1981.

One of the realities of mature industries with low growth rates is that competition is normally more intense than for businesses in which markets are growing more rapidly. As competition intensifies, the number of companies competing in the industry decline or ownership changes. Table III shows the US fatty acid producers 8 years ago and their role in the industry today.

CHALLENGES FACING THE FATTY CHEMICAL INDUSTRY

Markets

Oleochemical markets are exceedingly diverse. If they have one central, unifying function, it is that they modify surfaces in one way or another. This is the case when it is the surface of polyethylene film, as exhibited by fatty amide slip agents for polyethylene; the water/oil interface when a

TABLE III

US Fatty Acid Producers—1974-1983

Acme Hardesty Company[a]	A. Gross & Company[c]
Arizona Chemical	Humko Chemical[c]
Armak Company[b,c]	Hercules, Inc.
Ashland Chemical Company[c]	Pacific Vegetable Oil Company[a]
Capitol City	Petrochemicals[c]
Crosby Chemicals, Inc.[c]	The Procter & Gamble Company
Darling and Company	Reichhold Chemicals, Inc.
Emery Industries[c]	Sylvachem Corporation
General Mills[b,c]	Union Camp Corporation
Glyco Chemicals, Inc.	Westvaco Corporation

[a]No longer a producer.
[b]No longer in merchant fatty acid business.
[c]Changed ownership 1974-1983.
Source: Humko Chemical.

TABLE IV

US Consumption of Fatty Acids by Market Area, 1980

	MM lb	% of Total
Personal care products	235	19.7
Industrial lubricants, corrosion inhibitors, oil additives	215	18.1
Coatings	155	13.0
Household cleaners, laundry soaps, fabric softeners	95	8.0
Plastics	90	7.6
Textiles	80	6.7
Emulsion polymerization	65	5.5
Rubber compounding	60	5.0
Asphalt	40	3.4
Mining	20	1.7
Miscellaneous	135	11.3
Total	1190	

Source: Chemical Economics Handbook, SRI International (used by permission).

fatty amine salt acts as a surfactant; and metal-to-metal interfaces when a fatty ester is used as a synthetic lubricant base stock.

US consumption of fatty acids in 1980 by market area is shown in Table IV.

The common thread in most of these markets is their dependence on the purchases of individual consumers—whether rubber tires, haircare products or fabric softeners. It has been demonstrated by historical data correlation (1) that there is a straight-line relationship between real consumer personal income and fatty acid disposition. In the 10-year period 1972-81, real consumer disposable income grew at an annual rate of 2.6%, which is very close to the 3% growth in fatty acids during the 1970s. An estimated 2% annual growth rate for fatty acids over the next few years would probably track closely with growth in real consumer disposable income in the 1980s.

We do not expect loss of a significant existing market, nor do we anticipate dramatic increase in any present use for fatty chemicals. The 1980s could see greater growth in consumer income in the USA as a result of sounder fiscal and monetary policies. If inflation is kept under better control, interest rates should be at levels that will stimulate economic growth.

A large new application for fatty acids and/or fatty acid derivatives is needed to improve the economic well being of the industry, but unfortunately we know of no such promising development.

Naturally derived fatty chemicals share markets and compete with petroleum-derived fatty chemicals. Fatty alcohols, amines and acids are examples. If the relationship between prices of natural (renewable) fats and oils and petroleum raw materials shifts in favor of the natural fats, the result should be an increased market share for the products of our industry in the manufacturing of fatty alcohols and fatty amines. In addition, there would be a positive impetus for the use of lubricants made in whole or part from fatty chemicals to replace petroleum products in automobiles, compressors, turbines and jet engines.

Raw Materials

The raw materials for US production of fatty acids in 1982 are shown in Table V.

Tallow has been the principal feedstock for a long time due to its relatively low price and its ready availability as a byproduct of the meat processing industry. US markets for tallow are unable to use all of it, resulting in a substan-

TABLE V

US Fatty Acid Feedstock Origin, 1982

Origin	Fatty acids (million lb)
Synthetic	16
Vegetable oils	104
Coconut oil	130
Tall oil	400
Animal fats	650
Total	1300

Source: Humko Chemical Estimates.

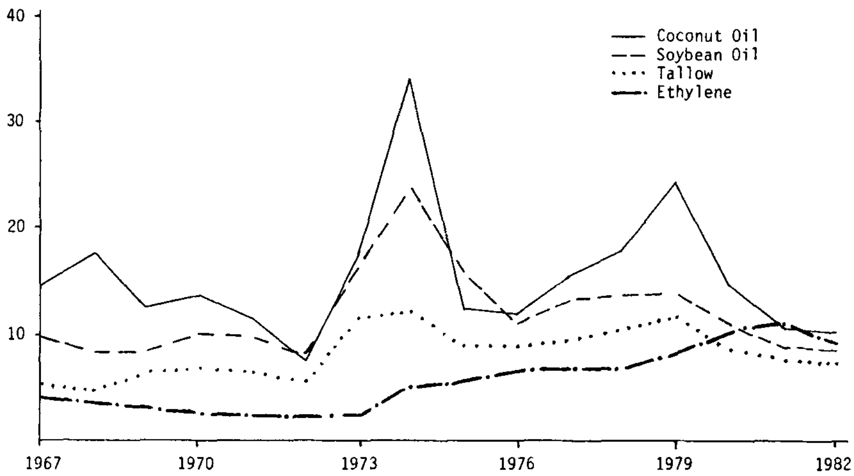

FIG. 1. Inflation-adjusted commodity prices (¢/lb; 1967=100). Source: Humko Chemical.

tial quantity that is exported.

Feedstocks for oleochemicals have certain characteristics and properties accounting for both their usefulness as well as their limitations.

—They are relatively low in price. Figure 1 compares real prices of bleachable, fancy tallow; soybean oil; coconut oil; and ethylene, the basic petroleum building block. The inflation-adjusted prices of natural fats and oils are approximately the same as they were 15 years ago. The real price of ethylene has about doubled in this same period.

—There is a significant degree of interchangeability in natural fats and oils. This factor plays an important economic role by tending to moderate price fluctuations. For high-stearic fatty acids, hydrogenated soybean oil will serve as feedstock as well as tallow. Hydrogenated tallow fatty acids can also be derived from palm stearine. Tall oil fatty acids and soy fatty acids compete with one another in some applications. Coconut oil and palm kernel oil are interchangeable sources of shorter-chain fatty acids.

—Natural fats and oils are renewable or replenishable, in contrast to petrochemicals—some on an annual basis and others on a little longer timeframe.

—Most natural fats and oils are byproducts or coproducts of human or animal food manufacture. Tallow is a byproduct of the red meat business; soybean oil, coconut oil, and palm oil have predominately food uses; and in addition, soybean oil is a coproduct of soybean meal used in the manufacture of animal feed. The important point is the large availability of these raw materials, and the fact that disposal is imperative. All of the byproduct or coproduct must be sold at a price that will clear the market.

—When compared to ethylene, fatty molecules are much less subject to chemical rearrangement. Ethylene is a molecule that can be polymerized to high-molecular-weight polymers, can be converted to molecules in the fatty range such as fatty alcohols, or can be reacted with small molecules to form chemicals with three atoms in the chain—ethylene oxide being an example.

—Prices of the natural fats and oils have fluctuated more than the price of ethylene. Ethylene has risen steadily in price in recent years but has not been subject to the wide price movements that have characterized coconut oil. In the days when petroleum was considered cheap, there was considerable research done on commercial processes for coconut- and tallow-range fatty acids based on petrochemical feedstocks. This research developed to the point of a large pilot plant for coconut-range fatty acids. No commercial development for petrochemical-based longer-chain fatty acids ever resulted, although Celanese did build a plant for oxo-derived 7- and 9-carbon fatty acids. When petroleum prices surged in the late 1970s and early 1980s, there were predictions of replacement of petrochemical-based products by those made from natural fats. As petroleum oil prices have leveled out, this has not happened. Two potential US natural fatty alcohol plants, one by Conoco and the other a Union Carbide/Henkel joint venture, have not come to fruition. The economic downturn of the early 1980s undoubtedly played an additional role in the decisions not to build these plants. Selection of the right raw materials has always been a major challenge to our industry. It will certainly continue to be.

Competition

It is difficult to imagine an industry more keenly competitive than fatty chemicals. This is in spite of the changes in the companies referred to earlier in this paper. Of fatty acids derived from animal fats and vegetable oils, tall oil fatty acids, fatty alcohols and fatty amines, only in one case does the company with the largest share have more than about one-third of the market. The one exception is in natural fatty alcohols where Procter & Gamble has 90% or more of the market.

Competition as a challenge to US fatty chemical companies is primarily a challenge from within as there has been little importation of fatty chemicals into the United States.

For exports of fatty acids the same situation of little importation exists as Table VI indicates.

TABLE VI

US Supply/Demand Balance for Natural Fatty Acids (Millions of pounds)

	1978	1979	1980	1981
Production	1346	1397	1320	1305
Imports	18	19	19	22
From inventory	0	0	0	9
Total supply	1364	1416	1339	1336
Consumption	1242	1270	1190	1245
Exports	117	141	109	91
To inventory	5	5	40	0
Total demand	1364	1416	1339	1336

Source: Chemical Economics Handbook, SRI International (used by permission).

Fatty acid derivatives are an entirely different story. There are significant exports of fatty nitrogen chemicals and polymerized fatty acids from the USA, particularly to South America.

Malaysia had in 1982 in excess of 60,000 tons/year of fatty acid capacity on stream. This is expected to grow to 200,000 in a few years (2). The principal raw materials for Malaysian plants will be palm and palm kernel oils. These oils will give fatty acids compositionally equivalent to those derived from coconut oil and tallow. The competition should primarily affect Western European fatty acid producers rather than those in the United States, since Western Europe imports almost all of its tallow requirements (mainly from the USA), whereas the USA imports virtually no tallow. However, small quantities of fatty acids produced in Malaysia come into the United States. Also, coconut fatty acid production in the USA amounts to a very small percentage ($\sim$10%) of its total fatty acid production.

Research and Development

—Oleochemical production is highly energy-intensive. Fat splitting, fatty acid distillation and glycerine water evaporation are specific examples. Energy reduction is at or near the top of the challenges we face. Enzymatic splitting of fats and oils is well known academically and offers promise of significant energy reduction. The lipase-induced hydrolysis of glycerides has been scaled up to batch size in Japan. For the technique to be applicable commercially, it will probably be necessary to develop immobilized enzymes and the continuous cycling of successive batches of glycerides over the fixed bed of enzymes. In addition to energy saving, the ambient-temperature hydrolysis of glycerides holds appeal as a nonoxidative approach to obtaining fatty acids and glycerine that could have marked stability improvement compared to products obtained by high-temperature continuous splitting. High temperature fractionation is the only feasible commercial method of separating fatty acids by chain length. Higher technology, such as chromatographic types of separation, remains to be developed to eliminate this manufacturing step which is a large consumer of energy.

—Improved hydrogenation catalysts is another example of a desirable advance in oleochemical technology.

—Development of new specialty oilseeds is a challenge for the industry which will have to be met in cooperation with agronomists, farmers and others.

—The high cost of meeting environmental requirements makes it necessary to work toward zero discharge of process waters. A lot has been accomplished but this is an area where a great deal more still remains to be done.

These are only a few of the numerous challenges for our research and development people. The successes of the researchers will probably play the biggest role of all in the future marketing and economics of the companies in the fatty chemical industry.

Profitability

The fifth and final category of challenges is profitability. Although no financial statements are available for public scrutiny, it is believed that the fatty chemical industry has had difficulty in consistently maintaining acceptable return on either equity or investment. This belief is given some credibility for fatty acids, in particular, by the reduced number of companies selling these products in the merchant market.

The overall challenge facing the oleochemical industry currently is twofold. First, how do you avoid the possiblity of extinction? and second, how do you achieve a reasonable rate of return on investment in a mature industry? The answer, we believe, lies in three common characteristics of business strategies which have succeeded in mature industries: growth segments within the industry are identified or created and then exploited; product quality and innovative product improvement are emphasized; and production and distribution efficiencies are systematically improved. In our business in the USA, this probably means fewer, more efficient, fatty acid producers and should mean a higher percentage of the sales dollar spent on research and development for processing improvement and innovation in applications.

REFERENCES

1. Aldag, C., Talk to the CMRA, New York, May 1975.
2. Eur. Chem. News, November 15 (1982).

Marketing and Economics of Fatty Alcohols

COLIN A. HOUSTON, Colin A. Houston & Associates, Inc., PO Box 416, Mamaroneck, NY 10543

ABSTRACT

Alcohols represent 35% of the world's major surfactant intermediates, with natural alcohols accounting for one-third of that percentage. Present trends suggest, however, that alcohols will become increasingly important in the detergent industry (the primary market for surfactants) during the next 10 years. Moreover, natural alcohols will frequently have an economic advantage over synthetics. Factors contributing to the growth of alcohols as surfactant intermediates include: better derivative biodegradability (especially compared to alkylbenzenes), better solubility (for use in low-temperature washing and in liquid detergents), better hard-water tolerance (for use in unbuilt liquid detergents), and a reputation for better detergency on synthetic fabrics. Factors favoring the natural alcohols (as opposed to the synthetics) include: frequently favorable raw material economics (especially as supplies of lauric oils increase), and integration of major manufacturers.

The primary outlet for the world's fatty alcohols is the highly competitive surfactant intermediate market. In this industry, natural and synthetic alcohols compete with linear and branched alkylbenzenes for market position. In 1982, free world production of major surfactants was 65% alkylbenzenes, 21% synthetic alcohols and 14% natural alcohols. The current question is, "How far can the alcohols (and especially the natural alcohols) go toward turning this situation around so that they are produced in larger volumes than alkylbenzenes?"

Total world production of these intermediates is ca. 2 million tons. If this 2 million tons were all converted to surfactant derivatives—linear and branched alkylbenzene sulfonates, alcohol sulfates, ethoxylates and ethoxysulfates —and converted to cleaning products, the yield would be over 20 million tons of finished detergents. There are other intermediates of importance, such as the alkylphenols, but upwards of 80% of the intermediate volume is concentrated in the products shown here.

Of these major surfactant intermediates, 70% of the volume is consumed by the household detergent industry, so I will focus on that industry. The three workhorse products of the detergent industry—53% heavy-duty powders, 3% heavy-duty liquids and 17% light-duty liquids—can all be made using either alcohol-based surfactants, alkylbenzene-based products, or combinations of both. The manufacturer's choice among these intermediates will be based on cost and performance considerations.

Along with cleaning power, biodegradability is a performance factor that must be considered carefully. It is difficult to assess biodegradability with a cost/performance equation, but we do need to comply with pollution regulations. Alcohol derivatives show better biodegradability than linear alkylbenzenes, and much better than the branched alkylbenzene derivatives.

The high volume natural alcohols are made from three natural fats or oils. Natural C_{12-14} alcohols usually come either from coconut oil or palm kernel oil, both of which are now in the 45¢/lb range. When the higher C_{16-18} range is sought, the feedstock used is now tallow, now approaching 20¢/lb. (These prices are as of the beginning of September, 1983.) Of course, many other oils can be and are used to produce lower volume alcohols, but today we are concentrating on the bulk, the highest volume products, since they are the key to alcohol industry economics.

Natural alcohol production processes yield potentially valuable byproducts. The fat or oil is first processed to fatty acids or methyl esters, either of which may be sold directly. The processes also yield glycerine.

The natural alcohol producer has great flexibility in that