PALM OIL technical bulletin

Vol. 1 No. 3

March 1995

INCREASE IN PALM OIL EXPORTS

According to PORLA figures, as much as 6 651 104 tonnes of palm oil were exported by Malaysia in 1994. This is an increase of 10% by comparison with 1993 (6 045 670 tonnes)

Source : PORLA January 1995

IN THIS ISSUE

PALM OIL AS FUEL FOR CARS FITTED WITH ELSBETT ENGINES

by

Dr. Ahmad Hitam

Introduction

The Elsbett engine was first introduced to Malaysia in 1984, starting with a joint study by Elsbett Konstruktion of Germany, Mitsui of Japan and PORIM. In this study, four Elsbett engines were brought in for testing. Two of the engines were used as generator sets running on palm diesel and neutralized palm oil as fuel. The other two were used in two cars, one running on palm diesel and the other on neutralized palm oil. The car using palm oil covered nearly 65 000 km and the one using palm diesel 75 000 kilometres.

Automobiles consume large quantities of petroleum products, including diesel : this is a significant contributor to major global problems such as depletion of petroleum resources and - because of the associated emissions - to global warming, acidification and urban air pollution. Approaches to dealing with these problems must take account of the fuel economy and emissions of automobiles and the choice of fuel. In 1983 a symposium on vegetable oils as alternative fuels to diesel revealed that they have good potential provided the problems of high viscosity, low volatility and the reactivity of the unsaturated hydrocarbon chains (causing polymerization) can be overcome.

The Trial

In late 1992, PORIM embarked on a long-term, exhaustive field trial using palm oil as fuel for Elsbett engines. Twenty of these were fitted to twenty Mercedez-Benz cars (Series 124) for the trial, the main objective of which is to monitor the long- term effects on engines of using palm oil as fuel. According to the experimental design, each car is to cover a distance of 300 000 km with the engine being dismantled for checking every 100 000 kilometres. Periodical analysis of the lubricating oil is being carried out to monitor its properties after each 5 000 kilometres.

This trial enables the following to be observed:
- Fuel consumption
- Fuel filter service life
- Exhaust emissions
- Smoothness of the engine in operation, and
- Cold starting

During the periodical stripping of the engines at 100 000 km, wear and tear of moving parts will be noted.

Twelve of the cars are chauffeur-driven. Fuel is supplied in 200 litre drums. The cars are subjected to normal driving conditions, both on highways and in town.

For palm oil to be used as fuel in a diesel engine, it must be able to be pumped through the fuel pressure line and the injectors in liquid form. It must also be sufficiently combustible for spontaneous ignition to occur upon compression. These conditions can be met by heating the palm oil in the fuel tank, the fuel lines (supply and back flow) and the fuel filters. Electric heaters were used with the battery as the power source. Heating the palm oil reduces its viscosity, giving smooth flow to the injectors.

Table 1 shows some of the fuel properties of diesel and of neutralized palm oil. As can be seen, the heat of combustion of palm oil is 39 600 kJ/kg as compared with 45 800 kJ/kg in the case of diesel. This results in a higher specific fuel consumption.

To avoid difficulty in morning starting, the cars are equipped to use diesel as the starting fuel. When the ignition switch is turned off, the starting fuel pump begins to fill the nozzles with diesel. Thus when the ignition is switched on again, the engine starts with the diesel while heating the palm oil. When the palm oil is liquefied the starting fuel pump stops automatically and the valve for the palm oil fuel is switched on. For the first start in the morning, the time taken for changeover to palm oil can be from 60 to 90 seconds. *Figure 1* shows the fuel line system.

Results

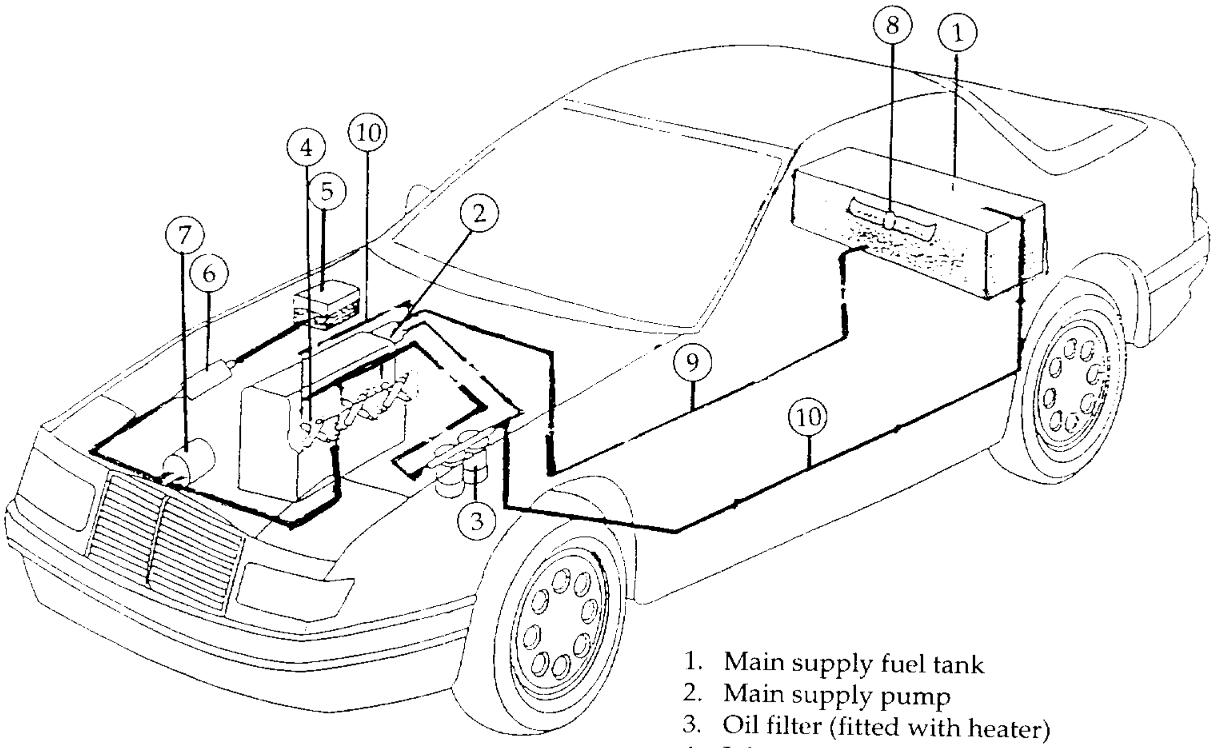
The first car to run on palm oil has covered about 80 000 kilometres. On average, the consumption of the cars in the trial is 8 litres per 100 km for city driving and about 7 litres per 100 km on the motorways.

Fuel filters have been monitored closely. They were found to be in good condition at each 5000 km inspection.

During the initial part of the trial, a problem was the sudden stalling of the engine after cold starting. It was

TABLE 1. PROPERTIES OF MALAYSIAN DIESEL AND CRUDE PALM OIL

Fuel Characteristic	Malaysian Diesel	Crude Palm Oil(CPO)
Specific gravity	0.8330 @60.0°F	0.899 @ 122°F
Sulphur content (% wt)	0.50	0.02
Kinematic viscosity	4.0 @40°C	24.3 @55°C
Pour point (°C)	15.0	12.8
Final recovery(%)	98.0	
Cetane index	53	37
Gross heat of combustion (kJ/kg)	45 800	39 600
Flash point (°C)	98	240
Distillation temperature 90% point	3338 max	359
Conradson carbon residue (% wt)	0.14	1.34
Moisture % wt		0.30
Free fatty acid (% wt)		3.26
Iodine value		53-57



1. Main supply fuel tank
2. Main supply pump
3. Oil filter (fitted with heater)
4. Injector
5. Starting diesel fuel tank (5 litre capacity)
6. Filter
7. Pump
8. Heater
9. Main Supply fuel line for crude palm oil (CPO)
10. Back flow pipe for crude palm oil (CPO)

Figure 1. The Fuel Line System For an Elsbett Engine Using Palm Oil

found that the fuel lines were not fully heated so that there was insufficient fuel going to the engine. When this was rectified the problem was overcome, and all the cars now have their fuel lines fully heated.

Another observation was made on the standard hoses for the fuel lines. These hoses lasted up to 30 000 km, after which they had to be changed as the ends swelled, resulting in leakage, which caused air to enter the fuel lines : the bubbles had to be removed with a hand pump.

Conclusion

The preliminary results showed that palm oil under controlled conditions could be used effectively as fuel for the Elsbett engine. As long as the fuel can flow easily from the fuel tank to the engine, without any hindrance from solid particles or air bubbles, the engine should be able to run smoothly.

The smooth running of the engine seems to result from the modifications of conventional diesel engine parts, which include the development of the nozzle, and the redesigning of the combustion chamber configuration and the engine cooling system.

None of the engines has been dismantled yet as the greatest accumulated distance travelled is only 80 000 kilometres. Thus any effects on engine parts cannot yet be reported.

This trial has shown that palm oil can be used as fuel for an indirect injection diesel engine with the modifications mentioned. More exploratory work would be needed before palm oil could be used as fuel in ordinary diesel engines.

TRANS FATTY ACIDS : THEIR DIETARY AND HEALTH IMPLICATIONS

by
Kalyana Sundram

The hydrogenation of edible oils and fats has been a well accepted processing technique for many years. Its importance can be related to its economic significance. In the United States alone, of the nearly 4.54 million tonnes of visible fats and oils consumed annually, almost 2.72 million tonnes (60%) are subjected to partial hydrogenation. The importance of this processing is further underscored when it is recognized that soyabean oil provides about 60% of the total visible fat in the American diet.

Hydrogenation converts liquid oils to a semi-solid form, primarily by the addition of hydrogen directly to the unsaturation in the fatty acids. This helps to increase the stability of fats or oils, protecting them against oxidative rancidity, and most importantly enables the use of liquid oils (after hydrogenation) in the formulation of margarines, shortenings, bakery and frying fats.

During hydrogenation, some of the fatty acid residues including those of oleic (18:1), linoleic (18:2) and linolenic (18:3) are isomerized with the production of the geometrical isomers referred to as *trans* fatty acids, and also of positional isomers.

These *trans* isomers have the effect of altering the melting point of fatty acids, e.g. oleic acid (*cis*) is a liquid at ambient room temperature whereas its isomer elaidic acid (*trans*) is a solid. The presence of *trans* fatty acid residues in triglycerides raises their melting points as well. Hence the hydrogenated liquid oil (monounsaturated and/or polyunsaturated) which are used in many food formulations are able to exhibit the physical characteristics of solid fats, partly, because of the higher melting point of the *trans* fatty acids, which contribute substantially to the solid-fat content of the finished product. Of course the conversion of unsaturated fatty acids (eg. oleic) to more saturated analogues (eg. stearic) is also important in raising the solid-fat content.

Formulations containing hydrogenated products have long been accepted by the food industry as a means to extend the otherwise limited applications of liquid polyunsaturated oils, which are prone to oxidative rancidity and even cyclic polymerization when heated. Unlike the natural saturated fats, partially hydrogenated oils and fats have not in the past been plagued by the controversy related to cholesterol and heart diseases. Nevertheless, there has always been a nagging concern about the true effects of *trans* acids in the human diet. Let us review some of the nutritional studies on *trans* fatty acids.

Animal studies indicate that *trans* fatty acids do not exert deleterious effects on growth when fed together with other fats. However, in the presence of essential fatty acid deficiency, *trans* fatty acids can aggravate the condition. From studies on rats it was also evident that hydrogenated vegetable oils can alter blood and tissue lipid levels and ultimately cause altered tissue and enzymatic functions. For these reasons the consumption of *trans* fatty acids must always be accompanied by adequate amounts of the essential fatty acids, *cis* linoleic (C18:2 n-6) and *cis* linolenic (C18:3 n-3).

In the past there have been several controlled human feeding trials that evaluated the effects of fats containing *trans* or other isomeric fatty acids by feeding them to groups of subjects and then measuring blood lipid levels, primarily serum cholesterol. Emken summarized the results from 14 such studies with hydrogenated oils (*Table 1*). Most of these studies suggested that hydrogenated oils caused an increase in plasma lipid levels, especially those of serum cholesterol. Surprisingly, however, the authors concluded that these increases were moderate and even normal. They even diluted these findings by suggesting that hydrogenated fats such as those found in margarines normally have a lipid lowering effect compared to highly saturated fats such as butter and coconut oil.

Fortunately for the general public, there appears to be a renewed desire to examine the nutritional properties of hydrogenated fats. This has also been facilitated by newer analytical tools that can provide greater clarity in understanding *trans* fatty acids. As examples of the new trend, Dr Scott Grundy, a highly respected lipid nutritionist, now acknowledges that *trans* fatty acids may not be entirely harmless to health while others like Drs. Kummerow and Holub advocate that *trans* fatty acids should be mentioned quantitatively on food labels so as not to mislead consumers.

A study by Mensink and Katan is largely credited with turning the tide of opinion against hydrogenated fats and oils. In this work subjects were randomly allocated to consume diets containing 10 energy per cent as natural monounsaturated fat (18:1), or saturated fat or *trans* fatty acids (mainly elaidic acid). The *trans* diet not only increased LDL-cholesterol and serum cholesterol, but also decreased HDL-cholesterol. As a result the important atherogenic ratio of total cholesterol to HDL-cholesterol was significantly increased on the *trans* diet as compared with both the monounsaturated and saturated diets. The net result of this study indicated, quite convincingly, that *trans* fatty acids may detrimentally alter these cardiovascular risk factors.

Subsequently studies by Nestel and co-workers also provided similar results associating *trans* fatty acids with increased LDL-cholesterol levels and decreased HDL-levels. In a study by Wood, a 29% *trans* fatty acid diet

TABLE 1. SUMMARY OF HUMAN STUDIES EVALUATING EFFECTS OF *TRANS* FATTY ACIDS ON SERUM LIPID LEVELS

Hydrogenated oil or isomeric fatty acid	Change in Serum Level		
	Triglycerides	Phospholipid	Cholesterol
1. Peanut	N.D.[a]	N.D.	Increase
2. Cottonseed	Increase	Increase	Increase
3. Corn	Increase	Increase	Increase
4. Corn	N.D.	N.D.	Increase
5. Corn	Increase	Increase	Increase
6. Sunflower	Increase	No change	Increase
7. Margarine (6 brands)	N.D.	N.D.	No change
8. Soyabean	No change	No change	No change
9. Soyabean	N.D.	N.D.	No change
10. Soyabean	No change	No change	No change
11. *trans,trans* and *cis trans*-18:2	Increase	N.D.	Increase
12. 44% *trans* acid	No change	N.D.	No change
13. 34% Elaidic acid	N.D.	N.D.	Increase
14. 37% Elaidic acid	N.D.	N.D.	Increase

[a] N.D. : Not determined.

Adapted from E.A. Emken. Utilization and effects of isomeric fatty acids in humans. In *Geometrical and Positional Fatty Acid Isomers* Ed. E.A. Emken and H.J. Dutton. AOCS 1979.

(hard margarine) additionally caused a decrease in apolipoprotein AI and B levels.

One of the factors that had long persuaded both legislators and researchers not to make recommendations against *trans* fatty acids was the perception that their actual consumption levels were very low. *Trans* isomers are estimated to constitute only 5%-6% of the dietary fat consumed in the USA, but the actual proportion varies depending on the food choice. Food products can contain between 5% and 30% or more of these isomeric fatty acids. The findings of Willet and co-workers published recently in the Lancet, provide a new insight into this matter. They calculated *trans* fatty acid intakes from dietary questionnaires completed by 85 095 healthy women. They found that *trans* fatty acid consumption was directly related to risk of coronary heart disease and that this association was especially significant in 69 181 women who consumed margarines during the past 10 years. Foods containing *trans* isomers including cookies, biscuits, cakes and white bread were all significantly associated with higher risk of coronary heart disease.

Animal studies had previously indicated that *trans* acids may alter certain enzyme functions independently of their effects on serum and lipoprotein lipids. Also, there is already mounting evidence suggesting that *trans* fatty acids can modify lipoprotein Lp(a) levels in humans. Lipoprotein Lp(a) level is a very powerful and independent indicator of risk of ischaemic heart disease. The circulating level of Lp(a) is primarily under genetic control and attempts to modify it by drugs or diet have not been very successful. Recently it was shown that the replacement of the habitual fat in a European type (Dutch) diet with palm oil resulted in a significant decrease in serum Lp(a) levels. Subsequently at least two independent groups of researchers in the Netherlands and Australia have shown that diets high in *trans* fatty acids increase serum levels of Lp(a). This finding, coupled with the ability of hydrogenated fats to detrimentally modify serum LDL and HDL cholesterols and their relevant ratios, suggests that substitutes for *trans* fatty acids must be found.

Can manufacturers formulate margarines, shortenings or bakery fats with zero *trans* content? The most obvious answer lies in the use of palm oil and its fractions in these food formulations. At least in Malaysia, the above mentioned food products are manufactured with little or no *trans* fatty acid content. Obviously, the consumer must be assured of the nutritional efficacy of substituting palm oil (high in palmitic acid) for *trans* fatty acids. There is an emerging body of evidence that palmitic acid, the major saturated fatty acid in palm oil, does not raise blood cholesterol levels, especially in the absence of myristic acid and high dietary cholesterol intake. We are optimistic that palm oil will continue to be seen as a highly desirable and nutritious edible oil and will be increasingly used as a replacement for hydrogenated oils containing *trans* fatty acids in a wide variety of food formulations.

References

Emken, E A (1979). AOCS Champaign, pp. 99-129.
Mensik, R P and Katan, M B (1990) N Engl J Med 323. pp. 439-445.
Nestal, *et al* (1992). J Lipid Res 33. pp. 399-410.
Wood, R *et al* (1993). J Lipid Res. 34.
Willet, W C *et al* (1993). Lancet 341. pp. 581-585.
Honstra, G *et al* (1991). Atherosclerosis 90.pp. 91-93.
Mensik, R P *et al* (1992). J Lipid Res. 33. pp. 1493-1501.

RESEARCH HIGHLIGHTS

Technology to Produce Carotene-Rich Refined Palm Oil is Now Available

Dr C.K. Ooi, a senior PORIM research officer, disclosed at the Food Ingredient Europe Conference and Exhibition October, 1994 that technology is now available to produce carotene-rich refined palm oil retaining the original carotene in the final product, which is called red palm oil.

This refined red palm oil has less than 0.1% of free fatty acids and contains 500 ppm of carotene and 700 ppm of vitamin E. The technology is now being applied and commercial production is expected in 1997. Apart from red palm oil, Dr Ooi also described a process for producing 90% pure carotene concentrate from palm oil consisting mainly of α- and ß-carotenes. This process is also in the process of being commercialized.

The development of these technologies is actually a gift to the world since carotenes are important for their nutritional attributes. Carotenes have long been known as precursors of vitamin A. More recently, their antioxidant properties have attracted attention. There is also evidence that carotenes, including those found in palm oil may have anti-cancer properties, and this has generated a lot of interest among nutritional scientists. In the food industry, carotenes are widely used as natural food colouring, especially in margarine formulations.

Contributed by Johari Minal

New Source of Lauric Acid

The Calgene Company of the USA has genetically engineered the canola plant with the addition of a thioesterase gene, yielding a seed oil with 40% lauric acid. According to a report in Chemistry and Industry, the world's first commercial planting of a genetically modified oilseed crop has taken place in Georgia.

Lauric acid is a key raw material in the manufacture of soap, detergents and cosmetics, and until now the only significant, commercial sources were coconut and palm kernel oils. Calgene claims that the new oilseed will help to smooth the price fluctuations of the lauric oils and ensure a domestic supply to US users.

PORIM draws attention to the fact that this is only a field trial as yet : the new oilseed will have to prove that it possesses the required attributes of disease resistance, adequate yield, stable fatty acid composition and harvestability before it can become a commercial proposition.

Contributed by Dr B.A. Elias

The Effects of Symmetrical Triglycerides on Palm Olein Cloud Point

Palm olein, the liquid fraction of palm oil, is widely used as cooking oil. It is important that the oil should remain clear, since cloudiness is always associated, in the minds of consumers, with low quality, although there is no scientific correlation between quality and clarity. It is an inherent physical property of palm olein that it becomes cloudy when it is stored at low temperatures (below 25°C). Several studies have been conducted to try to overcome this problem. Possible solutions include blending and fractionation to produce oleins with higher iodine numbers. However, the triglycerides that cause the cloudiness of palm olein have only recently been investigated. A study by P.Z Swe and co-workers has now revealed that POP and POS, the symmetrical triglycerides found in palm olein, are the two triglycerides present in the turbidity of cloudy palm olein. These crystallized triglycerides later on trigger the formation of more crystals. Therefore, the cold stability of palm olein could be improved by eliminating these triglycerides, which can be done through fractionation or interesterification.

Source : JOACS, 71(10), 1994
Contributed by Johari Minal

Palm Olein Improves Oxidative Stability of Soyabean Oil

W.E. Neff and his team have found that palm olein when blended with soyabean oil improves the oxidative stability of the latter.

Soyabean oil is known to be susceptible to auto-oxidation because of its high content of polyunsaturated fatty acids. Auto-oxidation is a reaction whereby oxygen molecules from the air reacts with the double bonds of polyunsaturated fatty acid residues in oils. This leads to the production of shorter-chain compounds including alcohols, aldehydes and ketones which are undesirable in food products because they produce the off-flavour characteristic of rancidity. The common methods used to improve the oxidative stability of polyunsaturated oils are hydrogenation, which reduces the proportion of polyunsaturated fatty acids, or blending with a more stable oil *e.g.* palm olein. The study by Neff *et al* showed that blending soyabean oil with palm olein of course lowered the polyunsaturated triglycerides (containing linoleic and linolenic acids) and increased the monounsaturated triglycerides. As a result, blended oils had better oxidative stability than that of soyabean oil alone. This was evident through a slower increase in peroxide value, and reduced formulation of the volatile compounds which are products of oxidation. The more palm olein added to soyabean oil, the more stable was the blend. A similar study was also carried out with interesterified blends of palm olein and soyabean oil. Interesterification altered the positions of fatty acids in the triglyceride molecules. However, the simple blend of soyabean oil and palm olein was more stable than the interesterified product, and therefore preferable.

Source : JAOCS, 71(10),1994
Contributed by Johari Minal

Suppository Materials from Palm Products

Suppositories are usually made with Theobroma oil (cocoa butter) as it satisfies various requirements. However, it is expensive and a cheaper substitute would be most welcome. Dr Ooi Tian Lye and co-workers in PORIM have investigated the use of palm oil fractions and cocoa butter substitute made from palm kernel oil as potential substitutes. They found that the dissolution rates of two drugs—sulphatizol and salicyclic acid—contained in palm-based suppositories were faster than those of the same drugs from cocoa butter and Witepsol (another established suppository base).

Source : Elaeis 6(2), 1994
Contributed by M Nasir Basri

Trisyl Improves Colour Stability of Refined Palm Oil

In the physical refining of crude palm oil, earth bleaching is one of the basic steps. The amount of bleaching earth required depends on its activity. If this is high, less bleaching earth is needed to obtain the final product. Siew Wai Lin and her team from PORIM have discovered that the use of silica (Trisyl) in combination with bleaching earth can facilitate the subsequent processes and produce better RBD palm oil.

The addition of as little as 0.06% of Trisyl to the bleaching earth improved the colour of the refined palm oil produced. It could be further improved by as much as 1.7 Red Lovibond units by using more Trisyl, e.g. 0.12 per cent. In addition, better colour stability was obtained. The level of phosphorus in the refined oil was also reduced twofold, to about 17.5 ppm (from 36 ppm without Trisyl). Addition of Trisyl also helped to reduce filtration time, thus leading to higher throughput in refining.

Source : JAOCS 71(9), 1994
Contributed by Johari Minal

PORIM to Commercialise Rapid Test Methods by 1998

Rapid methods for analysis of samples are often crucial in sophisticated present-day business operations. Methods should not only be rapid but also cost-effective in the sense of using minimal amounts of chemicals, and they should, as far as possible, avoid the use of toxic or polluting substances.

With the growing production of palm oil, there will be an increasing throughput of palm oil and products at mills and refineries. Rapid quality tests would contribute to speeding up operations and increasing efficiency. Realizing that better alternatives to the conventional test methods are important, PORIM is now developing rapid methods for quality tests on palm oil using Near Infrared Spectroscopy (NIRS). The methods are expected to be ready for commercialization by 1998.

For almost two decades NIRS methods have been in use in the form of diffuse reflection measurements for the analysis of agricultural products. Experience has shown that results from NIRS are reliable and repeatable, and useful for efficient quality and process control and rapid decision-making.

Since preparation of samples for NIRS is simple, no chemicals are required and the procedure is rapid, it has become widely used in the determination of quality parameters in food, grains, feeds, oilseeds and pharmaceutical and medical products. In the grain industry, it has been used for rapid determination of oil, protein and moisture content. In most cases, the precision was markedly better than that of conventional chemical methods. In addition, NIRS calibration is stable whereas some chemical methods need periodical recalibration. Other advantages are that NIRS allows non-destructive and simultaneous multiple analyses which could hardly be performed by chemical methods.

NIRS could be used to determine the moisture and oil content in palm fruits and spent fibre and bleaching earth as well as iodine value, moisture, free fatty acid, peroxide value and Deterioration of Bleachability Index (DOBI) in palm oil.

NIRS is categorized as a secondary measurement and it depends on established chemical methods (wet analysis) to supply data for calibration by multivariate analysis. The accuracy of an NIRS procedure will depend on the accuracy of data entered and the reliability of the method used.

In conclusion, NIRS appears to offer a better alternative to existing analytical methods since it is rapid, simple in sample preparation, non-destructive, uses no chemicals, and is environment-friendly. Development in the area is rapid and on-line monitoring by NIRS should become possible in the palm oil industry.

Contributed by Muhammad Nor Omar

ANNOUNCEMENT

The 50th (Golden Jubilee) Annual Convention of the Oil Technologists' Association of India (OTAI) will be held from 19 - 22 December, 1995 at Nehru Centre, Worli, Bombay, along with an International Seminar on Challenges Facing Fats, Oleochemicals and Surfactants in the 21st Century.

The seminar will discuss various current technological developments, which may eventually shape the industry in the next century.

Among topics proposed are the following:

- Oilseed scenario
- Biotechnology and enzyme engineering
- Margarines, spreads and shortenings
- Environmental and safety aspects
- Biochemistry and nutrition
- Quality management and assurance
- Energy conservation
- Newer oleochemicals
- Recent trends in detergent formulations
- Surfactants and specialty chemicals

Abstracts of papers based on technical, regulatory and environmental aspects of the above topics are invited. Presentation of papers can be in the form of lectures or poster sessions. The last date for the submission of abstracts is 30 June 1995. Authors will be informed about acceptance at the latest by 31 August, 1995.

An exposition, planned for 20-22 December, 1995 at the same venue will provide an opportunity for the suppliers of equipment and services to discuss their products with visitors.

For further information regarding submission of abstracts, the seminar programme, registration procedure, the exposition, spouses' programme, etc. please write to :

The Organizing Secretary
(Seminar'-95 & Expo)
Oil Technologists' Association of India (Western Zone)
C/O Dr D.N. Bhowmick
Division of Oils, Fats & Waxes
Department of Chemical Technology
University of Bombay
Matunga, Bombay 400 019
India

Tel (91-22) 4146526
Fax (91-22) 4145614

IN BRIEF

New ISO 14000 Standards

William D. Hickman commenting on the new ISO 14000 environmental, rules in the *Journal of Commerce* for October 1994, said that the standards could be costly as exporters will have to adapt to new systems covering environmental management, auditing, performance evaluation and life cycle analysis. Worse still, exporters have to pay third parties to certify them. Whether the standards help the growth of international trade is disputable but it is obvious that the certification increases costs and therefore constitutes a non-tariff barrier.

On the other hand, the emergence of multinational corporations and rapid advances in technology increase the need for a basic set of standards. GATT, for example, encourages the use of standards because they make international trade easier.

Looking at the trend of international trade, it is inevitable that exporters sooner or later will have to comply with the new ISO 14000 standards in order to remain competitive in the world market.

Source : Journal of Commerce, 1994

We invite readers to send in comments, suggestions and technical news which could be published in this newsletter.

For more information please contact :
Dr. Hamirin Kifli
Tel : 03-8259155/775
Tlx : MA 31609
Fax : 03-8259446