The Malaysian inventors of palm oil mill machinery appear to have a tough time protecting their inventions against unscrupulous competitors, who will go to any lengths to copy inventions originated by others. This is not just a regional phenomenon but is widespread sparing no countries either rich or poor.

An example is the current battle between Nokia and Apple computers on mobile phones. Apple filed a new patent-infringement complaint against Nokia Oyj, seeking to block US imports of mobile phones and increasing the legal battle between the two over smart phone technology. Nokia also filed its own complaint at the ITC seeking to ban imports of Apple’s iPhone, iPod and MacBook products. This is just a part of a large battle over smart phone market, the industry’s fastest-growing sector (Source: Star Biz, 18 January 2010).

We have also seen battles over the various types of fresh fruit bunch sterilizer manufacturers. The common theme is that every one is claiming the same thing - that they invented it. Patent writing is an art by itself and considerable skill is required to mould the words into an effective shield with no loopholes for infringement of any kind by anyone. Many millers are not aware of the fact that legal action can be instituted against a mill that buys a patented machine from a rival company, when its intellectual proprietary (IP) right is held by another company. The IP holder cannot sue the manufacturer or seller of the machine.

Sometimes the words are not properly drafted in the patent application docu-
CALL FOR ARTICLES

The millers are requested to send in articles of relevance to the palm oil industry in Malaysia for publication in Palm Oil Engineering Bulletin. By sharing your expertise you will be helping the industry and the nation as a whole. The topics of interest are:

1. Plant modifications done in your mill that resulted in improvements in milling operation or maintenance.

2. Innovations done in your mill that produced improvements in the operation of the mill and that you are willing to share them with others.

3. Any special work done in your mill that directly resulted in improvements in OER and product quality.

Please submit your article to us and we shall be pleased to publish them in Palm Oil Engineering Bulletin. Feel proud to have your articles published in this Bulletin that is circulated throughout the industry and MPOB offices worldwide.

Many millers have invented machines that can be called innovations whilst others would have succeeded in producing utility innovations (UI). Probably many millers may not have heard about UI and P Kandiah’s article in this issue will serve to guide millers on how to protect their innovations. We feel that an article of this nature will be of immense value to the industry. Perhaps it may also encourage millers to pursue a number of innovations that can be filed under UI.
Recent Events

Contributed by: Noor Asmawati Abd Samad*

MPOB Awards to Smallholders

A total of 45 smallholders received awards from various schemes under the Ninth Malaysia Plan. The awards were presented by Tan Sri Bernard Dompok, the Minister of Plantation Industries and Commodities on 25 October 2009 at Keningau, Sabah.

The schemes included supply of good quality oil palm seedlings to poor smallholders, integration of crops and livestock. In addition, the schemes that received financial stimulus were Oil Palm Replanting and the 2nd Economic Stimulus Package (PRE2) to plantation companies and smallholders.

Datuk Dr Mohd Basri Wahid, the Director-General of MPOB and Tuan Haji Idris Omar, Director of Integration Research and Extension Division, MPOB were also present at the function.

* Malaysian Palm Oil Board, P. O. Box 10620, 50720 Kuala Lumpur, Malaysia.
Recent Events

Business Talk on Offshore Opportunities for the Malaysian Palm Oil Industry

Datuk Dr Mohd Basri Wahid, the Director-General of MPOB, launched a seminar with the caption, Business Talk on Offshore Investment Opportunities for the Malaysian palm oil industry on 26 October 2009 at the Equatorial Hotel, Bangi. More than 100 participants from the palm oil industry attended the seminar.

Mohd Arif Simeh, Head of Techno-Economic Unit, MPOB and Charles Barton from the Charles Barton Associates, Norway - each presented a paper for this seminar.

Datuk Dr Choo Yuen May, Deputy Director-General (R&D) of MPOB and Dr Faizah Mohd Shariff, Director of Economic and Industry Development Division of MPOB were also present at the function.

International Workshop on Awareness, Detection and Control of Oil Palm Devastating Diseases

The 2009 International Workshop on Awareness, Detection and Control of Oil Palm Devastating Diseases, jointly organized by MPOB and the Indonesian Oil Palm Research Institute (IOPRI) was held on 6 November 2009 at the Kuala Lumpur Convention Centre.

The objectives of the Workshop were to provide a forum for meaningful interaction and exchange of ideas/experiences amongst participants on the detection and control of oil palm devastating diseases and its impact on the environment. The Workshop was attended by more 120 participants from various countries. Datuk Dr Choo Yuen May, the Deputy Director-General (R&D), MPOB and Dr Wijaksana Darmasarkoro, the Director of IOPRI also were present in the Workshop.
The International Palm Oil Congress (PIPOC 2009) organized by MPOB was held on 9 – 12 November 2009 at the Kuala Lumpur Convention Centre. Tan Sri Bernard Dompok, the Minister of Plantation Industries and Commodities officially opened the Congress.

More than 1800 participants attended the Congress with the theme, Palm Oil: Balancing Ecologies with Economics. The Congress consisted of five conferences, namely:

- Agriculture, Biotechnology and Sustainability Conference;
- Chemistry, Processing Technology & Bio-Energy Conference;
- Global Economics & Marketing Conference;
- Oleo & Specialty Chemicals Conference; and
- Food, Lifestyle & Health Conference.

A keynote address by Tun Dr Lim Keng Yaik, the former Minister of Primary Industries entitled Palm Oil and Energy: Managing Crisis was presented in conjunction with the Congress. A total of 137 papers and 171 posters were presented during PIPOC 2009.

In conjunction with PIPOC 2009, Tan Sri Bernard Dompok, also launched the Palm E-Tariff and Elaeis Genome Decoded Portals.

Tan Sri Bernard Dompok also launched three publications entitled MPOB Biomass Technology Centre, Biogas Utilization in Palm Oil Mills and Innovations in Palm Oil Milling Technology during his visit to the trade exhibition held in conjunction with PIPOC 2009.
Recent Events

Launching of Sustainable Palm Oil Cluster (SPOC)

The first Sustainable Palm Oil Cluster (SPOC) was officially launched by Tan Sri Bernard Dompok, the Minister of Plantation Industries and Commodities on 30 November 2009 at the Sapi Club House, PPB Oil Palms Bhd, Telupid, Sabah.

The cluster known as PPB Oil Palms Cluster was jointly established by MPOB and the PPB Oil Palms Bhd. With the establishment of the cluster, PPB SPOC will achieve the mission to improve and increase the productivity of the smallholders in line with the concept, Premium Quality, Premium Price.

Datuk Seri Panglima Michael Asang, the State Assemblyman of Labuk; Datuk Dr Mohd Basri Wahid, the Director-General of MPOB and Mr Goh Ing Sing, the Managing Director of PPB Oil Palms Berhad also attended the launching ceremony.
Development of MPOB
Palm Information Centre Complex

The development of MPOB Palm Information Centre Complex at Kota Kinabalu Industrial Park was officially launched by Tan Sri Bernard Dompok, the Minister of Plantation Industries and Commodities, at Kota Kinabalu, Sabah on 7 December 2009.

The project will be developed under the Ninth Malaysia Plan. It will focus on development of the MPOB Sabah Office, laboratory, pilot plant facilities for research and technological development, and palm garden. The first phase of complex is expected to complete in September 2010 and the second stage will be developed under the Tenth Malaysia Plan budget.

Dato’ Sabri Ahmad, the Chairman of MPOB; Mr M Nagarajan, the Under Secretary of the Vegetable Oils, Fats and Sago Division, Ministry of Plantation Industries and Commodities and Dr Salmiah Ahmad, Deputy Director-General (Services) of MPOB attended the event.
### 2010 MPOB Training Programme Schedule

<table>
<thead>
<tr>
<th>Code No.</th>
<th>Title</th>
<th>Date</th>
<th>Venue</th>
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<tbody>
<tr>
<td>A1.1</td>
<td>Kursus Kemahiran Menggred Buah Sawit</td>
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<tr>
<td></td>
<td>Bil. 1: Wilayah Sabah</td>
<td>23–25 Mac</td>
<td>Hotel Sunbay, Sandakan, Sabah</td>
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<tr>
<td></td>
<td>Bil. 2: Wilayah Sarawak</td>
<td>27–29 Apr</td>
<td>Hotel Plaza, Bintulu, Sarawak</td>
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<td>Bil. 3: Wilayah Tengah</td>
<td>18–20 Mei</td>
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<td>Bil. 4: Wilayah Utara</td>
<td>8–10 Jun</td>
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<td>Bil. 5: Wilayah Selatan (Permintaan Industri)</td>
<td>20–22 Jul</td>
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<td>Bil. 6: Wilayah Timur (Permintaan Industri)</td>
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<td>Peperiksaan Kemahiran Menggred Buah Sawit</td>
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<td>Bil. 16: Sarawak</td>
<td>Mei</td>
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<td>Bil. 17: Semenanjung</td>
<td>Sept</td>
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<td>A1.2</td>
<td>12th Intensive Diploma in Oil Palm Management &amp; Technology (IDOPMT)</td>
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<td></td>
<td>Semester I</td>
<td>12 Apr–7 May</td>
<td>MPOB HQ</td>
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<td>Estate Attachment</td>
<td>10–21 May</td>
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<td>Semester II</td>
<td>24 May–18 June</td>
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<td>Estate Attachment</td>
<td>21 June–2 July</td>
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<td>Semester III</td>
<td>5–30 July</td>
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<td>A1.3</td>
<td>Kursus Operator Mekanisasi Ladang</td>
<td>Mac.Ogos</td>
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<td>A1.4</td>
<td>Kursus Pengurusan dan Penyelenggaraan Tapak Semaian Sawit</td>
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<td>Bil. 1: Wilayah Tengah</td>
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<td>MPOB PLASMA Lahad Datu</td>
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<td>Bil. 2: Wilayah Selatan</td>
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<td></td>
<td>Bil. 6: Wilayah Utara</td>
<td>28–29 Sep</td>
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**Forthcoming Events**

### A2.1 Diploma in Palm Oil Milling Technology and Management (DIPOM)
- **Semester I**: 15–25 Mar
- **Semester II**: 10–20 May
- **Semester III**: 28 Jun–6 Jul
- **Exam. Semester III**: 9–10 Aug
- **Venue**: MPOB HQ

### A2.2 The 23rd MPOB Oil Palm Products Surveying Examination
- **Date**: 21–25 Jun
- **Venue**: Vistana Hotel, Kuantan, Pahang

### A2.3 Kursus Bengkel Kilang Minyak Sawit
- **Date**: 12–16 Apr
- **Venue**: MPOB PLASMA Lahad Datu

### A2.4 Kursus Drebar Enjin
- **Date**: 21–25 Jun
- **Venue**: MPOB PLASMA Lahad Datu

### A2.5 Cosmetic Course
- **Date**: 9–13 Aug
- **Venue**: MPOB HQ/AOTD

### A2.6 Introductory Course on Palm Oil Trading and Marketing
- **Date**: 9–13 Aug
- **Venue**: *

### A2.7 Diploma in Oleochemical Technology
- **Semester I**: *
- **Semester II**: *
- **Semester III**: *
- **Practical and Factory Visit**: *
- **Venue**: MPOB HQ

## 2010 MPOB CONFERENCES/SEMINARS

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<th>CODE NO.</th>
<th>TITLE</th>
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<th>VENUE</th>
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<tbody>
<tr>
<td>B1</td>
<td>Palm Industry: Issues, Performance and Sustainability (PILIPS) Workshop</td>
<td>8 February</td>
<td>Le Meredian Hotel, Kota Kinabalu, Sabah</td>
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<tr>
<td>B2</td>
<td>National Seminar on Renewable Energy (SREP)</td>
<td>11 March</td>
<td>Promenade Hotel, Kota Kinabalu, Sabah</td>
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<tr>
<td>B3</td>
<td>Programme Advisory Committee (PAC) Seminars</td>
<td>1 April</td>
<td>MPOB, HQ</td>
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<tr>
<td>B4</td>
<td>Seminar &amp; Workshop on Technology for Tertiary Treatment of Palm Oil Mill Effluent (POMET)</td>
<td>24–25 May</td>
<td>Promenade Hotel, Kota Kinabalu, Sabah</td>
</tr>
<tr>
<td>B5</td>
<td>MPOB Transfer of Technology (TOT) Seminar 2010</td>
<td>1 April</td>
<td>MPOB, HQ</td>
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</tbody>
</table>

**Note:** * To be confirmed. All information are correct as at press time.

**For enquiry or further information, please contact:**

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E-mail : rubaah@mpob.gov.my
MPOB’s website : http://www.mpob.gov.my
Feature Article

Clarification Station Operation (currently on-going)

N Ravi Menon*

INTRODUCTION

I am sure that most millers will concede that the clarification operation in a palm oil mill plays an important role in efficient oil extraction. But whether all millers are really concerned about this is questionable as in some mills despite the oil losses being higher than the normal values, no positive action seem to have been undertaken to remedy the situation.

Let us take a close look at the oil extraction operations from the digester onwards culminating at the storage tank. The operation can be sub-divided into the following process constituents.

DIGESTER DRAINAGE

Most millers do not seem to understand why it is necessary to drain as much oil as possible from the digester. If most of the oil is drained off at the digester itself, the press fibre will have less oil resulting in less slippery fibre. This will not only improve the efficiency of the pressing operation but the pressing itself can be done at a lower pressure. Some mills use a very high pressing pressure like even 80 bar against the normal pressure of about 20 bar. This will most certainly cause high nut breakage in the press. High nut breakage also can lead to high broken kernel that again will result in poor kernel quality. Resolve the problem at the source rather than fighting the consequences. The gap between the expeller blades and the bottom perforated drainage plate is critical (not many millers realize this) as severe nut breakage also can be caused by the wrong setting of this gap. This is primarily due to the lodging of nuts in the gap and nut breakage take place when the expeller arms rub against nuts. Mill’s maintenance personnel generally do not check this gap during digester liner or blade renewal. The problem can be solved in two ways; either set a wide or a narrow gap and monitor the nut breakage.

PRESSING

Presses have undergone some minor changes for the bad. The conical restraining plug at the front has now been converted to a flat one because it is easier to make. Those who did this must have assumed that the designers who initially designed the press would never have thought about the simple flat plate. There were good reasons for doing what they did. There is a difference between the profile of the press cake issuing out of the press when using the conical plug and a flat plate. The pressure distribution on the cake might be the same when a flat plate is used.

* Malaysian Palm Oil Board,
P. O. Box 10620, 50720 Kuala Lumpur, Malaysia.
Water injection in the press is useful to wash off the oil from the cake during pressing. Some engineers may have a doubt on how the water at a relatively low pressure can possibly flow into the press chamber where the press cake experiences a pressure of 30 bar. However, note that the whole chamber is not under 30 bar pressure, it is only the press cake that experiences the pressure brought about by screws. The water will still flow into the press chamber. Water addition at this point is preferable to water addition at the crude oil gutter as this will help to wash off the oil from the press cake.

**CRUDE OIL DILUTION**

This is a field that needs a great deal of intensive study as there are a number of misconceptions among millers about the right approach in clarifying the oil. The three phases that exist in the crude oil issuing out of the screw press does not offer a simple solution for the complete separation of phases. The current method of dilution criteria although based on the sound principles of fluid mechanics does not seem to have considered the impact of solids on clarification in a three phase mixture. This fact has been highlighted in the Mongana Report. The solids generated during pressing are a big obstacle for efficient oil separation.

The crude oil issuing out of the press has the least viscosity and at this point, the separation is most efficient. When this is diluted, solids in the crude oil absorb the water and begin to swell until they are saturated at about 50% dilution at which point the viscosity is maximum. After this point, no further water absorption takes place and the viscosity starts to decrease and at 200% dilution the viscosity drops to the same value as when the oil is discharged from the press. Almost all mills operate by adding about 43% water, when the viscosity is most unfavourable. This is a very strange way to operate the clarification station.

Let us look at how a better system can replace the existing system. One fundamental thing to remember in any industry is as far as possible do not add water as whatever water is added it has to be rejected at the end of the processing operation. Besides it is a source of effluent that we are trying our best to avoid. We have recognized that solids are a nuisance as it promotes viscosity. So the logical thing to do is to remove it first before commencing oil separation.

There are many methods of doing this. Decanters can separate the solid phase and the oil and water phase can be lumped together or separately recovered. The solids can carry a fair amount of oil if not properly set. On the other hand if water and solid phases are separated out together and the oil phase with some water separated as one phase oil losses can be minimized. The water from the heavy phase can be evaporated out and solids recovered. The oil phase without the usual solids and very little water can be clarified in a series of clarifiers and finally in a purifier. There are other options as well like coalescence plate separator that can separate the two phases efficiently. Another option is to use a second decanter for the separation of water from the mixture of lighter phase oil and traces of water discharged from the first decanter.

**PUMPING**

This is another area where the processing techniques took a reverse path and gone for the worse. It is a well-known fact that a centrifugal pump will churn up the oil when it is used for pumping oil. It is basically the characteristics of the oil. This was recognized as far back as more than 50 years ago and most mills were religiously using positive displacement pumps for pumping dilute crude oil to the clarification tank.

As no one could directly see the impact of the centrifugal pumps on the actual efficiency of separation, millers decided to opt for the cheap centrifugal pumps to replace the positive displacement pumps they already had. Another reason was that the positive displacement pumps and their spare
parts were more expensive. This encouraged millers to phase them out. It is also unfortunate that most millers do not know how to operate and maintain positive displacement pumps like Mohno pumps.

These pumps should not be allowed to operate with a negative suction head. If operated under suction head, the rotor and stator life will be drastically reduced. Another operational error is the rotor speed which should not be allowed to exceed about 600 rpm. The combined effect will bring the life of the rotor and the stator to only two to three months compared to two to three years under positive head. Once the oil is churned by the centrifugal pump, it is likely to attain some of the properties of an emulsion leading to a hindrance to oil separation. If we wish to carry out proper clarification we have to re-establish the original concepts as they were founded on scientific principles.

HEATING

Crude palm oil heating has its advantages and disadvantages. It is a question of higher oil extraction rate at the expense of quality and low oil extraction rate with better quality. Higher oil temperature for prolonged duration tends to bring down the DOBI value of the oil and vice versa. The best approach is a compromise. A clarifier temperature of about 90°C-95°C is ideal for oil separation. If this is below 90°C, the oil loss can be quite significant. Even though this temperature is very critical, it is surprising that thermometers installed in the clarification tanks of most mills in Malaysia are defective. If they are in working order, they are installed far away so temperature readings are not visible from the ground level with a naked eye.

OIL SEPARATION

For 99.3% of the oil to separate and rise to a height of 900 mm, the time needed is only 2 hr. The oil particles not separated during this time are unlikely to rise to 900 mm irrespective of the settlement time because these particles which are usually below 15 microns in size do not have the buoyancy to rise to this height. Table 1 gives a relationship between the time taken and the quantity of oil droplet risen to 900 mm.

The conclusion that can be drawn from this is that it serves no purpose using large clarifier tanks capable of giving very high retention times. It does not serve any purpose in extra oil recovery. A reasonable retention time is 2.5 hr. For a 60 t hr⁻¹ mill at 65% dilute crude oil, a 120 t capacity will give a comfortable retention time of 3 hr. It is not unusual to find 90 t hr⁻¹ mills having 300 t capacity clarification tanks. Very large tanks like this will have wide range of temperature profile at different points within the tank.

OIL DRYING

The initial drying takes place in the clarification tank. Further evaporation of moisture can take place in purifiers. Finally, the remaining moisture has to be flash dried in a vacuum dryer. In most mills, the operators of this station are not well versed with vacuum drying as they do not seem to know what the ideal vacuum should be. This applies to even the mill process supervisors who are unable to say the units displayed in their vacuum gauges. Unless they acquire the right knowledge, it will be difficult for them to appreciate their vacuum drying system.

TABLE 1. QUANTITY OF OIL SEPARATED AND THE TIME TAKEN TO RISE TO A HEIGHT OF 900 mm IN A CLARIFICATION TANK

<table>
<thead>
<tr>
<th>Min</th>
<th>Quantity separated (%)</th>
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<tr>
<td>20</td>
<td>95.9</td>
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<tr>
<td>40</td>
<td>97.6</td>
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<td>60</td>
<td>98.3</td>
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<td>120</td>
<td>99.3</td>
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</table>
OIL PURIFICATION

There is a tendency now for millers to do away with the purifiers as they find a series of heating tanks with heating coils could give the same result in terms of moisture content. But millers have to remember that prolonged exposure to heat can cause DOBI deterioration. This does not happen when purifier is used. This is something to watch out. If in any mill, the DOBI value dropped after the system alteration at least they know what could have triggered it.

PUMPING OF OIL INTO THE STORAGE TANKS

Ideally the oil should be cooled to about 40°C using a plate heat exchanger before the oil is pumped into the storage tank. Only very few mills in Malaysia still carry out this good practice. This is intended to minimize oxidation of the oil.

OIL STORAGE

Ideally, the storage tanks should be made of stainless steel if prolonged storage is required. But presently oil is not stored for long durations and as a result mills seldom resort to stainless steel tanks. The tank interior surface also is not coated even though at the bottom portion where the water condensation takes place could promote corrosion if the steel plates are not coated. It is therefore preferable to have epoxy or other coating 3 m from the bottom so that the risk of iron contamination is minimized.

CONCLUSION

Clarification operation is an important processing step that should be carefully handled with as much care as possible. As this is where the oil quality and part of the oil losses come into play, an in-depth knowledge of the clarification operation would be beneficial to the mill engineers.

2010 NATIONAL SEMINAR PALM OIL MILLING, REFINING, ENVIRONMENT AND QUALITY (POMREQ)

27-28 SEPTEMBER 2010
Magellan Sutera Harbour Resort, Kota Kinabalu, Sabah

PLEASE REGISTER EARLY

For further information, please surf MPOB website at www.mpob.gov.my or contact the following for further details:

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E-mail: lchin@mpob.gov.my or asiah@mpob.gov.my or shahirah@mpob.gov.my
Benefiting from Innovations in the Palm Oil Industry

P Kandiah*

INTRODUCTION

Technology in the palm oil industry is undergoing rapid changes initiated by dedicated research institutions such as the Malaysian Palm Oil Board and by independent oil mills, engineering workshops and individuals. There has been emphasis in research in all aspects of the industry, not only limited to creation of new clones/varieties of palm trees, process and apparatus used in the extraction of oil from fresh fruit bunches (FFB) but also to the following:

- extraction and creation of hydrocarbon components from crude palm oil;
- treatment of palm oil mill effluent (POME); and
- creation of new uses for all types of ‘waste’ in the industry such as tree trunks, fronds, empty fruit bunches (EFB), kernels, mesocarp fibre, etc.

Some of the research findings are totally innovative whilst a vast majority of research and development activities result in mere adaptation or minor modifications to known technology. Is the Malaysian palm oil industry fully exploiting the results of the R&D efforts? This article will attempt to answer this question.

As Malaysia and in particular, the palm oil industry transform into a knowledge-based industry, there is a strong and urgent need to identify, protect and manage the results of R&D activities. Are the industry participants taking full advantage of the intellectual property (IP) rights law and the provisions available?

All innovations in any field of technology are protectable under appropriate IP laws. Generally, new products (inclusive of machines, equipments, chemical products, and generally anything physically tangible) are protectable under the Patents Act or Industrial Designs Act. New processes (such as a method of extraction of oil from FFB, or method of extraction or production of chemical components) are protectable either under the Patents Act or under the common law of confidentiality/trade secrets.

Unless and until the innovations (whether on products or process) are protected under the appropriate laws, there is no ownership or property rights on the innovations. For example if Company A develops a new type of screw press and places the machine in the open market, then unless it obtains patent rights in Malaysia (and in any other country where it needs such rights) anybody can lawfully copy the machine and compete directly and openly with Company A. Similarly if Company B develops a novel method of molecular distillation or fractionation of palm oil to extract compound x, then un-
less Company B obtains patent rights for the process or maintains the process as a trade secret, anybody can legally copy, or adapt the process without the consent or authority of Company B. Unfortunately, the law does not recognize equitable or moral rights in ownership of unprotected technology. So, the golden rule is either obtain patent rights or keep the innovation as trade secret (if it can be considered as such) or be deemed to have donated the innovation to the public! In the latter case, anyone can freely and lawfully copy the innovation.

Malaysia grants two different types of rights under the Patent Act 1983. The first and more commonly known right is patents. The other (and for some reason not well-known) is Utility Innovation. To obtain a patent, the applicant has to satisfy the patent office’s requirements that the invention is:

- novel (the features claimed are new throughout the world at the date of filing the application);
- inventive (the features though new are not obvious to a person skilled in the same field of technology); and
- industrially applicable (there is shown a method of working the invention for the benefits claimed).

On the other hand, a utility innovation (UI) needs to satisfy only the first and third criteria – that the features claimed are novel at the date of filing the application and that the innovation is industrially applicable. Thus, it will be appreciated that it is easier to obtain UIs than patents. In fact, the government provided for the grant of UIs to encourage individual inventors and SMEs to protect their minor improvements. There is nothing inferior in obtaining UIs. It is far easier to obtain UIs, sue others or defend an action for infringement of UIs than patents. Industrialized countries such as Japan and Germany have a similar system. The UI system is fully utilized by the SMEs and the large industrial giants in Japan and Germany. The statistics from the Malaysian patent office shows that no UIs were obtained in the palm oil industry for the year 2006 and 2007 (until September) according to the Government Patents Gazette 2006-2007 (Table 1).

Patents and UIs can be used as monopoly rights in the industry, enabling the owner to derive premium prices for his inventions, or to gain market entry. A company with a strong portfolio of granted patents/UIs would be in a stronger position to defend against infringement, enter into cross licensing strategies or derive royalty income by selectively licensing its inventions to others.

A company with at least one strong patent or which has a portfolio of patents/UIs has a higher net asset value, in the event it enters into merger and acquisition.

**IMPACT OF PATENTS/UTILITY INNOVATION ON NET ASSET VALUES**

**M & A Activities**

Massachusetts (US)-based, Twin Rivers Technologies recently acquired by FELDA has a total of three patents granted in the US (as obtained from USPTO website). It is reported that FELDA paid RM 241.4 million for the total shares of 100%. How much of this value is attributed to Twin Rivers Technologies patent portfolio and possibly other IP rights?

As the palm oil industry becomes commercially attractive to other countries such as Indonesia, Papua New Guinea, Thailand, Colombia, Nigeria, and so forth, it is increasingly important for owners of IP rights to protect their inventions in all these countries in order to derive monetary value from any user of the rights in these countries. Otherwise anyone in those countries can freely copy the technology. Most of these countries are members of the Patent Co-operation.
TABLE 1. STATISTICS FROM THE MALAYSIAN PATENT OFFICE

<table>
<thead>
<tr>
<th>Grant No.</th>
<th>Title</th>
<th>Owner</th>
</tr>
</thead>
<tbody>
<tr>
<td>MY-125080-A</td>
<td>An evacuation system for evacuating harvested oil palm fruits</td>
<td>Borneo Samudera Sdn Bhd</td>
</tr>
<tr>
<td>MY-125435-A</td>
<td>A method for improving stability of palm olein at low temperature with mycelium bound lipase of <em>aspergillus flavus</em></td>
<td>Malaysian Agriculture Research and Development Institute (MARDI)</td>
</tr>
<tr>
<td>MY-124351-A</td>
<td>Improvements in and relating to oil palm nut processing</td>
<td>Infinite Product Sdn Bhd</td>
</tr>
<tr>
<td>MY-124490-A</td>
<td>High carotene palm oil production by repeated neutralization and low temperature deodorization</td>
<td>Malaysian Palm Oil Board (MPOB)</td>
</tr>
<tr>
<td>MY-119495-A</td>
<td>Mulch mat made from oil palm empty fruit bunches and the process of making the same</td>
<td>Forest Research Institute Malaysia (FRIM)</td>
</tr>
<tr>
<td>MY-122480-A</td>
<td><em>Trans</em>-free hard structural fat for margarine blend and spreads</td>
<td>Premium Vegetable Oils Berhad</td>
</tr>
<tr>
<td>MY-120416-A</td>
<td>Preparation of ruthenium-based catalysts and their application in the production of saturated alcohols</td>
<td>Malaysian Palm Oil Board (MPOB)</td>
</tr>
<tr>
<td>MY-120349-A</td>
<td>Oil palm fronds and fruit bunches cutter</td>
<td>Malaysian Palm Oil Board (MPOB)</td>
</tr>
</tbody>
</table>

**Treaty (PCT)**

It is now convenient for Malaysia applicants to seek patent rights in each of these countries. Malaysian palm oil technology is well recognized and enjoys premium value in the world. Owners of such technology, which is still not in the public domain, should seek to obtain patent rights in other countries which are competitors or are likely to become competitors to our industry.

With the present economic conditions, and state of technological capability of other countries, the value of technology lies more in intangible rights (such as patents, UIs, industrial designs, confidential information, sales network, etc.) and not in the physical products themselves. Any engineering firm in Indonesia, Thailand or China, for example, can reproduce a sterilizer, or screw presses or nut cracker identical to that used in Malaysia. One can only stop such reproductions, if the products enjoy patent/UI rights.

Similarly, new varieties of oil palm trees can be protected in Indonesia under the Indonesian New Plant Variety Act. Are Malaysian industries taking advantage of the Indonesian law? Otherwise all our R&D to produce new varieties of oil palm trees would be available to our strongest and largest competitor at no additional cost!

**CONCLUSION**

Malaysian industries need to be aggressive in protecting and managing their competitive advantages in the technology fields. Will Malaysians drive the innovation or will our foreign competitors use it to drive over us? In business, remember – unless you innovate, you will evaporate.
Effluent Treatment System in Palm Oil Mills: Part II - Biogas from Anaerobic Digestion

Lai Mei Ee*

INTRODUCTION

This article may play an important role in polishing the mind of researchers in the palm oil mill sector. Amidst the fascination of Mongana Report, still maintain its popularity and recognition by the mill engineers as well as researchers in the palm oil industry, I believe that treatment of palm oil mill effluent (POME) is also getting increased attention. Besides that, in recent times methane gas generated by POME also has come to the limelight as a very promising source of energy and income from the generation of renewable energy.

Undeniably, POME has contributed much to the pollution of the environment. A string of efforts has been undertaken in order to reduce the impact of the effluent on the environment. However, the question is how long can it last? It is always easy to start a brand new project which seems to bring a new shade of light to the future of palm oil mill treatment, but how are the maintenance works going to be? Will it be able to ensure the sustainability of the so-called sustainable effort? This is something every researcher must ponder before claiming their project as the pearl of the industry. A project can only be categorized as good if the project is able to contribute to the sustainable development in the long run.

In the context of palm oil industry, anaerobic digestion (AD) is a biological process of degrading the organic materials in the POME in the absence of oxygen. The microorganisms will degrade the organic wastes in the POME through bacterial fermentation at a temperature of around 30°C to 35°C (mesophilic fermentation) or 55°C (thermophilic fermentation), during which 60% or more of the organic materials may be converted to methane gas or biogas (www.unitrade94.hu).

Referring back to the previous issue, Anaerobic Digestion: Part 1, one should be able to understand that there are four stages involved in the process of AD: hydrolysis, acidogenesis, acetogenesis and methanogenesis. These stages result from the biological treatment of organic waste by two key bacterial groups, namely, acetogens and methanogens. I suppose it does not come as a surprise when small home and farm-based AD in developing countries offer great potential for cheap and low cost energy from biogas.

Owing to the increasing environmental protection pressures, researchers are forced to step forward and come up with an effective method of zero-discharge technology for the palm oil mill industry and hence,
the biogas capturing system that promises the industry the potential for the generation of income, from sale of electricity and carbon credit from reduction in emission of greenhouse gas (GHG). Currently, the unrestricted emission of methane gas poses a great threat to the environment as it causes greenhouse effect leading to global warming. As a result, a methane capturing system is vital for protection of the environment hopefully leading to slowing down of global warming.

Most of the biogas generated by the AD of the effluent is freely emitted into the environment thereby contributing to global warming. Methane, as a GHG is known to be 21 times more detrimental than carbon dioxide. Thus, the utilization of the biogas as a renewable energy is not only commercially attractive but will also reduce the GHG emissions, and be eligible under for funding from the Clean Development Mechanism.

**BIOGAS COMPOSITION**

Biogas is a fuel gas, a mixture of 65% methane and 35% of carbon dioxide. It is a renewable energy originating from biomass. Biogas contains a large variety of gases resulting from specific treatment processes, starting from various organic wastes – industries, animal and domestic wastes. It is lighter than air and its calorific value is half that of an equal volume of natural gas (Table 1).

The presence of traces of hydrogen sulphide (H₂S), carbon dioxide (CO₂) and water (H₂O) make biogas very corrosive and require the use of adapted materials. Composition of a gas issued from digester depends on the substrate, organic matter load and feeding rate of the digester (Table 2).

The production of biogas is becoming the preferred method of dealing with large quantities of organic wastes to provide a sustainable management system. It has been extensively adopted in United Kingdom, Europe and Scandinavia with the construction of many large scale AD plants in the past 10 years.

In our country, palm oil sector contributes significantly to the economy of Malaysia which is approximately 2.93% or RM 6.4 million of gross domestic productivity of Malaysia since 2002. And till now, this sector is still able to provide a yield of 10 times more than most of the other oil crops available. Therefore, oil palm is well-known for its status in land and resource utilization and contributing to the sustainable development.

There are vast potentials for oil palm sector to tap the abundant biomass waste and high organic content of POME effectively as renewable energy resources. The energy potential from biomass residue has been estimated at 365 MW and POME at 177 MW. One of the examples of the methane recovery system available for review is Novaviro technology.

**Biogas Refinement**

Biogas may require further treatment and cleaning or ‘scrubbing’ to further refine it for other uses.

**Hydrogen Sulphide**

Hydrogen sulphide is a toxic product of the anaerobic decomposition of sulphates contained within the input feedstock. This hydrogen sulphide is released as a trace component of the biogas.

Environmental enforcement agencies such as US Environment Protection Agency or the English and Welsh Environment Agency put strict limits on the levels of gases containing hydrogen sulphide. The US Environment Protection Agency has mandated that industrial facilities may not burn any fuel gas that contains more than 160 ppm by volume (0.016% by volume) of hydrogen sulphide. Therefore, if the levels of hydrogen sulphide in the gas are high, gas scrubbing and cleaning equipment may be...
### TABLE 1. PHYSICAL CHARACTERISTICS AND COMPOSITION OF BIOGAS

<table>
<thead>
<tr>
<th>Type of gas</th>
<th>Biogas 1 (household waste)</th>
<th>Biogas 2 (agri-food industry)</th>
<th>Natural gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>60% CH&lt;sub&gt;4&lt;/sub&gt;</td>
<td>68% CH&lt;sub&gt;4&lt;/sub&gt;</td>
<td>97% CH&lt;sub&gt;4&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>33% CO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>26% CO&lt;sub&gt;2&lt;/sub&gt;</td>
<td>2.2% CO&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>1% N&lt;sub&gt;2&lt;/sub&gt;</td>
<td>1% N&lt;sub&gt;2&lt;/sub&gt;</td>
<td>0.3% N&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>0% O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>0% O&lt;sub&gt;2&lt;/sub&gt;</td>
<td>0.1% O&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>6% H&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>5% H&lt;sub&gt;2&lt;/sub&gt;O</td>
<td>0.4% H&lt;sub&gt;2&lt;/sub&gt;O</td>
</tr>
<tr>
<td>Density (kg m&lt;sup&gt;-3&lt;/sup&gt;)</td>
<td>0.93</td>
<td>0.85</td>
<td>0.57</td>
</tr>
<tr>
<td>Mass (kg)</td>
<td>1.21</td>
<td>1.11</td>
<td>0.73</td>
</tr>
</tbody>
</table>


### TABLE 2. CHEMICAL COMPOSITION OF BIOGAS IN VARIOUS INDUSTRY

<table>
<thead>
<tr>
<th>Components</th>
<th>Household waste</th>
<th>Wastewater treatment plant sludge</th>
<th>Agricultural waste</th>
<th>Agri-food waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH&lt;sub&gt;4&lt;/sub&gt; % volume</td>
<td>50-60</td>
<td>60-75</td>
<td>60-75</td>
<td>68</td>
</tr>
<tr>
<td>CO&lt;sub&gt;2&lt;/sub&gt; % volume</td>
<td>38-34</td>
<td>33-19</td>
<td>33-19</td>
<td>26</td>
</tr>
<tr>
<td>N&lt;sub&gt;2&lt;/sub&gt; % volume</td>
<td>5-0</td>
<td>1-0</td>
<td>1-0</td>
<td>-</td>
</tr>
<tr>
<td>O&lt;sub&gt;2&lt;/sub&gt; % volume</td>
<td>1-0</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>-</td>
</tr>
<tr>
<td>H&lt;sub&gt;2&lt;/sub&gt;O % volume</td>
<td>6 (40°C)</td>
<td>6 (40°C)</td>
<td>6 (40°C)</td>
<td>6 (40°C)</td>
</tr>
<tr>
<td>Total % volume</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>H&lt;sub&gt;2&lt;/sub&gt;S mg m&lt;sup&gt;-3&lt;/sup&gt;</td>
<td>100-900</td>
<td>1 000-400</td>
<td>3 000-10 000</td>
<td>400</td>
</tr>
<tr>
<td>NH&lt;sub&gt;3&lt;/sub&gt; mg m&lt;sup&gt;-3&lt;/sup&gt;</td>
<td>-</td>
<td>-</td>
<td>50-100</td>
<td>-</td>
</tr>
<tr>
<td>Aromatic mg m&lt;sup&gt;-3&lt;/sup&gt;</td>
<td>0-200</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Organochlorinated or Organofluorinated mg m&lt;sup&gt;-3&lt;/sup&gt;</td>
<td>100-800</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


needed to process the biogas within regionally accepted levels.

**Siloxanes**

If siloxanes are present in the gas, they will adversely affect gas engines. The siloxane forms mineralized deposits on the physical elements of the engine, which will increase wear and tear. Therefore, increased level of siloxane will render greater attention to the maintenance of the gas engine. Over a certain threshold level, the gas will not be suitable for use in gas engine.

### BENEFITS OF METHANE CAPTURING SYSTEM

For every tonne of fresh fruit bunch (FFB) about 0.7 t of effluent is produced. The efflu-
Feature Article

An untreated waste product of the palm oil industry, palm oil mill effluent (POME), has a high organic content which leads to anaerobic conditions and the production of methane. Under the Environmental Quality Regulation (Prescribed Premises - crude palm oil in 1977), it is mandatory for the millers to treat the waste to certain regulated standards before discharge (EcoSecurity Ltd, 2003).

AD of the effluent to generate biogas as a renewable fuel has higher potential in Malaysia than most other options, and at present, this source of renewable energy is practically untapped. Only one commercial plant is known to harness and utilize the biogas generated as fuel burnt directly in a boiler. The potential amount of energy that can be harnessed from the biogas is listed in Table 3.

There is no doubt the methane capturing system will be able to benefit every party in the palm oil industry, farmers and energy entrepreneurs, government as well as improve the quality of environment. Following the reduction in the emissions of methane gas to the environment, greenhouse effects will also decrease, thus, contributing to a cleaner environment.

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**Figure 1. Recovery of methane from palm oil mill effluent (POME) by KS™ anaerobic digester technology.**

---

**RAW POME**
- 30 t FFB hr⁻¹
- POME: 400 m³ day⁻¹
- BOD: 25 000-35 000 mg litre⁻¹
- COD: 45 000-70 000 mg litre⁻¹ (with juice from EFB)

**DIGESTED POME**
- FLOW: 400 m³ day⁻¹
- BOD: 250-300 mg litre⁻¹
- COD: 8000-12 000 mg litre⁻¹

**BIOGAS**
- Production: 11200 m³ day⁻¹
- Composition:
  - CH₄: 62.5%
  - CO₂: 37%
  - H₂S: 1500-3000 vppm

**ANAEROBIC DIGESTER**
- 2 units floating cover and 1 fixed roof
- Continuous flow stirred tank reactor
- Combined operating capacity: 7500 m³
### TABLE 3. AVAILABLE ENERGY FROM ANAEROBIC DIGESTION OF PALM OIL MILL EFFLUENT (POME)

<table>
<thead>
<tr>
<th>Capacity of mills (t FFB yr⁻¹)</th>
<th>Effluent* (t)</th>
<th>Biogas** (m³)</th>
<th>Energy available (MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 000</td>
<td>66 500</td>
<td>1 915 000</td>
<td>52 467 328</td>
</tr>
<tr>
<td>192 000</td>
<td>134 400</td>
<td>3 870 720</td>
<td>106 019 021</td>
</tr>
<tr>
<td>288 000</td>
<td>201 600</td>
<td>5 806 080</td>
<td>159 028 531</td>
</tr>
<tr>
<td>384 000</td>
<td>268 800</td>
<td>7 741 440</td>
<td>212 038 042</td>
</tr>
<tr>
<td>530 000</td>
<td>371 000</td>
<td>1 684 800</td>
<td>292 656 672</td>
</tr>
</tbody>
</table>

Note:  
* Based on 0.7 t effluent generated per tonne of FFB processed.  
** Computed based on 1 t of POME releases 28.8 MJ biogas.  

### CONCLUSION

The palm oil sector has probably the most potential for the development of renewable energy in Malaysia given the available biowaste resources and institutional support for it. There are considerable quantities of biowaste in the form of solid biomass and biogas generated by POME at the mills, which could be used to generate electricity for grid connection under the Small Scale Renewable Energy Programme (SREP).
Mongana Basics: Part 19 - Plasticity**

N Ravi Menon*

PENETRATION

In order to satisfy the user’s oil of fairly constant plasticity, we have studied the relationship between the composition of the glycerides and the plasticity. At the same time, a survey was carried out on the plasticity of a few Congo oils.

Plasticity was measured with the Micrometer Adjustment Penetrometer (ASTM). For all determinations, oil was melted completely in porcelain dishes of 10 cm diameter. The capsules were then stored at -15°C for 16 hr, finally they were conditioned during 24 hr at the selected test temperature (generally 15°C and/or 20°C).

It has been possible to establish a very significant relationship between the free fatty acid (FFA) constant of oil and the melting point (the determination accuracy of which is always open to question). The relationship has been established using samples of the Congo oils survey (Tables 2 and 3) shipment samples drawn at the time of unloading in Antwerp (Table 1) but particularly with samples of oil subjected to spontaneous acidification (Table 4).

In the penetration test carried out on naturally acidified oil, a portion of the sample was neutralized according to the Wesson refining technique. It is remarkable to note that the differences in penetration subsist after separation of the fatty acids. The results obtained before and after refining shown in Table 4 are very close. For information purpose, we have given in Table 4 the penetration values at 0°C, 10°C, 15°C and 20°C. Owing to the poor plasticity of the oils at low temperature, only the results obtained at 20°C need to be taken into account.

In Table 4, the composition of the oil glycerides is established using an average molecular weight of 270 for the fatty acids. The second result, referred to as 10°C + 150 g, is obtained with an additional load of 150 g on the penetrometer needle in order to increase the accuracy of the test. The second determination at 15°C is carried out on dehydrated oils. (The drying of oil exerts no significant effect on plasticity.)

These results show that an increase in acidity from 1% to 8% induces a slight lowering of the melting point and sharp increase of the penetration, particularly between 15°C to 20°C. They show, moreover, that the changes in plasticity are not due to the FFA but to the mono and diglycerides formed in the course of enzymatic or natural acidification.

Although mild refining of the Wesson type does not alter the plasticity of the oil, it has been observed that the potent alkali refining hydrolysates the mono and diglycer-
TABLE 1. PENETRATION OF REPRESENTATIVE SAMPLES OF OIL DRAWN FROM SHIPS’ TANKS AT ANTWERP

<table>
<thead>
<tr>
<th></th>
<th>FFA</th>
<th>ASTM penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>15°C</td>
</tr>
<tr>
<td>Elisabethville (1º)</td>
<td>2.20</td>
<td>59</td>
</tr>
<tr>
<td>Lubilash (deep tank)</td>
<td>2.30</td>
<td>54</td>
</tr>
<tr>
<td>Mar del plate (1P)</td>
<td>2.70</td>
<td>54</td>
</tr>
<tr>
<td>Charlesville (4P)</td>
<td>2.70</td>
<td>51</td>
</tr>
<tr>
<td>Baudouinyille (4P)</td>
<td>2.90</td>
<td>51</td>
</tr>
<tr>
<td>Mar del plate</td>
<td>2.95</td>
<td>51</td>
</tr>
<tr>
<td>Charlesville (3P)</td>
<td>3.25</td>
<td>61</td>
</tr>
<tr>
<td>Leopoldville (3P)</td>
<td>3.45</td>
<td>61</td>
</tr>
<tr>
<td>Albertville (3St)</td>
<td>3.60</td>
<td>64</td>
</tr>
<tr>
<td>Baudouinyille (2P)</td>
<td>3.70</td>
<td>52</td>
</tr>
<tr>
<td>Leopoldville (1P)</td>
<td>3.60</td>
<td>59</td>
</tr>
<tr>
<td>Lufira (2P)</td>
<td>3.90</td>
<td>57</td>
</tr>
</tbody>
</table>

Note: FFA - free fatty acid.

TABLE 2. SAMPLE OF THE CONGO OILS SURVEY

<table>
<thead>
<tr>
<th>August 1955</th>
<th>Leerville</th>
<th>Bosondjo</th>
<th>Binga</th>
<th>Elisabetha</th>
<th>Flandria</th>
<th>Brubanta</th>
<th>Alberta</th>
<th>Yaligimba</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFA (molecular weight 256)</td>
<td>6.17</td>
<td>2.02</td>
<td>1.56</td>
<td>2.35</td>
<td>4.90</td>
<td>2.05</td>
<td>6.44</td>
<td>1.23</td>
</tr>
<tr>
<td>Iodine value</td>
<td>53.71</td>
<td>53.17</td>
<td>54.13</td>
<td>54.13</td>
<td>54.83</td>
<td>54.98</td>
<td>54.61</td>
<td>52.69</td>
</tr>
<tr>
<td>Total saturated acids</td>
<td>45.46</td>
<td>47.99</td>
<td>47.00</td>
<td>44.71</td>
<td>43.86</td>
<td>45.02</td>
<td>47.83</td>
<td>45.81</td>
</tr>
<tr>
<td>% Oleic acid</td>
<td>35.34</td>
<td>30.28</td>
<td>31.35</td>
<td>35.62</td>
<td>37.34</td>
<td>35.16</td>
<td>32.51</td>
<td>35.78</td>
</tr>
<tr>
<td>% Linoleic acid</td>
<td>9.70</td>
<td>12.37</td>
<td>12.28</td>
<td>10.16</td>
<td>9.31</td>
<td>10.33</td>
<td>10.17</td>
<td>9.98</td>
</tr>
<tr>
<td>% Conjugated dienes</td>
<td>0.13</td>
<td>0.05</td>
<td>0.03</td>
<td>0.13</td>
<td>0.10</td>
<td>0.14</td>
<td>0.11</td>
<td>0.08</td>
</tr>
<tr>
<td>% Linoleic acid</td>
<td>0.20</td>
<td>0.15</td>
<td>0.18</td>
<td>0.21</td>
<td>0.22</td>
<td>0.17</td>
<td>0.20</td>
<td>0.18</td>
</tr>
<tr>
<td>% Conjugated trienes</td>
<td>0.005</td>
<td>0.003</td>
<td>0.001</td>
<td>0.003</td>
<td>0.003</td>
<td>0.004</td>
<td>0.006</td>
<td>0.001</td>
</tr>
<tr>
<td>Melting point (°C)</td>
<td>37.7</td>
<td>40.0</td>
<td>42.0</td>
<td>37.0</td>
<td>39.4</td>
<td>37.9</td>
<td>41.3</td>
<td>43.0</td>
</tr>
<tr>
<td>Optical density @ 450 mµ</td>
<td>220.3</td>
<td>139.7</td>
<td>146.1</td>
<td>195.3</td>
<td>151.3</td>
<td>232.2</td>
<td>201.3</td>
<td>166.9</td>
</tr>
<tr>
<td>ASTM plasticity @ 16°C</td>
<td>78</td>
<td>44</td>
<td>44</td>
<td>56</td>
<td>77</td>
<td>52</td>
<td>75</td>
<td>43</td>
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<tr>
<td>ASTM plasticity @ 20°C</td>
<td>135</td>
<td>88</td>
<td>95</td>
<td>91</td>
<td>151</td>
<td>105</td>
<td>134</td>
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<tr>
<th>December 1995</th>
<th>Leerville</th>
<th>Bosondjo</th>
<th>Binga</th>
<th>Elisabetha</th>
<th>Flandria</th>
<th>Brubanta</th>
<th>Alberta</th>
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<tr>
<td>FFA (molecular weight 256)</td>
<td>3.68</td>
<td>1.92</td>
<td>2.14</td>
<td>1.97</td>
<td>2.84</td>
<td>4.34</td>
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<tr>
<td>Iodine value</td>
<td>53.26</td>
<td>52.33</td>
<td>52.46</td>
<td>52.31</td>
<td>54.72</td>
<td>53.67</td>
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<td>-</td>
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<tr>
<td>Total saturated acids</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>% Oleic acid</td>
<td>35.34</td>
<td>41.20</td>
<td>33.80</td>
<td>36.45</td>
<td>31.55</td>
<td>33.55</td>
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<td>-</td>
</tr>
<tr>
<td>% Linoleic acid</td>
<td>9.41</td>
<td>12.80</td>
<td>11.11</td>
<td>10.91</td>
<td>12.67</td>
<td>11.91</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% Conjugated dienes</td>
<td>0.05</td>
<td>0.07</td>
<td>0.06</td>
<td>0.12</td>
<td>0.05</td>
<td>0.04</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% Linoleic acid</td>
<td>0.21</td>
<td>0.29</td>
<td>0.26</td>
<td>0.33</td>
<td>0.24</td>
<td>0.23</td>
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<tr>
<td>% Conjugated trienes</td>
<td>0.005</td>
<td>0.003</td>
<td>0.014</td>
<td>0.003</td>
<td>0.006</td>
<td>0.011</td>
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<td>-</td>
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<tr>
<td>Melting point (°C)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>Optical density @ 450 mµ</td>
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<td>-</td>
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<tr>
<td>ASTM plasticity @ 16°C</td>
<td>75</td>
<td>58</td>
<td>59</td>
<td>53</td>
<td>62</td>
<td>59</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ASTM plasticity @ 20°C</td>
<td>138</td>
<td>84</td>
<td>87</td>
<td>77</td>
<td>114</td>
<td>114</td>
<td>-</td>
<td>-</td>
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</table>

Note: FFA – free fatty acid.
### TABLE 4. COMPOSITION AND PLASTICITY OF SAMPLES OF OIL AT VARIOUS LEVELS OF ACIDITY

<table>
<thead>
<tr>
<th>Sample No.</th>
<th>Initial oil</th>
<th></th>
<th>Same oil after neutralization</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A.1</td>
<td>A.2</td>
<td>A.3</td>
<td>A.4</td>
<td>B.1</td>
<td>B.2</td>
<td>B.3</td>
</tr>
<tr>
<td>% FFA (MW = 256)</td>
<td>1.76</td>
<td>3.50</td>
<td>8.35</td>
<td>13.33</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% FFA (MW = 270)</td>
<td>2.08</td>
<td>3.91</td>
<td>9.03</td>
<td>14.28</td>
<td>0.03</td>
<td>0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>Acid value</td>
<td>4.31</td>
<td>8.11</td>
<td>18.73</td>
<td>29.62</td>
<td>0.06</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>Hydroxyl value</td>
<td>3.79</td>
<td>8.28</td>
<td>20.66</td>
<td>27.19</td>
<td>2.80</td>
<td>7.42</td>
<td>15.39</td>
</tr>
<tr>
<td>% Monoglycerides</td>
<td>0.82</td>
<td>0.88</td>
<td>1.85</td>
<td>3.41</td>
<td>0.85</td>
<td>0.66</td>
<td>0.95</td>
</tr>
<tr>
<td>% Glycerol</td>
<td>0.013</td>
<td>0.022</td>
<td>0.013</td>
<td>0.032</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% Diglycerides</td>
<td>0.95</td>
<td>5.38</td>
<td>15.33</td>
<td>16.49</td>
<td>0.04</td>
<td>5.72</td>
<td>13.02</td>
</tr>
<tr>
<td>Melting point (°C)</td>
<td>37.0</td>
<td>41.0</td>
<td>34.10</td>
<td>33.50</td>
<td>38.3</td>
<td>36.9</td>
<td>26.60</td>
</tr>
<tr>
<td>Refraction index (nD60°C)</td>
<td>1.4517</td>
<td>1.4515</td>
<td>1.4508</td>
<td>1.4504</td>
<td>1.4516</td>
<td>1.4516</td>
<td>1.4513</td>
</tr>
</tbody>
</table>

Plasticity expressed as
1.1 millimeter of penetration:

- 0°C: 30.9 26.2 24.8 26.4 - - - -
- 10°C: 45.4 42.0 43.2 18.5 - - - -
- 10°C + 150 g: 59.8 71.5 63.4 57.7 54.3 54.4 54.4 49.5
- 15°C: 49.2 73.7 89.7 84.6 59.9 58.2 65.2 75.5
- 15°C dehydrated: 53.7* - 83** - - - -
- 20°C: 92.6 153.7 189.0 156.5 88.8 102.4 167.1 195.2

Note: * Moisture content 0.05%.
** Moisture content 0.0%.
ides resulting in modifying characteristics of the oil.

However, it is odd that an increase in mono and glycerides with high melting point corresponds to a lowering of the melting point of the oil and to an increase in penetration.

The melting points of the glycerides according to Bailey are given in Table 4.

Logically, oil should be less plastic when the proportion of mono and diglycerides increases. The explanation is provided by the microscope examination of the oil. It shows that oils with higher acidity give, under identical conditions of cooling, significantly smaller crystals (see microphotographies). It is not clear if crystals remain when a large quantity of diglycerides are present. In short, variations in the plasticity of Congo oils depend on the type of refining used.

The subject is till under investigation. It may be however concluded at present that the chief factor to watch for the production of oil with constant plasticity is the acidity.

Dilatometry

The plasticity of oil can also be determined by dilatometry. It has been confirmed that the method is suitable for sufficiently fluid oils (at temperatures close to the melting point) but that it is unlikely to lead to accurate results if tests are carried out at temperatures appreciably lower or higher than the melting point. As an illustration, the dilatometry curve of two samples of oil with FFA 1.76% and 8.35% respectively are given in Figures 1 and 2.

SAME TYPE OF COOLING (SLOW) DIFFERENT ACIDITY

Explanatory Comments

• The microphotographs 1, 2, and 3 above refer to Table 4;

• Compare the crystallization of 1 and 2. The identical cooling of the two samples of oil is induced by turbomixing in the presence of carbon dioxide ice. In both cases, the oil is slowly heated up to +15°C. The FFA of the oil is 1.76% and 8.35% respectively;

• Compare the crystallization of 2 and 3. The oils have the same acidity (8.35%). Sample 3 is melted then cooled down slowly to ambient temperature, then stored at -15°C. It is finally slowly heated up to +15°C; and

• Compare the crystallization of 4 and 5. Standard cooling (slowly to -15°C), and storage at 15°C of two samples of oil of different acidity (1.56% and 6.44%).

METAL CONTENT

In addition to the triglycerides and other constituents (pigments, antioxidants, sterol etc.), the oil contains a large number of metals which can be detected by spectrographic analysis. The usual metals of the oil are iron and copper. The ash normally amounts from 20 to 100 ppm of the oil weight. A typical analysis of the ash is given below*

Fe₂O₃ : 30% (polurography)
SiO₂ : 11.4%
Al₂O₃ : 7.0% (titration with oxinate)
SnO₂ : 9.0% (polaroography)
ZnO₂ : 26% (polarography)
PbO : 2.5% (flame photometry)
NaCl : 1.0% (flame photometry)
KCl : 2.0% (flame photometry)
Mg : Traces
Cu : Traces

Note: *Carried out by the “centre d’analysis spectrales moleclaires de l’Universite de Liege”.

The determination of iron and copper (with orthophenanthroline and diethyldithiocarbamate respectively) was carried out on various samples of oil obtained either by
large scale processing or by laboratory extraction without contact with metals. The presence of copper has not been proven in the oil as it exists in the fruit, but it has always been possible to detect iron regardless of the care taken during extraction of the oil from the fruit. There are several methods of extraction of metals from the oil. It has been possible to demonstrate that the procedure using the hydrochloric acid extraction of the boiling oil is far from being quantitative. Even after several hours of ebullition, the whole of the iron is not extracted from the oil (as one can verify by titrating the residual iron in the ‘iron free’ oil). The wet digestion is recommended (using sulphuric and nitric acid mixture). Iron and particularly copper affect the bleachability of oil.

In industrial processing, the contact between oil, even of low acidity (less than 1%), and copper should be avoided. As an indication, very good oil may contain 5 ppm of iron and 0.1 ppm of copper.

![Figure 1](image1.png)

**Figure 1. Dilatometry curve of all low density and of a mixture of low and high density oils.**

*Note: d = Density obtained by extrapolation of the density of the liquid oil.

   d' = Actually experimentally determined density.*

![Figure 2](image2.png)

**Figure 2. Dilatometry curve of all high density and of a mixture of high and low density oils.**

*Note: d = Density obtained by extrapolation of the density of the liquid oil.

   d' = Actually experimentally determined density.*
OTHER PROPERTIES

A number of characteristics of the oil were studied in relation to the treatments applied to the oil. The characteristics are as follow:

- the alkali refining loss (Wesson Loss);
- the transparency; and
- the formation of maturation products.

At the same time and still in relation to the treatment, the following were determined: peroxide value, bleachability with the Avros technique and the impurities content according to three different analytical procedures.

The transparency is assessed as follows: oil at 100°C is progressively poured into a test tube until a black dot on a white paper placed under the tube can no longer be seen. The test tube is lit laterally with a 40 W bulb.

The technique leads to good reproducibility provided tests are carried out with standardized equipment (temperature, source of light, test tube, distances, etc.).

The formation of maturation products is assessed either by storage in an oven or by the Baasrode test.

In the oven test, oil and an excess of water are placed for three days in an oven maintained at 60°C. After that time, the thickness of products formed at the oil interface is measured.

The Baasrode test is conducted by mixing together 25 g of oil with 10 ml of 10% alcoholic potash followed by agitation for 1 min and again addition of 40 ml ethyl alcohol followed by an additional 1 min of agitation. After adding 50 ml of petroleum ether to this mixture it is allowed to settle. As above, the amount of products formed at the interface are measured.

In Table 5 are given the results obtained in a series of treatments involving the washing of oil with a number of solutions of different composition:

- control;
- water: 3% on oil;
- anionic surfactant: 3% of 0.05% solution;
- ethylpolyoxide (non-ionic surfactant): 3% of 0.05% solution;
- cationic surfactant: 3% of 0.05% solution;
- mixture of various anionic surfactants: 3% of 0.05% solution;
- sodium chloride: 3% of 1% solution;
- sodium ethylene diamine tetracetate (sequenerring agent): 3% of 0.05% solution; and
- hydrosulphide: 3% of 1% solution.

Transparency

All compounds subjected to tests improve the transparency of oil except sodium chloride which is obviously deleterious. The best results are obtained with:

- hydrosulphide;
- cationic detergent; and
- non-ionic detergent.

In that order.

Peroxide Value

All products tested render the oil sensitive to oxidation except hydrosulphide. It would appear however that the non-ionic surfactants sensitize oil less than the anionic or cationic ones.

Bleachability

It would appear that washing has no effect on bleachability, except the hydrosulphide which has a beneficial effect in the case of the Avros method.
Refining Losses

The hydrosulphide appears to reduce refining losses, so does ethylene polyoxide but to a lesser extent. The anionic tension active agent appears to have a deleterious effect.

CONCLUSION

The hydrosulphide has the property to exert a beneficial influence on the following factors:

- resistance to oxidation;
- bleachiability;
- refining loss; and
- transparency.

The anionic surfactants on the contrary, adversely affects:

- resistance to oxidation;
- bleachiability;
- refining loss; and
- resistance to oxidation.

The other compounds have various effects on factors under study.

### TABLE 5. EFFECT OF VARIOUS CLEANING COMPOUNDS ON QUALITY OF PALM OIL

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Sample 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>% FFA</td>
<td>0.96</td>
<td>0.97</td>
<td>1.05</td>
<td>1.45</td>
<td>2.03</td>
<td>1.46</td>
<td>1.50</td>
<td>0.94</td>
<td>1.25</td>
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<tr>
<td>% Moisture</td>
<td>0.12</td>
<td>0.15</td>
<td>0.10</td>
<td>0.10</td>
<td>0.08</td>
<td>0.09</td>
<td>0.10</td>
<td>0.07</td>
<td>0.05</td>
<td></td>
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<tr>
<td>Peroxide value</td>
<td>1.9</td>
<td>2.1</td>
<td>2.2</td>
<td>2.6</td>
<td>3.3</td>
<td>3.0</td>
<td>3.0</td>
<td>2.9</td>
<td>2.1</td>
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<tr>
<td>Transparency #</td>
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<td>100</td>
<td>115</td>
<td>146</td>
<td>186</td>
<td>124</td>
<td>87</td>
<td>124</td>
<td>238</td>
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<tr>
<td>Maturation</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Baasrode test for maturation</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td></td>
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</tbody>
</table>

**Avros Bleaching Lovibond:**

- Red: 0.6 0.6 0.9 0.5 0.4 1 0.6 0.2 1.1
- Yello: 5 4 9 4 4 9 5 4 7

**Lumetron:**

- OD at 420 mµ: 0.145 0.140 0.150 0.130 0.165 0.140 0.140 0.135 0.05
- Wesson Loss: 2.40 1.85 2.52 2.05 2.70 2.50 2.48 1.73 1.53

**Impurities:**

- Minicol: 0 0 0 0 0 0 0 0 0
- Kaufmann: 0 0 0 0 0 0 0 0 0
- Acetone extract: 0.02 0.02 0.07 0 0 0 0.2 0.2 0.3
- Peroxide value after 1 month: 4.4 3.4 7.2 4.8 9.7 8.2 17.5 6.1 3.5
- Wesson Loss = Δ Acidity: 2.5 1.9 2.4 1.4 1.3 1.7 1.7 1.8 1.2

Note: # accuracy ± 1 unit.
## DENSITY OF COMMON MATERIALS

<table>
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<tr>
<th>Common materials</th>
<th>Weight (t m⁻³)</th>
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<td>Bitumen</td>
<td>1.04</td>
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<tr>
<td>Cement</td>
<td>1.44</td>
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<tr>
<td>Coal-solid</td>
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<tr>
<td>Coal-pulverized</td>
<td>0.85</td>
</tr>
<tr>
<td>Charcoal</td>
<td>0.30</td>
</tr>
<tr>
<td>Coke</td>
<td>0.50</td>
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<tr>
<td>Hay and straw</td>
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<td>Paper in rolls</td>
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<tr>
<td>Limestone</td>
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<tr>
<td>Granite stone</td>
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<tr>
<td>Slake lime</td>
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<td>Brick ballast</td>
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<tr>
<td>Stone ballast 38 mm</td>
<td>1.44</td>
</tr>
<tr>
<td>Stone ballast 13 mm</td>
<td>1.92</td>
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<tr>
<td>Fire wood-chopped</td>
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</tr>
<tr>
<td>Dry sand</td>
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</tr>
<tr>
<td>Dry earth filling (moderately rammed)</td>
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<tr>
<td>Compacted earth filling</td>
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<tr>
<td>Puddled clay stiff</td>
<td>2.16</td>
</tr>
<tr>
<td>Stag wool</td>
<td>0.27</td>
</tr>
<tr>
<td>Gravel (loose)</td>
<td>1.60</td>
</tr>
<tr>
<td>Gravel (rammed)</td>
<td>1.92</td>
</tr>
<tr>
<td>Stocks of books and files</td>
<td>0.85</td>
</tr>
<tr>
<td>Building rubbish</td>
<td>1.40</td>
</tr>
<tr>
<td>Glass in sheets</td>
<td>2.60</td>
</tr>
<tr>
<td>Timber</td>
<td>0.064 to 0.96</td>
</tr>
<tr>
<td>Wheat</td>
<td>0.83</td>
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<tr>
<td>Water</td>
<td>1</td>
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Due to the increased cost of printing, the advertisement rate is RM 700 per issue for an A4 size page of black and white, whereas the cost for colour is RM 900. One year of complimentary Vendor’s List advertisement for every one page A4-size colour or black & white advertisement. Advertisers are required to submit to us either their own black and white artwork or colour separation films. Cheque should be made payable to the ‘Malaysian Palm Oil Board’. If you have any queries, please contact the following at MPOB.

**Tel:** 03-87694400  **Fax:** 03-89262971

Dr. Lim Weng Soon  ext: 4406  •  N. Ravi Menon  ext: 4467  •  Lim Soo Chin  ext: 4676
E-mail: milleng@mpob.gov.my

Advertising Schedule for MPOB *Palm Oil Engineering Bulletin*

<table>
<thead>
<tr>
<th>Issue</th>
<th>Quarter</th>
<th>Deadline for Registration</th>
<th>Deadline for Submission of Artwork</th>
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<tbody>
<tr>
<td>94</td>
<td>Jan - Mar 2010</td>
<td>30 Jan 2010</td>
<td>28 Feb 2010</td>
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<tr>
<td>95</td>
<td>Apr - June 2010</td>
<td>30 Apr 2010</td>
<td>30 May 2010</td>
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<tr>
<td>96</td>
<td>July - Sept 2010</td>
<td>30 July 2010</td>
<td>30 Aug 2010</td>
</tr>
</tbody>
</table>

**REPLY-SLIP**

Dr. Lim Weng Soon/Ir. N. Ravi Menon  
Engineering and Processing Division  
Palm Oil Engineering Bulletin  
MPOB  
6, Persiaran Institusi  
Bandar Baru Bangi  
43000 Kajang, Selangor

PALM OIL ENGINEERING  BULLETIN ADVERTISEMENT – FULL PAGE ADVT.

1. We confirm our intention to advertise in the MPOB *Palm Oil Engineering Bulletin*.

   Company: 
   Address: 
   E-mail:                                                     Tel. No.:                              Fax No.: 
   Contact Person:                                                             Issue No.: 

2. The artwork is attached/will be sent on __________________________________ for your further action.

3. Please find enclosed *crossed cheque No.:__________________________ for RM ___________________ ( ____________________________ ) being payment for the advertisement fee.

4. Thank you.

   ________________________________  ________________________________
   (Signature and Date)             (Company chop)

* Made payable to ‘MALAYSIAN PALM OIL BOARD’.
Following a decision by the Editorial Board to further increase the role of Palm Oil Engineering Bulletin to serve the industry better, a new addition called Palm Oil Mill Vendor’s List has been introduced similar to Telekom Yellow Pages to assist mill engineers to know where to source materials or services pertaining to the industry. In order to make this useful, we need the co-operation of the mill engineers/managers to persuade their vendors to advertise in the Vendor’s List for a nominal fee of RM 100/year (four issues). If you have any queries, please contact the following at MPOB.

Tel: 03-87694400    Fax: 03-89262971

Ir. Ravi Menon ext. 4467 or e-mail: nravi@mpob.gov.my
Ms. Lim Soo Chin ext. 4676 or e-mail: milleng@mpob.gov.my

---

**REPLY SLIP**

Dr. Lim Weng Soon/Ir. N. Ravi Menon
Engineering and Processing Division
Palm Oil Engineering Bulletin Advertisement
MPOB, 6, Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia.

We wish to advertise in the MPOB Palm Oil Engineering Bulletin Vendor’s List

<table>
<thead>
<tr>
<th>Company:</th>
<th>Issue No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Person:</td>
<td>H/P:</td>
</tr>
</tbody>
</table>

Address:

E-mail: Tel: Fax:

Please find enclosed a crossed cheque No.:

for RM: Bank: (Ringgit Malaysia)

drawn in favour of MALAYSIAN PALM OIL BOARD

Please select the headings from the list given below (not more than five headings) under which you wish to advertise.

- Air filters/dryers
- Air separators
- Bearings/belts/bushes
- Biomass/bio-compost/products
- Boiler spares/control/others
- Boiler suppliers
- Bunch crushers
- Castings
- Cleaning - general
- Civil engineering
- Condition monitoring
- Control/automation/spares
- Conveyors/chains/elevators
- Consultancy services/certification
- Diesel eng./services/spares
- Dynamic balancing
- Electric motors/systems
- Expansion joints
- Fabrication works
- Fans
- Filter press/materials
- Fluid control system/connections
- Gaskets/packing materials/seals
- Gear boxes
- Hardware
- Hydraulic systems/services/spares
- Laboratory analysis
- Laboratory equipment
- Lubricants
- Mill machinery/spares
- Miscellaneous
- Nut crackers
- Oil recovery systems
- Oil palm kernel oil crushing plant
- Pollution control/safety systems
- Pressure vessels
- Pumps/services
- Purifiers
- Renewable energy
- Screw press/parts
- Scrubbers
- Sludge separators/decanters
- Steam turbines/generator/spares
- Sterilizer/ports
- Storage silos
- Vacuum pumps
- Valves/seats
- Waste water treatment
- Water treatment
- Welding equipments
- Weighing machines/spares
- Wheel loaders/spares

Signature: ____________________________
Name: ______________________________
Date: ______________________________

Company chop
From: 

Address: 

Question/Comment: 

Signed: 

Date: 

(We have enclosed this form to assist you in sending to us any questions or comments)