Quality Requirements from a Consumer's Point of View (Oleochemical Products)

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ABSTRACT

The term "quality" includes not only intrinsic properties but also concepts such as availability, service, packaging, price level, price stability, delivery time and transport logistics. This paper discusses this definition as it relates to the oleochemical markets for commodity chemicals, specification chemicals and performance chemicals.

INTRODUCTION

What is the meaning of the word *quality* in the context of this paper? A first approach is to consider quality as a global concept. One can define quality as the aggregate sum of all the properties of a given product, by which that product is acceptable to or preferred by a given customer. Beyond the basic idea of "intrinsic properties," this definition also includes such concepts as availability, service, packaging, price level, price stability, delivery time and transport logistics.

How does this definition relate to the specific market of oleochemicals? I shall restrict the discussion to fatty acid markets, because they represent the bulk of the oleochemical market. What makes a given customer buy a given fatty acid or not?

The answer to this question depends on which of the three distinct market segments, shown in Table I, one considers. In each of these, the reasons for buying are ranked in a different order.

TABLE I

Market Segments for Oleochemicals

COMMODITY CHEMICALS	SPECIFICATION CHEMICALS	PERFORMANCE CHEMICALS
Price	Specification	Performance
Service	Price	Service
Specification	Service	Price

Today, practically everybody is able to produce the so-called "commodity fatty acids." They are products with rather ill-defined characteristics. "Specification fatty acids," as could be expected, are mainly purchased because they match well-defined specifications, while "performance fatty acids" have a unique performance in a particular application.

The original idea of producing fatty acids was to find a useful way to dispose of byproducts from the food industry. The first applications were for soap and candle making and—at that time—specific quality requirements were unimportant. Because of this, customers were looking for the cheapest source of supply. Even if today commodity fatty acids are used in numerous other fields, the purchasing decision is still almost entirely based on price considerations.

Also in the case of specification fatty acids, the customer takes complete care of the application. The difference is that he requires a well-defined set of characteristics, called specifications, and that he expects the supplier to match them.

The requirements of this type of customer go far beyond the traditional notions of melting point, chain-length composition, acid and other values and color. They can frequently include a specification relating to the presence or absence of ppm's of nonfatty material or they can include such elements as heat stability under given conditions. In most cases, the development and sale of a specification fatty acid will require a direct dialogue and frequent contacts between the supplier and the consumer of the fatty acid.

A good example of a performance fatty acid is the recent development of the flotation process in the de-inking of paper. It is almost impossible to introduce fatty acids in that industry, unless you have field technicians working closely with the suppliers of the flotation equipment and with the de-inking companies themselves. You can only succeed if you, as a fatty acid supplier, understand de-inking processes and are able to formulate according to your customer's specific needs and to supply assistance whenever needed.

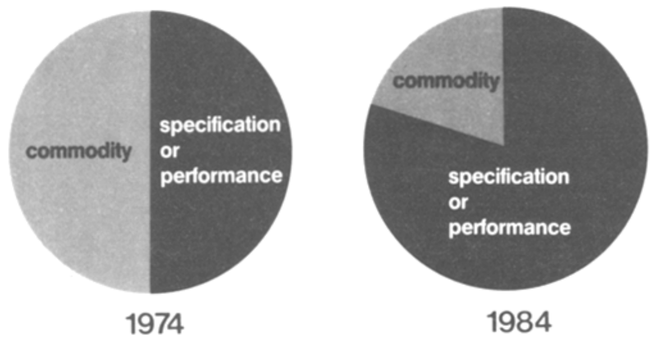

FIG. 1. Fatty acids in Western Europe, 10 years ago and in 1984.

This can become very complex, because you cannot have a single product that works in every individual case. The best you can hope for is to have a general standard answer that has to be adapted slightly to individual differences between plants using similar processes.

Another difficulty is that, very often, you will have to build a relationship of confidentiality with your customer before embarking on the process of developing a performance chemical. Conversely, the supplier of the fatty acid must be able to trust his customer. The confidentiality part of the relationship must work both ways. The evolution of the fatty acid industry is towards more and more specification and performance products.

Western Europe consumes substantially more than 800,000 tons of fatty acids per year, and the existing and potential customers number several thousand. The standards for consumer products are becoming ever more severe. The natural consequence of this is that the consumers of oleochemicals are becoming more and more demanding and that the range of oleochemicals to be offered grows increasingly diversified.

The commodity type of fatty acid is definitely on its way out. We estimate that ten years ago the fatty acids market in Western Europe was made up of about 50% commodity chemicals, whereas in 1984, about 80% of the fatty acids are either specification chemicals or, to a lesser extent, performance chemicals (Fig. 1).

The bulk of the west European fatty acids market in the mid-1980's is in the field of specification chemicals. Several sizable fatty-acid consuming industries have gone through this phase of development in recent years. A list of just a few includes: candles, metal stearates, soap, detergents and synthetic rubber.

Soap used by the Egyptians long before Christ was a novelty product of high value. Today we wouldn't accept it anymore. In the same way, our customers get used very fast to a new and better product quality, and after a while they expect this to be the general standard.

In a typical, but by no means unique example, some 20 years ago a quaternary ammonium chloride for fabric softeners needed only a Gardner 10 color. Today's general requirements in western Europe are very close to Gardner 1.

The evolution toward higher product quality in oleochemicals is only possible because the suppliers and the consumers of oleochemicals frequently have direct contacts.

Unfortunately, the oil and fat consumption of the oleochemical industry represents only about 5% of the total worldwide production. This low percentage is certainly not an incentive to the producers of fats and oils to have the same type of direct and frequent contacts with oleochemical companies, although such contacts would be tremendously important to an industry for which the raw material cost represents 70% of the price to the customer.

I feel confident, however, that more direct contacts could lift some fatty raw materials out of the sphere of commodities and allow them to enter the category of specification or performance products. For example, the fatty acid producers have caused American tallow renderers to respect a maximum content of 100 ppm polyethylene, thereby upgrading the commodity tallow to a specification tallow.

To a certain extent, performance fats also exist. Take the example of the production of top-grade imidazolines in the USA. It is based on direct selection and shipment of freshly rendered tallow to the oleochemical producer.

Let us now look at quality from a different angle: the quality chain.

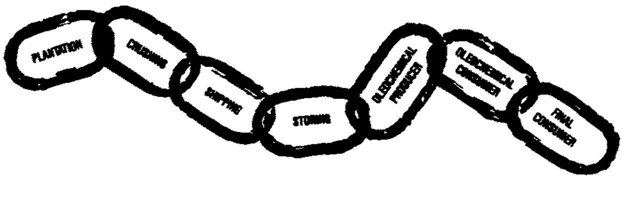

FIG. 2. The "quality chain" for oleochemistry.

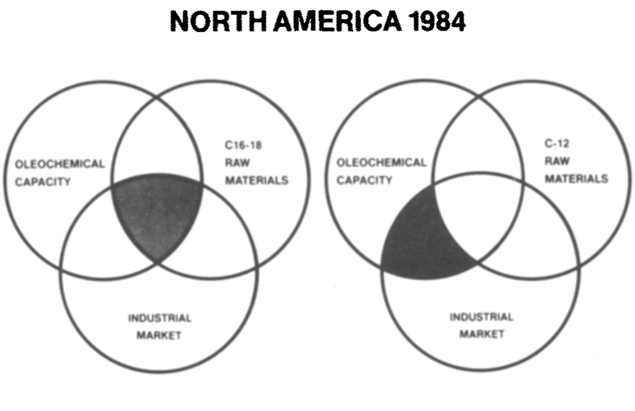

FIG. 3. North American's oleochemical home market is closest of any to an ideal situation.

Consider a banana. Eating it ripe and freshly picked is a gastronomic delight. Eating a banana that has matured on a ship or in a storage house leaves a mealy taste in the mouth. As a general rule, the quality of vegetable and animal products is inversely proportional to the length of the chain between their origin and their final consumption.

This is also true in the case of industrial uses of products of living origin, when the latter are transformed into processed foods. Through artificial means, the ingenious human race manages to let the chain grow longer. Techniques such as refrigeration, deep freezing and canning are expensive, but they allow us to preserve quality to a certain extent.

The oleochemical industry could of course never afford such expensive quality conservation techniques, although their potential usefulness is perhaps best illustrated by the following example: the best soaps are made if the fatty acids are saponified within the shortest possible time after their distillation.

To oleochemistry, quality is a chain with, at one end, the slaughtering of a cow or the picking of a palm fruit and, at the other end, the final consumer of the finished product (Fig. 2). Simple common sense tells us that it is in the interest of quality and thus also in the interest of consumer satisfaction that the chain should be as short as possible, both in time and space. Everybody in the oleochemical business is located somewhere on his own part of the chain, between his raw material supplier and his finished products customer.

Ideally, the source of raw material, the oleochemical producer and the consumer of oleochemicals should be located within a short distance of each other. In the same way, the industry that consumes oleochemicals would prefer to have its source of oleochemicals nearby and to be located close to its main markets. At the present time, however, no single industrial or developing country in the world has fully reached the ideal situation.

Today North America—with an annual oleochemical home market in excess of one million tons—has come closest of all to the ideal situation. North America has ample availability of tallow, soybean oil and tall oil, the most widely used raw materials for C_{18} oleochemicals. The oleochemical industry is well developed and the home markets are large and mature (Fig. 3). For C_{12} oleochemicals, however, North America is dependent on the import of coconut oil or palm kernel oil to feed the very sizeable segment of the oleochemical industry that is based on a high local demand for detergents and other final products derived from lauric oils.

This situation, in which only oleochemicals and final consumers are located in the same area, is the second best, because it allows a fast reaction of the oleochemical producer to any modification of market needs.

Western Europe, with an annual oleochemical consumption exceeding 1,200,000 tons, is the largest market for oleochemicals in the world. The local supply of C_{18} raw materials is limited, and the local supply of C_{12} raw materials is, as in North America, nonexistent (Fig. 4). Western Europe therefore has to import the bulk of its raw materials from outside. Local availability is limited to some tallow, lard, rapeseed oil, olive oil, tall oil and sunflower oil. Western Europeans, however, have learned to live with this situation, and the lack of local raw materials finds a high degree of compensation in a tradition of excellent logistic organization: overseas transport, unloading and storage facilities, etc. Furthermore, the need for protein has given rise to a local soybean crushing industry that produces more than one fifth of the world's soybean oil. This alleviates the western European raw materials situation to a large extent.

The situation in Japan is very similar to that of western

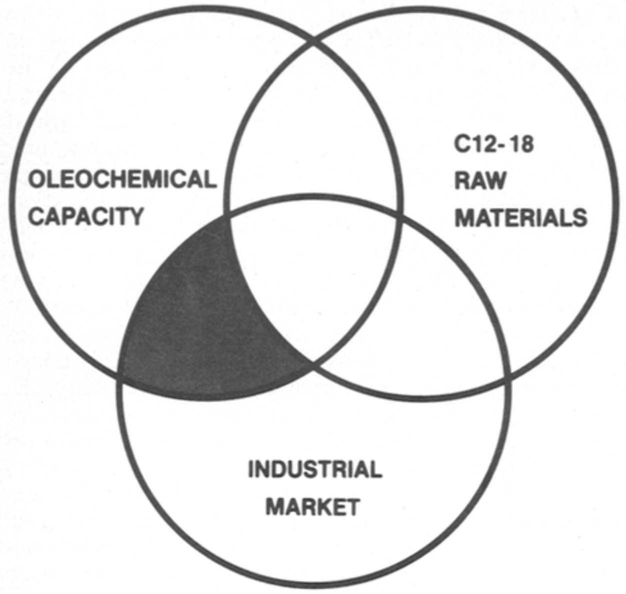

FIG. 4. Western Europe and Japan have similar oleochemical market situations.

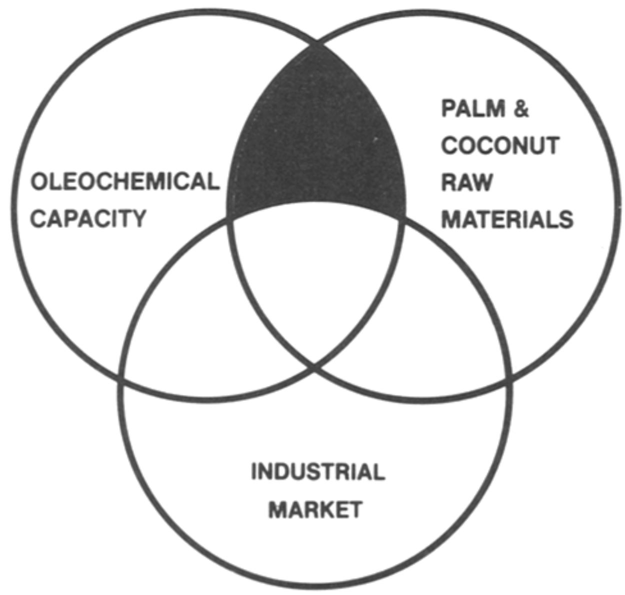

FIG. 5. ASEAN oleochemical producers have some raw material limitations and lack sufficient home markets.

Europe. On the one hand, the Japanese have even less local raw materials, but on the other hand, their geographical situation is closer to raw material production areas.

The southeast Asian countries have more than sufficient C_{16}-C_{18} and C_{12} oleochemical raw materials, but local supply is limited to palm and coconut product. This means that ASEAN oleochemical producers also have their raw material limitations, especially in the fields of C_{20}-C_{22} and of polyunsaturated chains (Fig. 5).

At present, ASEAN countries lack sufficient home markets, which causes them to be in the least preferable situation. With a population of more than 250 million, the future potential of the ASEAN market as a consumer of its own oleochemicals is comparable to that of today's western Europe, Japan and North America.

In the meantime, the large oleochemical capacities that were installed in recent years can only operate if they export either a limited number of commodity-type oleochemicals or up-graded intermediates that are shipped to oleochemical producers in industrially mature markets. An alternative solution for ASEAN countries would be to develop the use of oleochemicals in endproducts that are specifically adapted to their own markets. One might, for instance, imagine a soap-based detergent industry that relies entirely on local natural resources.

In the future, one might see new scenarios emerging. The Cuphea plant, for example, can produce lauric oils outside tropical regions, but nobody can say when the first industrial crops will be harvested. This would improve the west European and North American situation.

In ASEAN countries, on the other hand, the home markets will develop and the climate provides more than sufficient potential to grow a more diversified local raw material supply. In the medium term, the ASEAN oleochemical industry can therefore be expected to reach a diversified state of development that is closer to that of today's industrialized countries.

In the future, improved plant breeding and biogenetics will equalize all raw material position. A likely scenario for the future is the tailor-made production of specific and well-defined fatty materials by fermentation. Several biochemists firmly believe in this possibility, but it is certainly quite difficult today to make a realistic prognosis on when this might happen. These subjects are being discussed today in the European Common Market.

Notwithstanding the fact that Europe has too much butter and olive oil, it is a net importer of fats and oils. The European Common Market spends a great deal of money on subsidizing agricultural production. Instead of subsidizing the production of excess fats and oils, it might be preferable to spend that money on research, which would then lead to a number of industrial crops that would open up nonsubsidized markets for European agriculture.

Some of these new crops, such as jojoba, crambe, cuphea, 90% oleic sunflower and euphorbia, will yield higher-value oils. The specificity of their fatty chains might save some manufacturing steps. In the same way, southeast Asian-oriented research has the potential to create agricultural sources that can supply almost pure palmitic or almost pure oleic triglycerides to oleochemistry. These and similar developments in many parts of the world will take the oleochemical industry a big step further.

A European success with some or all of these crops and a healthy industrial development in southeast Asia will, before the end of this century, decrease the length of both quality chains to something that is much closer to the ideal situation.

We do, however, live in the present, and what is of immediate interest to us is what will occur in the next few years. And of specific interest to this symposium is of course the question, what does a west European oleochemical consumer of palm and coconut products have to say about the quality of these products?

The *intrinsic quality* of a raw material is an important factor, but it is only a part of the picture. The west European, American and Japanese oleochemical industries have long years of experience in working with the most diversified range of raw materials. Some companies have even made a policy of buying low-grade and, therefore, cheap raw material. They can only do this because they have developed the necessary techniques to make acceptable oleochemicals out of low-grade fats and oils.

The quality of southeast Asian oils is generally well accepted, although it might for instance be argued that the

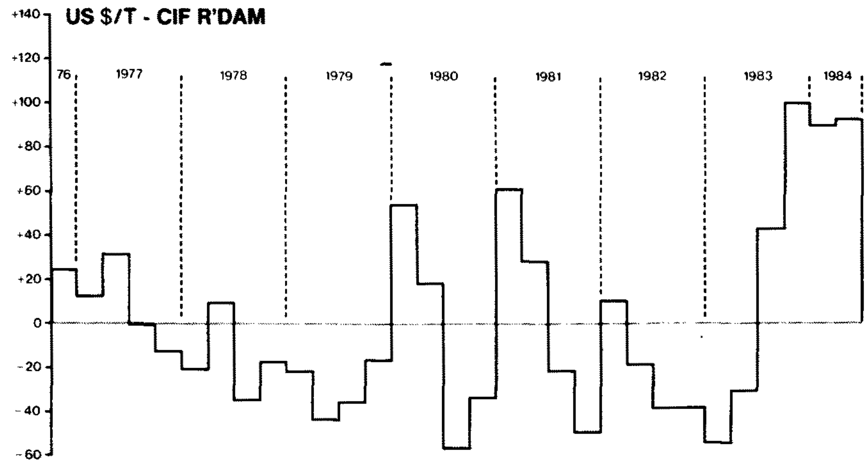

FIG. 6. The average quarterly price differences for palm stearin relative to the price of tallow, represented by the "0" line.

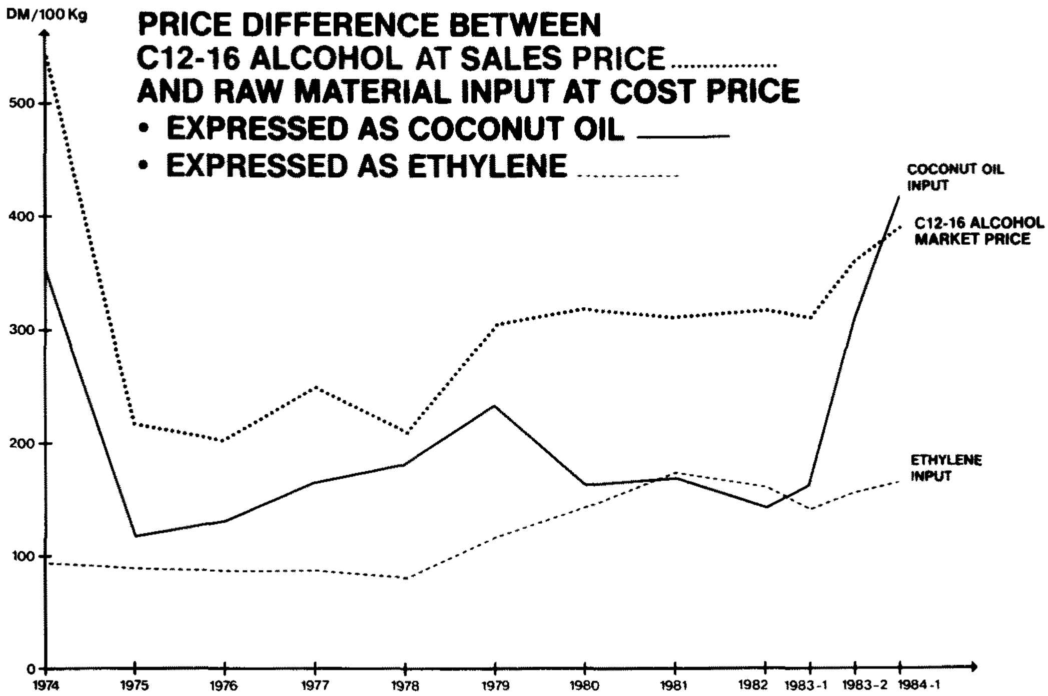

FIG. 7. Price differences between C12-16 alcohol at sales price and raw material input at cost price, from 1974 to the first half of 1984.

palm fatty acid distillate (PFAD), from a physical refining process, contains impurities and unsaponifiables that are detrimental to stability and that make this raw material unsuitable for the manufacture of high quality oleochemicals. Moreover, acid oils from chemical and physical refining are systematically mixed for export, thereby deteriorating the quality of what would otherwise be a satisfactory raw material for oleochemistry.

One of the real problems, however, is that in working with southeast Asia, the quality chain often grows too long. It happens that palm products make a trip around the world before arriving in western Europe. Moreover, during such a round-the-world trip the goods may be transshipped. This causes uncertainty about arrival dates and creates problems of discrepancy between departure and arrival quality.

Most of the southeast Asian producers and traders of palm and coconut products to the chemical industry do their utmost to respect contractual specifications and sell on FOSFA terms that stipulate "arrival quality to be final." They also accept the contractual clause "direct shipment without transshipment," as well as the specific payment terms that are included in all contracts for palm products concluded with my company, for example.

Generally speaking, fats and oils for the oleochemical industry are still commodity products. This means that, in the aggregate sum of properties that I have defined as *quality*, price is one of the main points. As is very often the case with commodity products, numerous substitution possibilities exist. Palm stearin for oleochemistry started as

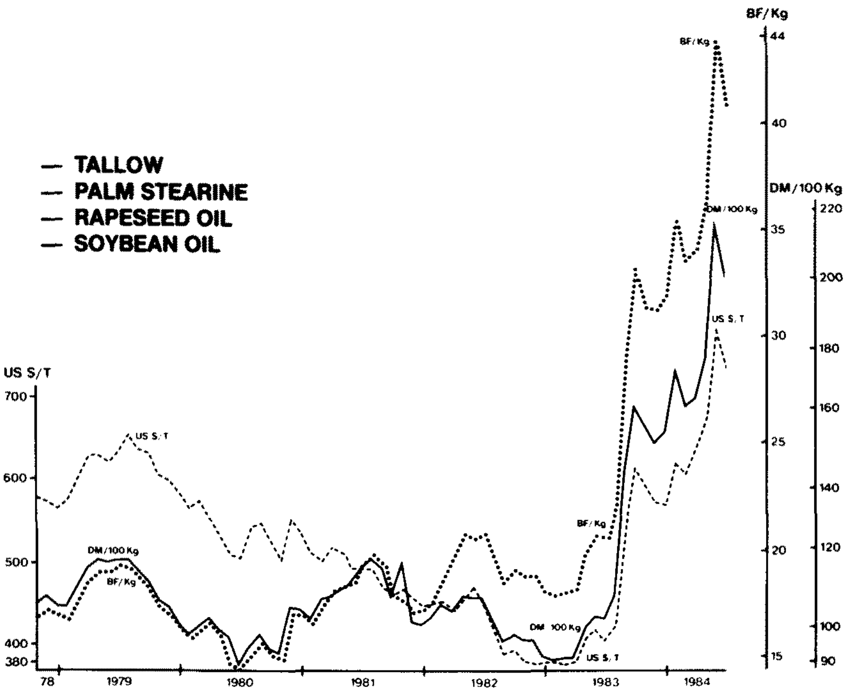

FIG. 8. Average price of selected C16-18 raw materials.

a potential substitute for beef tallow, and the price graph (Fig. 6) clearly shows that at given times, the price of palm stearin can be either attractive or unattractive. Palm stearin has been unattractive during the last 12 months of this graph, even particularly unattractive in October of 1983, when it cost 140 U.S. dollars per ton more than tallow.

This situation of relative price fluctuations is an obstacle to the setting up of a continuous flow of business. Tallow, from the lowest to the highest grade, is used by all European oleochemical plants on a continuous basis. Palm stearin, on the other hand, is only used when the price relation to tallow is attractive.

But worse situations exist. In certain applications, natural fats and oils and petrochemical raw materials are interchangeable. The most typical example here is the manufacture of detergent-cut fatty alcohols from either lauric oils or ethylene. It is clear from Figure 7 that in the second half of 1983 and the first half of 1984, life was made extremely difficult for companies anywhere in the world who produce natural fatty alcohols. In fact, if such a situation were to last too long, it would lead to the loss of a substantial part of the international market for coconut and palm kernel oil. It could also very understandably strengthen the incentive of industrialized countries to speed up programs for the local production of substitutes. Another possibility that has already been achieved in part in recent years is the replacement of C_{12}-C_{14} fatty alcohol-surfactants for detergents by C_{16}-C_{18} alcohol-surfactants.

Realistic and stable pricing is of paramount importance to the oleochemical industry. We have to accept that adverse climatic conditions will continue to cause dramatic changes in supply and in price. We also realize that we have no control whatsoever over currency exchange rates, one of the most upsetting factors of the last years.

In recent years and up to mid-1983 (Fig. 8), the oils and fats market was marked by a stable or, if calculated in U.S. dollars, by a decreasing price picture. During this period, which coincided with a worldwide economic crisis, the oleochemical industry managed to perform better than the chemical industry as a whole. Recent explosive price developments endanger oleochemistry's level of performance, and all measures to improve the price stability of oils and fats are keys to success.

The best guarantee for the long-term health of the oleochemical industry as a whole, from the producer of raw materials to the producer of oleochemicals, lies in a joint effort by all parties concerned to respect the quality chain in all aspects.

Sessions V and VI Discussion

The following questions, answers and comments were presented during the joint discussion session held for these two sessions at the conclusion of the plenary lectures.

Q: Why is palm oleic acid not widely used?

Knaut: Henkel tried to introduce palm oleic acid into the market but without any success. Apparently the textile people need low linoleic acid content in the palm oleic acid to prevent autoxidation.

Q: Can you please elaborate on the use of methyl esters as lubricants?

Knaut: Some quantities of methyl ester are used as metal working agents (as cutting and drilling oil). However, I cannot produce details because the company using the methyl ester will not disclose the technology nor the proportion of methyl ester used.

Q: Can you compare and contrast the refining of glycerol using ion-exchange and distillation?

Combs: There is no difference between the quality of the glycerine using ion-exchange or distillation. In order to decide on the method of refining, a few variables need to be considered including cost of energy, cost of resin and availability of water. In the United States, both are available.

Q: Is it possible to replace SLS with a sodium salt?

Ogoshi: I don't really know, but it could be possible.

Q: Can fractionated stearic acid be used to make soap as against a mixture of palmitic stearic acid? If so, what are the advantages and disadvantages?

Ogoshi: We use methyl stearate to make soap. More coconut and palm kernel oil should be used for higher foam.

Q: Do you anticipate using α-sulphonated fatty methyl esters (αS-FME) in detergents? If so, what is its cost performance?

Ogoshi: I hope so. The price of PO could be low enough to enable us to substitute LAS and AOS with αS-FME.

Q: What is the importance of using methanol in the bleaching process?

Ogoshi: Methanol plays an important role in bleaching. In the absence of MeOH, H_2O_2 decomposition is very fast. In the presence of MeOH, decomposition is moderate.

Q: Soap based on PO has a slight odor compared to tallow-based soaps. Do you see this as a disadvantage? If so, suggest methods of improvement.

Ogoshi: Odor from PO is slightly different from tallow. Soaps based on PO have passable odor, implying the odor is acceptable to the customers.

Q: What type of lipase did you use in the SPH process? Is the lipase available commercially?

Akaike: The lipase M1 produced by a Japanese company was used. It is produced by yeast. It is reported in J. Chem. Soc. of Japan No. 9 pg. 1358 (1983). The patent number is Japanese Tokkai No. 57-55799.

Q: What sort of hybridization do you expect to see in palm oil?

Akaike: Palm oil as a raw material for oleic acid with low content of linoleic and palm oil for C_{16} with low C_{18}. The hybrid of guineensis and oleifera should meet the needs for oleic acids.

Q: Can the Kao reactor be used for the sulphonation of AOS? Can you comment on the differences between the Kao reactor and the T.O. reactor?

Wakatsuki: The reactor is based on the sulphonation of fatty alcohol ethoxylate. It is possible to sulphonate AOS using this reactor. I have no experience with the T.O. reactor, hence I will not be able to compare.

Q: You mentioned the possibility of selective hydrogenation of palm oil fatty acids to reduce the amount of linoleic acid. Can you give some figures of the actual selectivity required and what catalyst has been used?

Ho: At Acidchem (M) Sdn. Bhd, we do not have any experience regarding the selective hydrogenation and linoleic acid. However, the catalyst supplier has indicated the use of Cu-Cr catalyst.

Q: At the lipase water to oil ratio of 1:1, what can be used to increase efficiency?

Ho: We do not have any experience. Probably some emulsifier system or better agitation system could enhance mixing.

Q: Why do you say that the enzymic process is only applicable to triglycerides of low titre?

Ho: The only reason I know is that at temperatures above 30 C this could lead to inactivation of lipase.

Q: In Australia the bread manufacturers have encountered problems using stearic acid. Can you explain?

Ho: It was found that certain companies are producing stearic acid by using improper quality palm oil such as sludge which can produce odor in the final product.

Comment, W.F. Bernholz: Heat test limit should be used in assessing the quality of stearic acid. Usually stearic acid with good heat test limit will produce products of good color and quality.

De Vries: Those low quality fatty acids that were sold in Australia were not made in Malaysia.

Q: What is the market potential of oleate stearate amides?

Smith: Amides are often used as lubricants or plasticizers in PE, PP and PVC. I have no idea of their market potential and specification.

Q: Can you describe the uses of fatty acids based on chain length?

Reck: C_8, C_{10}, C_{12} are better as flotation agents than C_{16}, C_{18}. C_{12}, C_{14} are used as fungicides, biocides, pesticides and herbicides. C_{16}, C_{18} are used as emulsifiers and pesticides, and as anti-caking agents. C_{12} derivatives are better detergent enhancers.

Q: What is the effect of long distance transportation on the quality of fatty acids?

deWaet: For saturated fatty acids oxidation process is limited. Therefore, long distance transport is possible. Unsaturated fatty acids are more prone to oxidation, therefore additional physical and chemical processes are required to help counter oxidation.

Q: What is the prospect of cuphea as a source of lauric oils?

Knaut: Some work from universities in the U.S.A. and Germany reported more than 300 hybrids have been selected. It is a difficult task to select hybrids with the highest C_{12} content. Projects are going on this aspect. Some countries are beginning to grow cuphea. We are under an obligation to look for other sources of lauric acid.

Q: What is the ideal price correlation between lauric oils and tallow for the West European end-users?

deWaet: The correlations are to be seen between palm stearin and tallow on the one side, where at the same level or slightly below, palm stearin would be an alternative for the use of tallow for many applications, the important thing being that the differential should be constant. The lauric prices are to be contemplated in correlation with the ethylene points. Here again one should consider that if the coconut oil price is slightly under ethylene price. This would mean a good long term potential for lauric oils versus ethylene in the manufacture of fatty alcohols.

Q: There have been some remarks lately that soybean oil will be more expensive in the future due to high energy requirements for cultivation and harvesting since it is an annual crop, and tallow too because the cattle breeding trend is toward producing lean meats. Would you kindly comment on these?

deWaet: Soybean oil and tallow can become more expensive in the future, for the reasons you mention. Palm stearin, in such a case, would be a very good substitute provided that the price of palm stearin would be more related to the price of tallow than to the price of palm olein, which might happen in case that the palm olein market for edible use would develop considerably while the use for edible palm stearin would not follow. As far as soy is concerned, it is most of the time used as a raw material for PUFA, and an alternative source is rapeseed oil.