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Present and Prospective Development in the Palm Oil Processing Industry

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ABSTRACT

Malaysia, the leading producer of palm oil, is now also the major producer and exporter of processed palm oil (PPO). Since 1977 she has been exporting PPO in increasing amounts. As a result about 50% of world production of palm oil is now traded as PPO in the international market.

Currently, Malaysia has processing capacity far exceeding her production of crude palm oil. Guaranteed capacities for physical refining, fractionation and chemical neutralization are 12,075, 9,940 and 4,949 metric tons (MT) per day, respectively. These can be increased to 16,285, 12,705 and 6,170 MT per day, respectively, by some modification and rationalization. Thus Malaysia is geared to cope with increased production of PPO at least up to 1990.

The PPO products exported are the results of primary down streaming of crude palm oil. The production and export of these products are very well established. The emphasis is now on further down-streaming of PPO products into specialized products such as food ingredients, nonfood applications and finished products such as shortenings, margarines, cocoa butter replacer fats and oleochemicals both for local consumption and export. By the end of the decade, Malaysia is likely to become a center for the manufacture of basic oleochemicals and their derivatives.

INTRODUCTION

Palm oil had a tremendous growth during the past decade and as a result is now playing an increasingly important role in the world oils and fats trade. It is now the second largest vegetable oil, after soybean oil, both in terms of world production and export.

The bulk of palm oil is produced in a number of Southeast Asian and Pacific Basin countries, notably in Malaysia and Indonesia. In order to increase the domestic added value and also to open new markets for palm oil, substantial resources have been invested in processing industry.

Malaysia, the leading producer of palm oil, is now also the major producer and exporter of processed palm oil (PPO). Since 1977 she has been exporting PPO in increasing amounts. Consequently, in 1984 about 41% of world production and about 66% of world export of palm oil was traded as PPO in the international market.

Before Malaysian export of PPO there was no established international trade in fully processed edible oils and fats, and most of the oils and fats were traded in crude form. The steps taken by Malaysia have had a great impact on almost all activities (such as trading contracts, surveying, shipping, bulk storage) involved in this established trade. These steps have also consolidated her position not only as one of the leading producers of edible oils and fats but also as a major exporter of processed edible oils and fats in the international market. She is likely to keep this position because of the dynamic nature of the industry and also the understanding and cooperation which exist between the policy makers and the palm oil industry in this country. Both the policy makers and the palm oil industry have been able to anticipate and respond to the demand, the competitive nature of the edible oils and fats market and the new technology to improve their competitive position.

Because of Malaysia's leading position and dynamic nature, the current situation and the prospective developments in the Malaysian industry will accurately reflect the current situation and development in the palm oil processing industry on a global basis. This paper will discuss the palm oil processing industry in Malaysia.

PROCESSING TECHNOLOGY

The edible oil processing industry has never been a "high technology" industry. Many basic processes, such as extraction, refining, bleaching, deodorization, hydrogenation, interesterification, fractionation, etc. go back decades. Much of the progress affecting the world edible oil processing industry originated in other sectors of the economy, especially the chemical industry, government and private sector research and development organizations, equipment designers and suppliers.

The above is also true for the palm oil processing industry in Malaysia, where the technology of processing crude palm oil (CPO) was supplied by the equipment suppliers. The technology provided by these sources is based on the existing established technology used in the developed countries for processing edible oils and fats. The technology in some cases was modified either by the equipment suppliers or by the local refiners to suit palm oil and also to increase efficiency.

The palm oil processing industry in Malaysia is based on two basic technology groups: refining and fractionation. These two technologies have enabled the industry to offer up to 14 types of partially and fully processed products of CPO to the world market (Table I).

Refining

Most of the refining plants installed in the early 1970s were of conventional type, consisting of a chemical neutralization section, an earth bleaching section and a steam deodorization section. By the late 1970s the industry realized the economic benefit of the physical refining process. Consequently, all the new refineries installed during this period as well as some old ones incorporated a physical refining plant. In 1984, out of 51 refineries already installed 46 refineries have physical refining plants. Twenty-two refineries have kept or included chemical neutralization section in order to enlarge their product range.

In Malaysia, the technology of refining plants can be

TABLE I

Processed Palm Oil Products (PPO) Offered by the Industry

Palm Oil (PO)

1. Neutralized (NPO)
2. Neutralized & bleached (NB PO)
3. Neutralized, bleached & deodorized (NBD PO)
4. Refined, bleached & deodorized (RBD PO)

Palm olein (POo)

5. Crude (CPOo)
6. Neutralized (NPOo)
7. Neutralized & bleached (NB POo)
8. Neutralized, bleached & deodorized (NBD POo)
9. Refined, bleached & deodorized (RBD POo)

Palm stearin (POs)

10. Crude (CPOs)
11. Neutralized (NPOs)
12. Neutralized & bleached (NBPOs)
13. Neutralized, bleached & deodorized (NBD POs)
14. Refined, bleached & deodorized (RBD POs)

Byproducts

15. Palm acid oil
16. Palm fatty acid distillate
17. Flaked stearic acids (rubber grade)

grouped into three categories:

1. *Physical refining plants* consist of a pretreatment section (degumming and bleaching) and a steam refining section (thermal bleaching, deacidification and deodorization). Such refineries produce fully refined, bleached and deodorized (RBD) products only.

2. *Integrated plants* consist of a neutralization (chemical) section and a physical refining section such as described in category (1). Apart from RBD products, such refineries also produce neutralized (N) products, neutralized and bleached (NB) products and neutralized, bleached and deodorized (NBD) products.

3. *Conventional plants* consist of a neutralization (chemical) section, a bleaching section and a steam deodorization section. Such plants produce N, NB and NBD products.

The plants in the three categories, the types of the products which can be made in them and their respective capacities are shown in Figure 1.

The common physical refining and neutralization plants installed in Malaysia are given in Tables II and III, respectively. Most of these plants incorporated the latest technology and have been operating successfully.

Fractionation

The fractionation industry in Malaysia is based on three

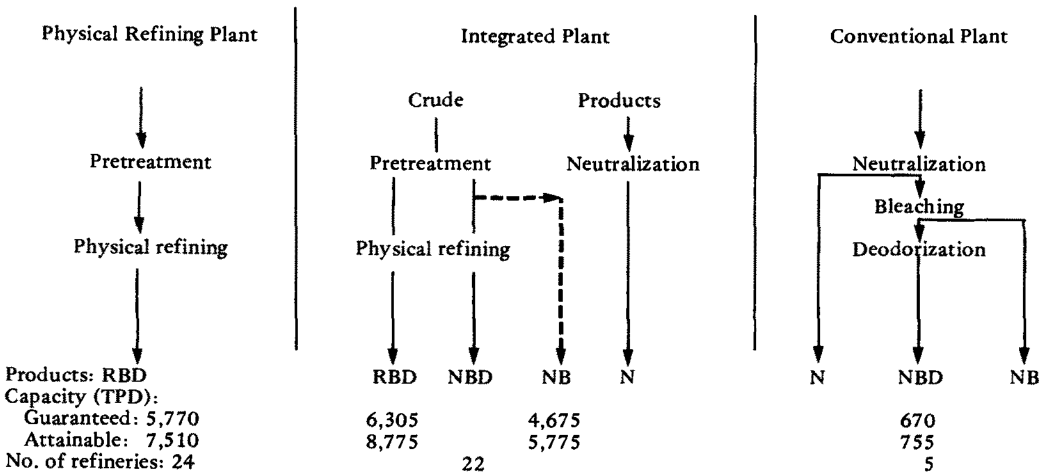

FIG. 1. Types of refining plants in Malaysia.

TABLE II

Physical Refining Plants Installed

No.	Equipment	No. of plants	Capacity (TPD) Guaranteed	Capacity (TPD) Attainable
1.	Alfa-Laval (Sullivan), Sweden	10	2,195	2,650
2.	CMB, Italy	1	100	150
3.	DeSmet, Belgium	7	1,960	3,045
4.	EMI, U.S.A.	5	1,920	2,180
5.	Feld and Hahn, Germany	2	290	395
6.	Gianazza, Italy	1	120	145
7.	Japan Gasoline Co., Japan	1	240	290
8.	Lurgi, Germany	10	2,340	3,400
9.	Yashino Seisakusho, Japan	1	460	550
10.	Unknown	11	2,450	3,480
	Total	49	12,075	16,285

TABLE III

Neutralization Plants Installed

No.	Equipment	No. of plants	Capacity (TPD) Guaranteed	Attainable
1.	Alfa-Laval, Sweden	13	2,520	3,095
2.	Pellerin Penith, Sweden	1	95	100
3.	Sharpel, India	1	25	30
4.	Westfalia, Germany	6	1,220	1,675
5.	Unknown	7	1,085	1,270
	Total	28	4,945	6,170

fractionation technologies:

- Dry fractionation (winterization)
- Detergent (wet, Lanza) fractionation
- Solvent fractionation.

The government has encouraged the industry to fractionate palm oil by giving tax incentives. Fractionation, therefore, has become an integral part of the processing industry.

The dry fractionation process is claimed to be the cheapest in terms of cost per unit of oil fractionated, followed by the detergent process. Solvent fractionation, on account of high cost of organic solvents, is the most expensive process. Some of the higher production costs in detergent fractionation process are compensated for by the higher yield of the high premium fraction, olein. The average yields of olein obtained by the three processes are:

Dry fractionation	60-65%
Detergent fractionation	70-80%
Solvent fractionation	70-80%

Both the detergent and solvent fractionation processes are more flexible and give cleaner and purer separation of the fractions than does dry fractionation, where a substantial amount of olein is trapped in the stearin crystals. As a result, the stearin produced by the dry process is softer and has a higher iodine value.

Most of the solvent fractionation plants, especially the ones based on hexane, have been shut down due to the high cost of production. Solvent plants using acetone are being used to make high-premium midfraction from palm oil.

In order to obtain higher yields of olein, one refiner has replaced the drum and belt filter with a press-filter in the dry fractionation process. It is claimed that this gives a yield of olein equivalent to the detergent fractionation process and produces a drier stearin.

Almost all the refiners in categories A, B and few refiners in category C have one or two types of fractionation plants working in conjunction with their refining plants. This has enabled them to produce processed fractions in addition to processed palm oil. The common fractionation plants installed in Malaysia are shown in Table IV.

PROCESSING CAPACITY

Malaysia's first refinery was approved in 1973. The Malaysian government had approved about 68 applications by November 1978. Thereafter, the government imposed a freeze on all future approvals, except under special circumstances. Some of the approved refiners, according to the latest Malaysian Investment Development Authority (MIDA) estimates, have surrendered their approvals, leaving 57 approved applications, of which 51 already have been implemented. Recent estimates of the total processing capacity, based on CPO input, approved by MIDA, are given in Table V.

The number of actual operational days also will affect the above capacities. While the general practice in the manufacturing industry is to operate for 300 working days, Malaysian refiners use modern plants made for continuous operation. From contacts with a number of refineries, it is estimated that the plants are operated between 330-350 days.

In general, any one of the following definitions can be used to quantify the output of the industry:

1. *Approved Capacity:* Output and input approved by the officials in the licenses given.

2. *Guaranteed Capacity:* Output or input of the plant installed, guaranteed by the manufacturers. Changes in the agreed specifications for either the feedstock or the final product, or both, will change the guaranteed capacity.

3. *Maximum Operated Capacity:* Excess capacity available beyond the guaranteed capacity. Plant manufacturers, as a matter of safety, built 10-20% capacity in excess of the guaranteed capacity.

4. *Maximum Attainable Capacity:* Capacity achieved beyond the guaranteed and/or maximum operated capacity after modifying the plant.

From the points of view of trend and potential of the industry, approved capacity has very little relevance. More

TABLE IV

Fractionation Plants Installed

No.	Equipment	Methods	No. of plants	Capacity (TPD) Guaranteed	Max. operational
1.	Alfa-Laval, Sweden		21	4,425	5,945
2.	CMB, Italy		7	730	970
3.	DeSmet, Belgium		4	850	1,260
4.	Feld and Hahn, Germany		1	145	170
5.	Tirtiaux, Belgium		6	1,925	2,340
6.	Yashino Seisakusho, Japan		1	120	130
7.	Unknown		12	1,745	2,340
	TOTAL		52	9,940	12,705
		Dry fractionation	12	3,020	3,920
		Solvent fractionation			
		Hexane	6[a]	630	820
		Acetone	1	120	130
		Detergent fractionation	21	4,425	5,945
		Unknown	12	1,745	2,340

[a]Closed down due to the high cost of operation.

TABLE V

Capacity Estimates by MIDA (Based on CPO Intake)

Status	No. of plants	Capacity (TPD)	Annual CPO requirement (million tons)		
			360 days	340 days	300 days
Approved	57	16,851	6.066	5.729	5.055
Not implemented	6	838	0.302	0.285	0.251
Implemented (installed)	51	16,013	5.765	5.444	4.804

TABLE VI

Capacity Estimates: The Industry (Based on CPO Input)

Status	No. of plants	Capacity (TPD)	Annual CPO requirement (million tons)		
			360 days	340 days	300 days
1. Physical refining	49				
(i) Guaranteed		12,075	4.347	4.106	3.623
(ii) Attainable		16,285	5.863	5.537	4.886
2. Fractionation	52				
(i) Guaranteed		9.940	3.578	3.380	2.982
(ii) Attainable		12.705	4.579	4.320	3.812
3. Neutralization	28				
(i) Guaranteed		4,945	1.780	1.681	1.484
(ii) Attainable		6,170	2.221	2.098	1.851

TABLE VII

Annual CPO Requirements Based on the Capacity Estimated by the Industry

Operational status	Annual CPO requirements (million tons)		
	360 days	340 days	300 days
Physical refining fractionation and neutralization units working independently			
(i) Guaranteed	9.705	9.167	8.089
(ii) Attainable	12.608	12.055	10.851
Physical refining and fractionation units working in sequence, neutralization unit working independently			
(i) Guaranteed	6.127	5.787	5.107
(ii) Attainable	8.084	7.635	6.737
Physical refining unit working independently, fractionation and neutralization units working in partial sequence			
(i) Guaranteed	7.925	7.486	6.605
(ii) Attainable	10.437	9.857	8.698
Physical refining, fractionation and neutralization units working in partial sequence			
(i) Guaranteed	4.347	4.106	3.623
(ii) Attainable	5.863	5.537	4.886

relevant is the current and future capability of the industry to make different types of products and the volume the industry is able to produce. This is indicated by the types and capacities of the plants, both guaranteed and attainable, already installed.

Guaranteed and attainable capacities of physical refining, neutralization and fractionation plants which have already been installed in Malaysia are shown in Table VI. Some of these plants have stopped operation due to one reason or the other. Their capacities are still available.

In the industry, however, the three processing plants, i.e., physical refining, neutralization and fractionation, are either operated independently of each other or in partial sequence as shown in Table VII. The way the units are operated will also affect the type of the products made in them as well as the total CPO requirements.

It is obvious from Table VII that, even based on 300 working days, CPO requirements can vary from 3.6-8.1 million tons, depending on the operational status of the three units. From the types and volume of various processed products exported by the industry (Table VIII) it is obvious that status B, i.e., physical refining and fractionation plants working in sequence and neutralization plant working independently, is the status mostly used by the industry.

From the magnitude of the capacity already installed, one can safely conclude that the industry will be able to process forecast increases in production of CPO at least up to 1980, when the production of CPO is estimated to be around 5.6 million tons.

Table IX shows the capacity distribution of physical refining, neutralization and fractionation plants.

Physical refining plants: Total guaranteed and attainable

TABLE VIII

Export of PPO from Malaysia

Products	Crude (CP) %T_1	Crude (CP) Tons	Crude (CP) %T_2	Neutralized %T_1	Neutralized Tons	Neutralized %T_2	Neutralized-bleached %T_1	Neutralized-bleached Tons	Neutralized-bleached %T_2	N.B.D. %T_1	N.B.D. Tons	N.B.D. %T_2	R.B.D. %T_1	R.B.D. Tons	R.B.D. %T_2	Total (T_2) Tons	Total (T_2) %T_1	Refining loss Total PPO CP (tons)	Refining loss %
1978																			
Palm oil	79.2	574,002	58.9	84.7	157,922	16.2	70.4	10,038	1.0	37.8	138,906	14.2	58.4	94,459	9.7	975,327	67.1	–	–
Palm olein	1.5	10,725	3.5	0.4	621	0.2	6.0	854	0.3	61.7	226,655	74.3	40.9	66,198	21.7	305,053	21.0	–	–
Palm stearin	19.3	139,846	80.4	14.9	27,827	16.1	23.6	3,363	1.9	0.5	1,796	1.0	0.7	1,095	0.6	173,927	11.9	–	–
Total (T_1)	100.0	724,573	49.8	100.0	186,370	12.8	100.0	14,255	1.0	100.0	367,357	25.3	100.0	1,161,752	11.1	1,354,307	100.0		
Acid oil/PFAD																61,532		729,734	8.4
1983																			
Palm oil	0.4	251	–	94.2	122,074	8.5	91.2	27,270	1.8	21.1	10,355	0.7	51.2	1,276,561	89.0	1,435,511	51.8		
Palm olein	11.3	7,643	0.8	5.2	6,697	0.7	7.0	2,028	0.2	76.9	37,775	3.8	37.6	928,931	94.5	993,074	35.9		
Palm stearin	88.3	59,468	17.5	0.6	784	0.2	1.8	511	0.1	2.0	1,015	0.3	11.2	278,723	82.0	340,501	12.3		
Total (T_1)	100.0	67,362	2.4	100.0	129,555	4.7	100.0	28,809	1.0	100.0	49,145	1.8	100.0	2,494,215	90.1	2,769,086	100.0		
Acid oil/PFAD																N/A		2,701,724	N/A

%T_1 = % of the product volume; %T_2 = % of all the product volume.

TABLE IX

Capacity Distribution

Capacity (TPD)	Physical refining Refiners No.	Physical refining Refiners %	Physical refining Total capacity Guaranteed TPD	Physical refining Total capacity Guaranteed %	Physical refining Total capacity Attainable TPD	Physical refining Total capacity Attainable %	Fractionation Refiners No.	Fractionation Refiners %	Fractionation Total capacity Guaranteed TPD	Fractionation Total capacity Guaranteed %	Fractionation Total capacity Attainable TPD	Fractionation Total capacity Attainable %	Neutralization Refiners No.	Neutralization Refiners %	Neutralization Total capacity Guaranteed TPD	Neutralization Total capacity Guaranteed %	Neutralization Total capacity Attainable TPD	Neutralization Total capacity Attainable %
0 - 50	0	–	–	–	–	–	4	8.5	170	1.7	210	1.7	4	14.3	120	14.3	140	2.3
51 - 100	7	15.2	680	5.6	1135	7.0	11	23.4	1055	10.6	1690	13.3	5	17.9	425	8.6	505	8.2
101 - 150	4	8.7	570	4.8	775	4.8	6	12.8	830	8.4	955	7.5	6	21.4	760	15.4	1010	16.4
151 - 200	14	30.4	2745	22.6	3410	20.9	10	21.3	1960	19.7	2575	20.7	6	–	1200	24.3	1520	24.6
201 - 250	4	8.7	950	7.8	1140	7.0	2	4.3	500	5.0	850	6.7	0	–	–	–	–	–
251 - 300	4	8.7	1140	9.4	1795	11.0	5	10.6	1470	14.8	1745	13.7	4	14.3	1200	24.3	1510	24.6
301 - 350	1	2.2	340	2.8	410	2.5	2	4.3	670	6.7	805	6.2	0	–	–	–	–	–
351 - 400	6	13.0	2400	19.9	3550	21.8	4	8.5	1585	16.0	1955	15.3	2	7.1	760	15.4	910	14.7
401 - 450	1	2.2	450	3.8	550	3.4	0	–	–	–	–	–	0	–	–	–	–	–
451 - 500	2	4.3	960	8.0	1370	8.4	1	2.1	480	4.9	574	4.4	1	3.6	480	9.6	575	9.3
501 - 550	1	2.2	520	4.4	625	3.9	0	–	–	–	–	–	0	–	–	–	–	–
551 - 600	0	–	–	–	–	–	1	2.1	580	5.8	695	5.5	0	–	–	–	–	–
601 - 650	1	2.2	640	5.3	770	4.7	1	2.1	640	6.4	650	5.0	0	–	–	–	–	–
651 - 700	1	2.2	680	5.6	750	4.6	0	–	–	–	–	–	0	–	–	–	–	–
TOTAL	46	100.0	12,075	100.0	16,285	100.0	47	100.0	9,940	100.0	12,075	100.0	28	100.0	4,945	100.0	6,170	100.0

capacities are 12,075 and 16,285 tons per day (TPD), respectively; 75% have capacities above 150 TPD with the most prevalent capacity between 150-200 TPD. About 30% of the refineries have capacity in this range.

Neutralization plants: The total guaranteed and attainable neutralization capacities are 4,945 and 6,170 TPD, respectively; 66% have neutralization capacities above 150 TPD. The most prevalent capacity is 100-150 TPD.

Fractionation plants: The total guaranteed and attainable fractionation capacities are 9,940 and 12,705 TPD, respectively; 66% have fractionation capacities above 150 TPD and the most prevalent capacity is 150-200 TPD.

Capacity Utilization

There is no production data of individual refineries available from which the capacity utilization could be calculated. Export data, however, is readily available. Some idea of capacity utilization can be derived from this data for 1983.

1. *Physical refining*	
Total RBD/NBD products exported	2,543,360 tons
Physical refining capacity (guaranteed)	12,075 TPD
Utilization	149 days
2. *Fractionations*	
Total fractionation products exported	133,575 tons
Fractionation capacity (guaranteed)	9,940 TPD
Utilization	135 days
3. *Neutralization*	
Total N, NB and NBD products exported	207,509 tons
Neutralization capacity (guaranteed)	4,945 TPD
Utilization	42 days

Domestic disappearance of PPO is around 200,000-300,000 tons/yr. Even after taking this into account the capacity utilization of the industry is still alarmingly low.

PROCESSED PALM OIL PRODUCTS

Table VIII shows the types and the amount of PPO exported by Malaysian refiners. In 1978 about 50% of the palm oil products was exported as crude oil. In 1983 the export pattern changed in favor of RBD products. Only 2.4% of the products were exported in crude form and about 90.1% as RBD products, consisting of RBD PO (51.8%), RBD olein (35.9%) and RBD stearin (12.3%).

The ratios of PO products and the fractionated PO products, i.e., stearin and olein, exported from 1978-83 are:

Year	Ratio PO/Olein and Stearin
1978	2.91
1979	0.90
1980	0.56
1981	0.82
1982	0.80
1983	1.07

From 1979-1982 more fractionated PO (olein, stearin) was exported than PO. In 1983 it was slightly more in favor of PO. This indicates the flexibility of the industry to switch over to different products in response to changes in demand for various processed palm oil products.

Because of the export duty rebate, the fractionation of palm oil is more attractive to the refiners when the CPO/ PPO prices are high. At low CPO prices, i.e., below M$ 740.00/ton, there is no duty payable on any of the PPO products. Therefore, the utilization of fractionation capacity depends not only on the demand for fractionated products but also on the prices of CPO.

It is clear from this and the export performance of PPO products by the industry that the processing of CPO is now very well established in Malaysia. It has now developed to a stage where all CPO produced locally is processed into various grades of primary products. There products are mainly exported, with a small amount used for local consumption.

All the primary products are produced and exported by the industry according to the Palm Oil Refiners Association (PORAM) specifications given in Table X and sometimes according to specifications agreed to by buyers and refiners.

Increasing amounts of palm kernels are also being crushed locally and the products, PKO and cakes, exported (Table XI).

FURTHER PROCESSING OF PPO

As a first stage of the policy of local processing of CPO, Malaysia positively encouraged refining and fractionation. This she achieved in a short time. The next logical step being considered by the industry and also encouraged by the government is to engage in further processing of PPO into higher added-value edible and nonedible downstream products.

In general, the higher the level of technology and the number of processing steps required to make the product, the higher is the added value. The production of such products also becomes more capital intensive and marketing becomes more complicated.

Below are listed fat-based products which can be made wholly or partly from palm and palm kernel oil:

Edible Products

Fats/Oils for cooking
- Liquid cooking oil
- Cooking fats
- Vanaspati

Fats for bakery products
- Bread dough shortening
- Biscuit and short pastry shortening
- Puff pastry margarine
- Cake shortening

Table margarine
- Packet margarines
- Soft tube margarine
- PUFA margarine

Specialty fats
- Cocoa butter replacers
- Other specialty fats

Nonedible Products
- Soap
- Oleochemicals

Edible Products

In most of the above edible applications palm and palm kernel oil, either for technological or economic reasons, have to be modified into oils and fats having physicochemical characteristics required for such applications. The modification processes generally used are fractionation, hydrogenation, interesterification and blending.

Already three or four refiners are exporting special fractions of palm oil (PMF, low cloud point olein). No data is as yet available as to the amount of these exports.

Currently only 8 or 10 Malaysian refiners have hydrogenation plants with a total capacity of around 200-250 TPD. Four refiners are using these plants to make products for the local market. Others are hardening fatty acids for the local and export market.

TABLE X

General Specification of Processed Palm Oil Products

1. Neutralized palm oil	[a]FFA (as palmitic)	0.25% max.
	M & I	0.1% max.
	I.V. (Wijs)	50 - 55
	[b]M. Pt. (AOCS Cc 3-25)	33 - 39
2. Neutralized, bleached palm oil	[a]FFA (as palmitic)	0.25% max.
	M & I	0.1% max.
	I.V. (Wijs)	50 - 55
	[b]M. Pt. (AOCS Cc 3-25)	33 - 39
	Color (5¼" Lovibond cell)	20 red max.
3. Refined, bleached and deodorized (RBD)/ neutralized, bleached and deodorized (NBD) palm oil	[a]FFA (as palmitic)	0.1% max.
	M & I	0.1% max.
	I.V. (Wijs)	50 - 55
	[b]M. Pt. (AOCS Cc 3-25)	33 - 39
	Color (5¼" Lovibond cell)	
4. Crude palm olein	[a]FFA (as palmitic)	5.0% max.
	M & I	0.25% max.
	I.V. (Wijs)	56 min.
	[b]M. Pt. (AOCS Cc 3-25)	24 C max.
5. Neutralized palm olein	[a]FFA (as palmitic)	0.25% max.
	M & I	0.1% max.
	I.V. (Wijs)	56 min.
	[b]M. Pt. (AOCS Cc 3-25)	24 C max.
6. Neutralized, bleached palm olein	[a]FFA (as palmitic)	0.25% max.
	M & I	0.1% max.
	I.V. (Wijs)	56 min.
7. Refined, bleached and deodorized (RBD)/ neutralized, bleached and deodorized (NBD) palm olein	[a]FFA (as palmitic)	0.1% max.
	M & I	0.1% max.
	I.V. (Wijs)	56 min.
	[b]M. Pt. (AOCS Cc 3-25)	24 C max.
	Color (5¼" Lovibond cell)	3 or 6 red max.
8. Crude palm stearin	[a]FFA (as palmitic)	5.0% max.
	M & I	0.25% max.
	I.V. (Wijs)	48 max.
	[b]M. Pt. (AOCS Cc 3-25)	44 C min.
9. Neutralized palm stearin	[a]FFA (as palmitic)	0.25% max.
	M & I	0.15% max.
	I.V. (Wijs)	48 max.
	[b]M. Pt. (AOCS Cc 3-25)	44 C min.
10. Neutralized, bleached palm stearin	[a]FFA (as palmitic)	0.25% max.
	M & I	0.15% max.
	I.V. (Wijs)	48 max.
	[b]M. Pt. (AOCS Cc 3-25)	44 C min.
	Color (5¼" Lovibond cell)	20 red max.
11. Refined, bleached and deodorized (RBD)/ neutralized, bleached and deodorized (NBD) palm stearin	[a]FFA (as palmitic)	0.2% max.
	M & I	0.15% max.
	I.V. (Wijs)	48 max.
	[b]M. Pt. (AOCS Cc 3-25)	44 C min.
12. Palm acid oil	Total fatty matter	95% min. (basis 97%)
	M & I	3% max.
	[a]FFA (as palmitic)	50% min.
13. Palm fatty acid distillate	Saponifiable matter	95% min. (basis 97%)
	M & I	0.5% max.
	[a]FFA (as palmitic)	70% min.
14. Flaked stearic acid (rubber grade)	Acid value	200 - 208
	Sap. value	202 - 210
	I.V. (Wijs)	8 max.
	Titer	53 C min.
	Color (5¼" Lovibond cell)	4R, 30Y max.
	U.S.M.	3% max.
	Neutral fat	3% max.

[a]Slip point, softening point or rising point.
[b]Molecular weight of palmitic acid is taken as 256.

TABLE XI

Production and Export of Palm Kernel Products

		Palm kernel oil		Palm kernel cake	
Year	Palm kernel production (tons)	Production (tons)	Export (tons)	Production (tons)	Export (tons)
1980	550,000	227,306	218,937	316,719	359,593
1981	590,000	243,354	242,145	339,107	266,307
1982	910,000	336,976	333,439	444,155	395,911
1983	840,000	372,079	361,859	477,028	454,284

Three refiners have interesterification plants. These are used to produce fats for margarine and shortening for the local market. Hardly any hydrogenated and/or interesterified palm oil products are being exported from Malaysia. Hydrogenation of palm kernel oil products is also being done by the refiners for the export and local markets. The amount of these products exported, however, is very small.

Since the four technologies employed in the production of downstream products are simple to adopt and can be incorporated without difficulty into the existing refineries, it is expected that the future development in the palm oil processing industry in Malaysia will be in the export of interesterified, hydrogenated, fractionated and possibly blended products. The products will be based mainly on palm and palm kernel oils. However, where economically feasible, products containing other vegetable oils will also be made and exported. Inclusion of other vegetable oils may become necessary due to economic and/or technical reasons.

Export of these products will not open new markets for palm oil and palm kernel oil but will be used by the markets where these two oils are already being used by the margarine and shortening manufacturers who may find it convenient and more economical to import them from Malaysia than importing the oils and making them in their own factories. In the long run, however, it may find new markets by replacing other oils and fats.

According to MIDA, 56 companies were given approval to make cooking oil, margarine, vanaspati, shortening, etc. Of these, the approvals of 14 firms have been withdrawn. Some of these refiners already have installed plants to produce some of these products, but in spite of the approval and the tax incentives, the production of these products has not progressed very much. Most of the plants installed are not being fully utilized for making products for export market. Only 3 to 4 refiners are producing margarines and shortenings for the local market.

In spite of government incentives, it is unlikely that a significant amount of PPO will be processed by the industry into downstream products, because of the following reasons.

Formulation. Most of the products are made from blends of different oils and fats. The blend imparts to the final product certain characteristics that are not readily attainable with any single oil or fat. Least cost formulation is also an important factor as the blend gives the manufacturers the flexibility to respond to the prices of oils and fats.

Malaysia is not a producer of other vegetable oils and therefore, to make most of the tertiary products, the industry has to import other vegetable oils. This would make export of these products less competitive or even more expensive than the products made in the importing countries from locally available oils and imported primary and/or secondary downstreaming products of palm and palm kernel oils.

Freight charges. The freight charges for bulk shipment of PPO are significantly lower than charges for shipping container loads of margarine and other emulsion-based products containing 20-60% water and nonfat ingredients. For every 100 tons of the products shipped as expensive container loads the refiners will be paying premium freight charges for carrying 20-60 tons of water which, of course, will not be incurred if the product is made in the importing country.

Tariff rates. To protect their industry, most countries have higher tariff rates for packed consumer products than PPO shipped in bulk.

Storage and handling facilities. Most of the above products, once made, have to be kept at constant temperature in order to maintain their organoleptic properties and also their performance in the final products, e.g., cake, puff pastry, etc. This will require facilities for constant temperature not only during the shipment but also during storage, both at the forwarding and receiving ports, and also before distribution to the customers. As yet, Malaysia has not been able to find ideal storage and handling facilities for her PPO in a number of developed and developing countries.

Product shelf life. Most buyers keep an inventory of these products for not more than 3 or 4 weeks. In most cases they receive their supplies on a week-to-week basis. Most developed countries, major markets for the products, now require declaration of both the manufacturing and expiration dates on the label. Because of the long supply line between Malaysia and the markets, most of these products will already be 4 to 12 weeks old. In most countries, if the expiration date already has passed or the quality of the products is not acceptable to consumers, these are taken back by the manufacturers who reprocess them and/or blend them with the fresh batch of the products.

Legislation. Most countries have national legislation covering production, marketing, quality, labeling, etc., of most of these products to which products exported from Malaysia must conform. For example, in India, vanaspati can only be marketed if made from oils listed in the legislation. In Australia, puff pastry margarine must contain edible tallow. Labeling requirements in the U.S.A. and E.E.C. are elaborate. The packed products marketed to these countries have to conform with national labeling requirements. This involves printing different package labels for each country importing the products and as such involves extra cost.

Research and development facilities. Formulation and production of these products require high R & D inputs to translate the consumer's requirements into products at a price that the consumer is willing to pay and that covers all costs and overheads, leaving reasonable profit for the company. Unfortunately, because of a tight profit margin, Malaysian industry has not been able to invest in such R & D facilities. The laboratory and technical staffs currently employed by the industry are involved mostly in production and quality control activities. They have little or no experience in development and production of downstream products. The situation is not likely to change unless the refiners' profit margins improve.

To overcome these difficulties, some Malaysian refiners may establish facilities for making some products from PPO imported from Malaysia. These might be in important countries either independently or in collaboration with the local refiner or food manufacturer. Two Malaysian refiners have already established such facilities in the U.K. and U.S.A.

Palm and palm kernel oil products are the major fats used for making cocoa butter replacers (CBR) and some other specialty fats, e.g., coffee whitener, spray fat, etc. This is the area where Malaysian industry may make and export downstream products, since as the major producer of two oils they are in an advantageous position.

Palm-mid-fraction (PMF) is one of the major components used in the formulation of cocoa butter equivalent (CBE). Good quality PMF can only be produced in a solvent fractionation plant. PMF produced in dry and detergent fractionation plants has to be refractionated to upgrade its quality for formulation of CBE.

There is only one solvent fractionation plant in Malaysia that is operating and producing good quality PMF. Another solvent fractionation plant is being commissioned and was expected to be operating by the end of 1984. Some refineries with dry fractionation plants also are producing crude PMF. The mid-fractions produced are being sold to the overseas CBE manufacturers. The only way refiners can get a good return on their high-quality PMF is to market it directly to overseas chocolate manufacurers. Locally available illipe fat, sal stearin imported from India and Malaysian cocoa butter could be used to blend with good quality PMF to produce a range of reasonable quality CBE, which can be marketed directly to chocolate manufacturers overseas. Using these three components, at least up to 5,000 tons of CBE can be produced in Malaysia.

In order to expand production of CBE, the refiners have to import other SOS-rich fats, e.g., shea, acetune, etc. from West Africa and Central America. The total amount of these fats available is also small and unpredictable. The refiners have to work hard to get a supply of these fats, as supply has already been monopolized by the established CBE manufacturers.

The total demand for CBE, in countries where 5% addition of CBE is allowed, is estimated to be around 38,000 tons. Once this rule is harmonized in the E.E.C., permitting other member countries to use CBE, an additional market for 45,000 tons of CBE will be created. The total market for CBE, excluding U.S.A., Canada and South America, is expected to be around 94,500 tons. On an average 70% PMF is used in the formulation of CBE. Therefore, to meet the above demand about 75,600 tons of PMF and about 18,900 tons of SOS-rich fats would be needed. Unfortunately, the availability of these fats in the world is not enough to meet this demand. To produce 75,600 tons of PMF, about 270,000 tons of palm oil have to be fractionated by the solvent fractionation process. Malaysian industry does not have enough solvent fractionation capacity to produce this amount.

The majority of cocoa butter substitute (CBS) on the market is based on lauric oils, mostly palm kernel oil. This is the market Malaysian industry may try to monopolize. The total market for these products is also larger than the CBE market. In U.S.A. alone the CBS market in the bakery industry alone could be up to 100,000 tons. This includes both lauric and nonlauric-based CBS.

Another potential market is for specialty fats for coffee whitener, filled milk, hard stock for margarine, spray fat, etc., based on interesterified blends of palm and palm kernel oil products.

All specialty fats are made to meet specific requirements and therefore, are tailor-made. Malaysian refiners have to change their infrastructure and attitude of producing and marketing high volumes of low-margin products to producing and marketing small batches of tailor-made high-margin specialty fats. To remain viable the industry may produce a range of specialty products rather than concentrating only on one or two specialty products such as PMF and P.K. stearin.

It seems that Malaysia will, at least for some time to come, only export those edible downstream products which are based on 100% palm and palm kernel oil, and to a lesser extent margarine packed in airtight containers, provided the price of palm oil remains competitive with other vegetable oils. However, the amount produced and exported will not be of significant volume in relation to the volume of PPO exported.

Nonedible Products

Soap and detergents. Approved and installed capacities in Malaysia for the production of soaps and detergents are given in Table XII. Six of the 11 approved licenses for manufacturing these products have been implemented. At least two of the six plants in operation are geared mainly for export.

Malaysian production and export of these products are shown in Table XIII. The total production and export is almost equally divided between soaps and detergent powder. About 20% production of laundry soap, 33% production of toilet soap and about 50% production of detergent powder are exported. During the last two years there has been a big upsurge in production of laundry soap.

Since most of the raw materials required for making these products are available in Malaysia at competitive prices, there is a chance to export large quantities of these products, especially soap in the form of chips or noodles, without added perfume or color.

Oleochemicals. Tallow and coconut oil are the most commonly used feed stock for the production of oleochemicals. Palm oil and palm kernel oil have fatty acid compositions similar to tallow and coconut oil, respectively.

Because of this substitutability, and also due to increased availability and competitive prices, especially of palm stearin, palm fatty acid distillate and palm kernel oil, Malaysian manufacturing of basic oleochemicals such as fatty acids for the export market has become very attractive. A number of international oleochemical manufacturers and local entrepreneurs either have already established or are in the process of establishing plants in Malaysia to manufacture basic oleochemicals from palm and palm kernel oil. Approval for the plants given by MIDA and capacities of the plants installed to date are given in Table XIV.

TABLE XII

Approved and Installed Annual Single Shift Capacity of Soap and Detergent Plants in Malaysia (1984)

Product	Existing (tons)	Approved (tons)
Detergent powder	90,000	130,000
Other detergent, e.g., liquid	16,500	22,000
Soap	16,500	26,000
Total	122,500	178,000

TABLE XIV

Oleochemical Plants—Approved and Installed (1984)

Product	Status	No. of plants	Capacity (tons/yr)
Fatty acids	Approved	6	305,510
	Installed	5	150,000
Glycerine	Approved	6	28,360
	Installed	5	15,000
Fatty alcohol	Approved	6	165,000
	Installed	Nil	Nil
Methylesters	Approved	2	86,000
	Installed	Nil	Nil
Alkanolamide	Approved	1	2,000
	Installed	Nil	Nil
Fatty amines	Approved	1	1,000
	Installed	Nil	Nil
Anionic surfactant	Approved	1	2,500
	Installed	Nil	Nil

TABLE XV

Production of Oleochemicals in Malaysia (tons)

Year	Fatty acids	Glycerine
1982	20,000	2,500
1983	60,000	6,500
1984	116,000	12,000

TABLE XIII

Production and Export of Soap and Detergent from Malaysia (1976-1983)

	Soap							
	Laundry		Toilet		Detergent powder		Total	
Year	Production	Export	Production	Export	Production	Export	Production	Export
1976	11,696	1,241	4,744	2,065	23,750	3,658	40,190	6,964
1978	10,863	917	5,875	1,531	26,518	4,581	42,756	7,026
1980	12,093	1,365	6,656	2,500	30,296	6,202	49,047	10,069
1982	15,717	359	7,885	2,920	21,579	N/A	45,181	N/A
1983	18,320	910	7,981	5,252	20,831	N/A	47,132	N/A

TABLE XVI

Projected World and Malaysian Production of Selected Oleochemicals (Thousand Tons)

Products	Year 1982	1985	1990	1995	2000
Fatty acids					
World (3.3% growth rate)	1641	1949	2315	2750	3266
Malaysia	20 (1.2%)	140 (7.2%)	250 (10.8%)	600 (21.8%)	900 (27.6%)
Fatty alcohol					
World (2% growth rate)	260	275	300	330	370
Malaysia	0	0	30 (10%)	60 (18.2%)	90 (24.3%)
Fatty acid methyl esters					
World (4% growth rate)	390	425	495	570	660
Malaysia	0	10 (12.1%)	60 (15.8%)	90 (15.8%)	150 (22.7%)
Fatty amines					
World (4% growth rate)	270	300	370	450	550
Malaysia	0	0	0	10 (2.2%)	20 (3.6%)
Glycerine					
World (2% growth rate)	420	445	495	545	600
Malaysia	2	17 (3.8%)	34 (6.7%)	76 (13.9%)	116 (19.3%)

( ) = % of world production.

Most oleochemicals are derived from fatty acids. The Malaysian oleochemical industry has, therefore, rightly started with production and export of fatty acids and glycerine. The amounts of the two products exported during the last three years are shown in Table XV. The industry has shown a very high growth rate during these three years.

The oleochemical industry is highly capital-intensive and requires a high level of technology. The added value is also high. It is therefore expected that, at least for the next 5-10 years, development and investment in Malaysia will be in establishing plants and infrastructure required for downstreaming of palm and palm kernel oils into basic oleochemicals, such as fatty acids, fatty alcohols, fatty acid methyl esters, fatty amines and glycerine. Based on average growth rate of world production of these oleochemicals, the projected production of these products by Malaysia up to the year 2000 is shown in Table XVI.

It looks as though Malaysia is ready to make a great impact on world production and marketing structure of oleochemicals as it has successfully done on edible oils and fats. By the end of the next decade, she is likely to become one of the centers for manufacture of basic oleochemicals and their derivatives.

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Session I Discussion

The following questions and answers were presented during the informal discussion held at the conclusion of the session.

Q: What basis and factors were considered in the projection of future (up to the year 2000) oils and fats demand presented?

Mielke: First, population will increase to 6.07 million in 2000 from 4.49 in 1981, implying a gradual decline in the annual growth rate from 1.7 to 1.4%. Second, per capita demand is expected to rise from 12.82 to 15.6 kg. This means an average annual growth of 1.0% against average annual growth of 1.4% in the 20 years ended 1980. If the rate of growth in population and/or per capita disappearance does not slow down as expected in my forecasts, the increase in demand will be correspondingly larger.

Q: Where will the increased soybean production take place? With 1.6 billion more people to feed by the year 2000, there will be a substantial increase in the requirement for staple food such as wheat and rice. Where do you foresee this will take place?

Mielke: First, the forecast increase in world soybean production of 50 million tons is expected to be mainly in the U.S.A. (27 mill. T), Brazil (8 mill. T), Argentina (4½ mill. T), China (4½ mill. T) and the rest of the world (6 mill. T). It will come chiefly from higher yields, with only a small part from higher acreage. With the liberalization in China now being enforced, the increase in that country might well turn out larger, thus a smaller increase will be needed in the U.S.A.

Second, the needed increase in the production of staple foods such as wheat and rice is expected to come mainly from higher yields in the U.S., Canada, Argentina, China and Australia, and only a small part from higher acreage.

Q: You mentioned that about 2.2 million ha. would produce approximately 11 million tons of palm oil by the year 2000. Malaysia presently produces about 3.5 million tons from approximately 1.25 million ha. Would you please explain why you expect such a substantial increase in production, from 2.8 tons/ha to 5 tons/ha.?

Mielke: We expect the Malaysian yield to increase to 5.2 T from a harvested area of 2.2 million ha. in 2000 compared with 3.6 T from 0.71 million ha. in 1980. (The last 2 figures represent the annual average of the 5 years ended 1982.) This is expected to be due mainly to an increase in the plantings of cloned palms (which yield about 30% more than the present varieties) from nil to 1.3 million ha. in 2000, and an increase in the area planted with present varieties from 0.71 to only 0.9 million ha. The present varieties already yielded 3.9 T in 1982. Adding 30% gives us 5.1 T. We expect the yield of cloned palms to reach 5.4 T and those of other palms 4.85 T by 2000, due to additional yield-improving factors.

Q: With the current interest in Malaysia in preparing oleochemicals and using palm oil and palm kernel oil for nonfood uses, what do you envisage will be the effect on the actual exports of these oils from Malaysia in the year 2000?

Mielke: With the demand for nonfood uses in general and oleochemicals in particular increasing, this will mean further increases in exports and in pressure to raise palm oil and kernel production in Malaysia.

Q: Do you expect an increase of refining capacity in the Philippines up to the crude coconut/oil production?

Ignacio: No increase in refining capacity. The domestic market is limited. For RB (refined, bleached) or semi-refined oils our customers are processors on the U.S. West Coast and some Australian companies.

Q: Has the Philippines increased the export tax on crude oil for the support of their supply of refined coconut oil?

Ignacio: Export tax law does not differentiate export taxes on coconut oil, whether semi-refined, refined or crude. It is 9% on FOB value of all coconut oil products.

Q: You mentioned the replanting program for the new hybrids in the Philippines. How long would it take to replant the total coconut farmland in the Philippines?

Ignacio: Original replanting had a rate of 30,000 ha./yr, and it takes 40 years to replant about 1.2 million ha. or 33% of our coconut lands. A possible revised program up to the year 2000 would replant 640,000 ha., or 20% of total land area. Completion of the original program would have raised the Philippines coconut oil production by 1.89 million MT but add only about 605,000 MT coconut oil/year by the year 2000.

Q: What about the growing of oil palm in the Philippines after the experience of the last years?

Ignacio: The Philippines has had limited oil palm hectarage on Mindanao Island starting in the late 1960s. Our state enterprise of pioneer industries, National Development Company, has joint ventures with Guthrie and Sime Darby in this field on a modest scale, but if more companies take advantage of the incentives of cultivating logged-over forest areas we can see some increases in hectarage provided investment funds are available.

Q: How would you compare the economics of extending your lipase reactor to total hydrolysis of triglycerides, rather than rearrangement, versus the high temperature-high pressure process currently used in most cases?

James: Glyceride hydrolysis by conventional procedures is very cheap. An enzyme process would produce only one advantage, i.e., glycerol at a high concentration. A very stable lipase at a pH of about 5 would be necessary. The economics do not look very attractive.

Q: Could the recombinant DNA or manipulations be harnessed for the increased production of carotenoids, retinoids and tocopherols in palm oil (or coconut oil)?

James: Yes, a very complex set of genes would have to be expressed at a higher level. This would need an increase in copy number, feasible but difficult at this stage of technique.

Q: Please elaborate the differences between RBD and NBD products in the following aspects: physical and chemical properties; processing cost; shelflife stability, e.g. cold stability for olein (NBD/RBD), color reversion for NBD St/RBD St, and effects on further downstream processing, e.g. in PMF production.

Kheiri: First, if the proper conditions, as recommended, are practiced, there should not be any difference in the physical and chemical properties. Use of high temperature or decrease in the amount of bleaching earth could affect the quality of oil during physical refining. Second, physical refining is significantly cheaper than chemical refining. Third, the stability of stearin, especially in case of physical refining, usually is lower because most of the tocopherol goes into olein and the iron is concentrated in stearin. Finally, chemical refining usually is carried out for downstream products.