Editorial

Malaysian entrepreneurs interested in investing in palm biodiesel production must be in a real dilemma on whether it is sustainable as a long-term investment. There are many favourable and an equal number of unfavourable issues associated with this venture. One thing we are sure about is that we are going to convert a food into a fuel and the basic question anyone would like to ask will be which should be given priority - food or fuel?

Granted, that if food is in excess, the excess could be diverted as fuel. But will palm oil always remain as a surplus commodity especially when the world population is growing in geometrical proportions in the present mainly warless state? Added to this is the natural evolution of human mind to improve their living standard. One of the criteria for the measurement of living standard of any nation is the per capita consumption of oils and fats, which in developed nations is above 20 kg yr\(^{-1}\) but considerably less in Third World countries.

If world population rise is directly proportional to the production rate of palm oil then it is possible to maintain the existing production rate of biodiesel but attempts to increase the production rate of biodiesel at any point of time will upset the balance of production and excess feedstock. This certainly is not going to be of much help in reducing the rate of carbon emissions when biodiesel production is in a stagnated state. Not withstanding the above, we believe that palm biodiesel production will contribute partly to solving our
energy and environmental issues. At the same time, it will serve to stabilise the palm oil price.

We need to look also at other solutions which are independent of the sensitive food chain. Biomass, no doubt, is readily available but being bulky with high moisture content does not attract the investors as a viable fuel at the moment for electricity power production. In addition, man-made obstacles like subsidy on fossil fuels indirectly make the biomass less attractive in terms of return on investment.

Another attractive potential is the use of cellulose as the feedstock for producing ethanol for long-term sustainability of using oil palm biomass. This also does not compete with the food chain but more R&D will be needed to produce ethanol. Many world experts believe that solution for the energy crisis lies in the use of biomass and cellulose for displacing fossil fuels.

The use of non-edible oils like jatropha is gaining global attention in recent times as feedstock for biodiesel production. Palm oil producers like Malaysia and Indonesia may not favour this crop as they are used to high oil yields like 4-6 t ha\(^{-1}\) yr\(^{-1}\) compared to about half of this for jatropha. Jatropha could be planted in marginal areas, which are not suitable for oil palm as jatropha is known to be suitable for such areas. A number of countries such as Myanmar, Indonesia, India and a few African nations have already gone into jatropha cultivation.

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**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.
Recent Events

Berita Sawit Contract-Extension Signing Ceremony

The Malaysian Palm Oil Board (MPOB) will continue to look at commercialization of research and technology to help develop the palm oil industry.

“So far, 30% of the technology has been commercialized and transferred for the benefit of the industry. This will also open up business opportunities for small- and medium-sized entrepreneurs,” Dato’ Dr Mohd Basri Wahid, Director-General of MPOB said at the Berita Sawit contract-extension signing ceremony at Balai Berita on 11 September, 2006.

Berita Sawit is a monthly advertorial pull-out in the Berita Harian that features articles on Malaysian palm oil industry.

“A total of 350 new technologies and products have been developed so far to increase palm oil’s competitive edge,” Dato’ Dr Mohd Basri said.

The technologies are for various sectors such as planting, manufacturing and processing, food, oleochemicals, biomass and palm oil-based biofuel.

Palm oil is the nation’s main agriculture commodity with exports contributing RM 28.6 billion towards Malaysia’s total export revenue in 2005.

Launching of Supervized Fertilizer Cluster Scheme

Thirty smallholders in Sabah received their grant under the Scheme to Supply Good Quality Oil Palm Seedlings to Poor Smallholders in Sabah and Sarawak from the Deputy Minister of Plantations Industries and Commodities, Datuk Anifah Haji Aman on 20 July 2006.

The objectives of the scheme is to help poor smallholders to increase the productivity of their crops by giving away good quality oil palm seedlings and advices on planting, fertilizer application, pest and disease control, and harvesting.

During the event, the Deputy Minister also launched the Supervised Fertilizer Cluster Scheme (or Kelompok Baja Terselia [KBT]).

The supervised fertilizer cluster was a well-received concept initiated in August 2003 to improve the productivity amongst the millers, fresh fruits bunch dealers and smallholders. For the Sabah Region, two

Contributed by: Noor Asmawati Abd Samad*

*Malaysian Palm Oil Board, P. O. Box 10620, 50720 Kuala Lumpur, Malaysia.
schemes were launched, namely KBT Kota Kinabatangan and KBT Asiatic Sabahpalm.

Since 2003, 12 supervised fertilizer clusters had been launched. The Deputy Minister also gave away prizes for Smallholders Lucky Draw.

**Technology Demonstration Month**

The MPOB Technology Demonstration Month (3 – 28 July 2006) was held at MPOB Head Office in Bandar Baru Bangi. The Technology Demonstration Month (TDM) is organized annually to ensure the industry is aware of the latest research results available for adoption and commercialization.

During the month, the latest and previous MPOB research and development findings are displayed. Four mini series of half-day, once each week were organized on selected topic such as engineering and processing, food and product development, biological and oleochemical technology.

The main objective of organizing TDM is MPOB will license its technologies to interested parties who will do the production and marketing of the products. Forms of transfer of technology and collaboration include licensing, pilot plant development, use of incubator facilities and consultancy.

**Workshop on Clonal and Quality Replanting Material**

Clonal and Quality Replanting Material Workshop 2006, was organized by the Malaysian Palm Oil Board (MPOB) at the Palace of the Golden Horses Hotel, Seri Kembangan, Selangor and officiated by the Minister of Plantation Industries and Commodities, Datuk Peter Chin Fah Kui on 10 August 2006.

The Minister said, “it is the right time to address an important issue currently facing the industry. This issue relates to stagnating oil yield”.

“The theme of the workshop, Towards Increasing National Productivity by 1 tonne per hectare per year is an exciting topic and one that will engender much discussion on formulating recommendations that can be translated into policies and programmes to realize the government’s vision of achieving 35 t oil palm FFB ha⁻¹ yr⁻¹ and 25% oil extraction rate by year 2020”, said the Minister.

The opening ceremony was also attended by the Chairman of MPOB, Tan Sri Dato’ Seri Haji Basir Ismail, Deputy Secretary
The National Seminar on Palm Oil Milling, Refining Technology, Quality and Environment was officiated by the Chief Minister of Sarawak, Pehin Sri Haji Abdul Taib Mahmud in Crowne Plaza Riverside, Kuching, Sarawak on 14 August 2006. It was a two-day event.

A total of 26 oral presentations including two keynote papers and nine posters were presented. The seminar had attracted 400 participants. Besides that, the seminar also included an exhibition, which provided opportunities for the various technology suppliers to showcase their latest technologies applicable to the palm oil industry.

It attracted 38 companies and in recognition of their continued support and to encourage the exhibition to be more dynamic in their marketing, MPOB had prepared three awards for the best exhibiting booth, based
on a few criteria such as the overall appeal and appearance of the booth, the technical services provided by the staff manning the booth and other marketing skills employed by the company. The overall winner was Leesonmech Engineering Sdn Bhd, first runner-up Sawipac Sdn Bhd and third place went to Betronics (M) Sdn Bhd.

**Official Opening of the World’s First Integrated Palm Biodiesel Plant**

The World’s First Integrated Palm Biodiesel Plant developed by MPOB and Carotino Sdn Bhd was officially launched by the Prime Minister of Malaysia, Dato’ Seri Abdullah Haji Ahmad Badawi at Pasir Gudang, Johor on 15 August 2006.

The MPOB-Carotino relationship is maturing with the commercializing of the World First Integrated Palm Biodiesel Plant. The plant produces both regular palm biodiesel and winter grade palm biodiesel that meets the stringent European specification (EN 14214) and US specification (ASTM 6571).

Also present for the launching were the Menteri Besar of Johor, Dato’ Abd Ghani Othman and the Minister of Plantation Industries and Commodities, Datuk Peter Chin Fah Kui.

**MoU on Biodiesel and Biomass**

MPOB and the Department of High-Technology Development and Industrialization, Ministry of Science and Technology (MOST), China signed an agreement for bilateral cooperation in research and development on biofuel and biomass. The Director-General of MPOB, Dato’ Dr Mohd Basri Wahid represented MPOB and the Director-General, Mr Feng Jichun represented the Department of High-Technology Development and Industrialization, MOST, China.

The signing ceremony was witnessed by the Plantation Industries and Commodities Minister, Datuk Peter Chin Fah Kui and Vice Minister of Science and Technology of China, Prof Ma Songde, at KLIA Pan Pacific Hotel, Sepang, Selangor on 29 August 2006.
### 2006 MPOB TRAINING PROGRAMME SCHEDULE

<table>
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<th>CODE NO.</th>
<th>COURSES</th>
<th>TITLE</th>
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<th>VENUE</th>
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<tr>
<td>A1.1</td>
<td>Oil Palm</td>
<td><strong>Kursus Kemahiran Menggred Buah Sawit</strong></td>
<td>25 – 27 Julai</td>
<td>Kuala Terengganu, Terengganu</td>
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<td></td>
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<td>Bil. 5: Timur</td>
<td>22-24 Ogos</td>
<td>Kuching, Sarawak</td>
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<td>Bil. 6: Sarawak</td>
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<td><strong>Peperiksaan Kemahiran Menggred Buah Sawit</strong></td>
<td>28 Sept.</td>
<td>MPOB Lahad Datu, Sabah</td>
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<td>Peperiksaan Bil. 6</td>
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<td>A1.2</td>
<td>Oil Palm</td>
<td><strong>8th Intensive Diploma in Oil Palm Management and Technology Course</strong></td>
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<td>Semester I Estate Attachment</td>
<td>12 June – 5 July</td>
<td>MPOB HQ</td>
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<td>Semester II Estate Attachment</td>
<td>7 - 16 July</td>
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<td>Semester III Estate Attachment</td>
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<td>28 Aug. - 21 Sep.</td>
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<td>A1.3</td>
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<td>21 – 25 Nov.</td>
<td>Trolak Country Resort, Perak</td>
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<td>Palm Oil</td>
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<td>A2.1</td>
<td>Palm Oil</td>
<td><strong>The 19th MPOB Oil Palm Products Surveying Examination</strong></td>
<td>22 – 24 Aug.</td>
<td>Port Klang, Selangor</td>
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<td>A2.2</td>
<td>Palm Oil</td>
<td><strong>Reclamation Welding Technology in Palm Oil Industry</strong></td>
<td>21 – 23 Nov</td>
<td>PLASMA, MPOB, Lahad Datu</td>
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## Forthcoming Events

### 2006 MPOB CONFERENCES/SEMINARS

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| 1.  | MPOB Technology Demonstration Month 2006                           | 6 July
    |                                                                       | 13 July
    |                                                                       | 20 July
    |                                                                       | 27 July               | MPOB HQ |
| 3.  | Persidangan Kebangsaan Pekebun Kecil Sawit                         | 20 – 21 Nov.          | Hotel, Kota Kinabalu, Sabah                    |

Notes: *
- To be confirmed.

† By invitation.

** Course approved under PROLUS scheme of Pembangunan Sumber Manusia Berhad.

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

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Feature Article

Automated Non-Chemical Water Treatment for Boiler
Andrew S B Liew*

ABSTRACT

Electronic water conditioning is a relatively new technology which has evolved from the use of magnetic fields in water quality improvement. The advent of these systems introduces both variable energy and frequency changes. Electronic treatment is based on the principle of creating an oscillating field of energy with the use of low frequency radio or square waves. As water passes through a pipe delivering variable frequencies and energy levels, physical changes in the water clusters structure and preferred crystal structure of calcium and magnesium occurs. It changes the CaCO$_3$ crystalline structure to aragonite rather than the random crystalline structure of calcite. Aragonite is a form of calcite crystal that stays in suspension and does not adhere to surfaces. This action stops any further build-up of scale and because the solubility of the water is increased, existing scale is taken back into the water and gradually removed. It is also a magnetite generator, causing the formation of black rust Fe$_3$O$_4$ called magnetite instead of the common red rust Fe$_2$O$_3$. This acts as a protective layer, preventing further corrosion, as it is an inert material. The magnetite layer is self-generating, if there is any damage to it. Scale prevention and corrosion control provided by this process result in an non-chemical water treatment for boiler. This environmental friendly system does not require daily chemical analysis of water, reduces labour requirement and even equipment replacement, all at a cheaper cost over the existing chemical treatment.

INTRODUCTION

The treatment of water by magnet has been in the market for many years, and reports from as early as the 1930s has been reported of the scale controlling affects of magnetic force. Due to the misunderstanding of the science behind it, coupled with the results, where sometimes it has not shown to be so effective, this water treatment system based on magnetic treatment has picked up quite slowly (Chew, 2001).

However, due to the technological advancement today, electromagnetic water treatment, which has evolved from magnetic water treatment is becoming generally accepted. To many, it is already a mainstream technology. Reputable water treatment companies around the world are applying hundreds of thousands of units. In the industrial market, most are going onto boiler make-up and cooling towers. Chemical supply companies have been very vocal in attacking this technology for very obvious reasons. When descaling did occur, those results were dismissed as a result of some other unknown variable influencing the application (Chaplin, 2006).

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While the evidence supporting the technologies may be thought of as mainly anecdotal, the fact remains that upon visual inspection after installation of these devices the formation of new scale deposits has been inhibited. In addition, in most cases, scale deposits present within the system at the time of installation have been removed. Probably the most significant general trend in water treatment is the shift from chemical-based treatment technologies. This trend which begun at the consumer level, is becoming apparent at the corporate level, and will continue to grow as awareness and pressure not to pollute the environment increases.

There may be some confusion between magnetic treated water and electromagnetic wave treated water with Bac Comber descaler. Magnetic treated water, whether with the use of permanent magnet or electromagnet clamped onto the pipe produce a magnetic flux which magnetise the water as it flows through the equipment. In this treatment, a high velocity flow is required to get the water magnetized or polarized. Rapid movement (1200 rpm) in a strong magnetic field (4.75 T) produces a significant effect compared with the movement within field alone (Gehr et al., 1995). Static magnetic effects have been shown to cause an increase in the ordered structure of water formed around hydrophobic molecules and colloids (Ozeki et al., 1991), as shown by the increase in fluorescence of dissolved probes (Higashitani et al., 1996). This reinforces the view that it is the movement through a magnetic field, and its associated electromagnetic effect, that is important for disrupting the hydrogen bonding. Passing an electromagnetic field or an electrostatic force through water breaks the hydrogen bonds between the water molecules. By breaking even a small percent of the hydrogen bonds, water becomes wetter and the surface tension of the water decreases.

However, treatment of water with Baccomber descaler has the opposite effect. It increases the hydrogen bonds between water molecules, increasing the strength of water lattice structure or the water cluster size. This will increase the surface tension of the water as the water molecules hold onto each other much stronger as shown in Figure 1. The increase in surface tension can actually be measured by a water tensor meter.

The treated water has the ability to hold dissolved ions in the water cluster and even better as the temperature increases because the water lattice become stronger. This increases the solubility of water (Chew, 2001).

The langelier saturation index (LSI) which is used to measure water condition to determine a theoretical thermodynamics equilibrium model of calcium carbonate provides an indication of whether the water be it corrosive or scale forming will actually shift to the right for water treated with BacComber descaler as shown in Figure 2. So the scale will not form so easily. However, LSI cannot be used to measure corrosiveness for BacComber descaler treatment as the magnetite generated will prevent corrosion (Chew, 2001). In actual fact, the term corrosivity here is better referred to as dissolvability, as it is the ability of the water to dissolve a substance into the water.
Notes: If LSI is negative <0: no potential to scale, corrosive, will dissolve calcium carbonate.
If LSI is positive >0: scale forming and calcium carbonate precipitation may occur.
If LSI = 0: stable

Figure 2. Langelier saturation index of treated water shifted.

The stronger water lattice structure traps the dissolved ions so that ions like calcium and carbonate ions will have less opportunity to come together to form calcium carbonate or calcite, as shown in Figure 3.

The use of extremely low frequency electromagnetic wave of varying randomized wavelength from a few hundred Hz to 50 000 Hz in digital square wave form, which is the technology that BacComber descaler utilizes, requires water to pass through slowly. This allows a longer period of exposure time when water passes through the inductor coil that emits the wave. As the frequency is emitted by an electronic device, it is also stable and constant, unlike a magnet in which the magnetic flux strength can decrease over time because of vibration and heat on the pipe which it is clamped onto. The magnet gets demagnetized a period of time. BacComber descaler utilizes a technology that is completely different from the magnet treatment.

The increase in H-H bond of the water molecules result in the OH part of the water molecules being free and sticking out. This phenomenon results in the pH of the water becoming alkaline even without the

Figure 3. How water cluster traps ions and dissolved gas.
addition of chemicals. In fact, pH of water in an enclosed container can actually become alkaline when it is placed within an inductor coil attached to the descaler for a period of time. This is one of the reasons why pH of water inside boiler can go up to pH 10 - 11, the other being the presence of bicarbonate ions in the water.

The principle or technology that the BacComber descaler utilizes can also be applied to age wine. A bottle of cheap wine can be treated to improve its taste to gain a more complex and balanced aroma, to gain a full spectrum of subtle taste and to reduce the puckery, astringent feel of tannins, and overall to smoothen and soften the mouth feel. Why does wine age and why does it takes so long to happen? In the ageing process, Tannin monomers polymerize with themselves or with the pigment (anthocyanin). Once polymerized during ageing, the Tannins will not bind with the salivary protein or glycoprotein and the effect of astringency is removed. That’s why we get the smooth feel after ageing. The Polar Bon attraction force is very weak in comparison, hence, it will take years for natural ageing to happen. The technology that BacComber uses strengthens the Polar Bon, accelerating the ageing process from years to minutes (Chew, 2005).

BacComber technology can be used in all heat transfer systems that use water as the medium for heat transfer. Cooling tower, chillers and boilers are the major equipment. In the cooling tower, where microbes such as algae and bacteria are present, the use of another space technology is the introduction of copper and silver ions into the water through the ionization of copper and silver in the form of electrodes. Copper and silver are algaecide and bactericide (Chew, 2001).

**HARD SCALE CONTROL**

Limescale (consisting of mainly calcium carbonate, plus calcium sulphate, barium phosphate, calcium phosphate, magnesium hydroxide, zinc phosphate, iron hydroxides and silica, dependent on the geographical area) is a problem in heated water systems wherever water is obtained from limestone area, chalk countryside. It is formed primarily because the solubility of calcium carbonate decreases with increasing temperature. Limescale is only a problem if calcium carbonate deposits rhombohedral calcite crystals, which may form directly or subsequent to metastable hexagonal and fibrous vaterite crystal formation (Coey et al., 2000) as shown in Figure 4. When calcium carbonate is formed at a higher energy level, orthorhombic aragonite crystals that have a higher density is formed, as shown in Figure 5. Although aragonite is intrinsically harder, it is less prone to form hard scale (Young et al., 2005). Aragonite, usually powder in nature, is suspended in water. During blow down, a large amount of the aragonite goes out with the water. Since aragonite does not really stick to the surface it will not impede heat transfer.

![Figure 4. Rhombohedral calcite crystal.](image1)

![Figure 5. Orthorhombic aragonite crystal.](image2)
CORROSION CONTROL

The BacComber is not only an equipment that prevents scale formation and removes scale formed on the steel surface, it also prevents corrosion on boiler surface. There are two levels of corrosion protection:

- the excited water molecules will trap the dissolved oxygen ions and reduce the chances of formation of iron oxide at the steel surface, hence, reducing the corrosion rate; and
- when steel surface and water are electromagnetically excited, they acquire a higher energy, causing the formation of black rust called magnetite instead of the common red rust Fe₂O₃. The magnetite has composition of Fe₃O₄ adhering to steel surfaces in contact with water. Unlike Fe₂O₃, the Fe₃O₄ layer is stable and will act as a protective layer preventing further corrosion by dissolved oxygen.

Where damage of this magnetite layer occurs, the process is constantly repeated ensuring that the damage is repaired.

During the process of magnetite formation, steel surface exposed to oxygen upon descaling will form a layer of rust and thereafter an inert layer of magnetite is formed underneath protecting the steel against further corrosion as shown in Figure 6. As the red rust dissolves and goes into solution, the inert magnetite layer beneath is exposed.

Even without addition of an oxygen scavenger, concentration of Fe in blow down water will be 1-2 ppm once in equilibrium as shown in Figure 7.

THE SYSTEM

The descaler system basically consists of two servers and several drivers in a console box, which are made up of both hardware and software. One server is the operating server while the other one acts as a back-up. When the operating server fails, it will automatically switch over to the back-up server and a warning light will lit up to indicate that the normal server needs repair. Each driver can cater for 10 – 20 t steam per hour, depending on the quality of the water. Each driver will have a LED light to monitor that it is functioning. An inductor consists of wire coils on a polypropylene pipe which is used to reduce interference on the wave signal and is connected to the control panel that houses the drivers through the wire coil ends. The numbers of drivers or inductors required will depend on the capacity of the boiler and quality of the water, especially the concentration of silica in the water. The descaler is installed to a circulatory system where water from the hot water tank or feed tank, usually 70°C - 80°C, is pumped through the inductors several times to allow sufficient dosage or exposure time before the water is pumped to the deaerator with the mill’s existing system to the boilers. Therefore, during installation and operation of the BacComber system, it does not interfere with the the existing mill’s boiler system.
system. A typical circulatory system is shown in Figure 8.

The circulatory system will have two pumps, with one as a standby, and each has a capacity three times that of the boiler capacity. This is to circulate the water three times before it goes into the boiler.

PARAMETERS

The parameters for monitoring the operation of the descaler system are very different from that of chemical treatment. The parameters that are monitored for both feed water and blow down water are total hardness (TH), total dissolve solids (TDS), pH, iron (Fe) ions and silica (Si). It is highly recommended that the TDS be maintained at about 1200 ppm and silica at 120 ppm, whichever comes first for blow down. The calcium carbonate can also be monitored if desired. This will be in the form of aragonite which is in the blow down water. Sample of blow down can be taken and the aragonite filtered out using a filter paper and then reacted with hydrochloride acid to find out the amount of aragonite (calcium carbonate) in the sample. Mean values of the water parameters measured for both feed water and blow down water of a boiler fitted with BacComber descaler is shown in Table 1.

It was seen that even though the TDS has increased from 88 ppm to 1063 ppm, the TH has more or less remain unchanged, indicating that the calcium has been converted to aragonite and blown out together with the blow down water. Even without oxygen scavenger, the Fe ion in the blow down water is only 1.6 ppm. The formation of an inert magnetite layer over the steel surface of the boiler protects and prevents the steel surface from rusting.

BacComber descaler has been used in both small package fire tubes boilers and bigger water tubes boiler in many countries now without any chemical inputs. Water does not need softening anymore. Old calcite scales were removed from the boiler surface, and an inert layer of magnetite was formed on the surface to prevent further corrosion of the boiler surface. The descaler has given good results except for one or two cases where the blow down TDS of the

Figure 8. Circulatory system of descaler for boiler water treatment.
boiler water was at 2500 ppm to 3000 ppm for several months because the automatic blow down valve was not functioning properly. During this time, bore well water was used instead of river water. The silica content of the water was not measured and it has resulted in calcium silicate formation in the boiler. When the silica content in the water was measured, it was at the 500 - 600 ppm concentration which is four to five times more than the recommended value for blow down. Regardless of chemical or non-chemical treatment, calcium silicate would have formed in the pipes. However, in this case, it was also observed that the calcium silicate was also getting descaled without any input of chemicals in the boiler. This preliminary finding has shown that besides descaling of calcite from the boiler surface, the descaler is also able to descale calcium silicate. Part of these calcium silicate scales will be flushed out together with the blow down water and the rest removed from the mud drum and header during opening of the boiler for servicing. However, in normal circumstances when the TDS in the blow down is maintained at 1200 ppm or silica at 120 ppm, formation of calcite and calcium silicate should not occur.

If problems of calcium carbonate or silicate scale do arise they can now be overcome or removed within 480 hr by using a product called Nano Pipe Cleaner (NPC) which uses nano technology. This product will dissolve the calcium carbonate or silicate scale from the surface back into the water and will be flushed out together in the boiler blow down. It is non-acidic and will not corrode the steel surface, and the treatment is done in 480 hrs. The BacComber descaler system for automated non-chemical boiler water treatment will work very well together with Nano Pipe Cleaner to make the boiler surface absolutely clean without any use of abrasive chemicals in the boiler for good efficient heat transfer, providing longer life span to the boiler tubes while contributing to a greener environment.

**COST SAVINGS**

The cost of installing the descaler system depends on the size of the boiler used and the quality of the water. Being a capital item, it will be cheaper for mills that have long operating hours. There will be savings on labour, supervision, water analysis, equipment, pipe replacement due to corrosions and damages and the yearly pipe and boiler cleaning before the boiler inspection. Since softener treatment of boiler feed water is not required anymore, there will be huge savings on resin replacement, and water consumption from backwash. A typical mill of 90 t hr⁻¹ processing 486 000 t FFB yr⁻¹ with two 35 t hr⁻¹ boilers operating consecutively with no high silica problem will require a descaler system with four drivers. Based on a payback period of three years, the cost but will be RM 0.166 per tonne of FFB. This cost saving is only when compared with softener and chemicals cost, it excludes other savings. There will be saving on fuel used as there will be saving on energy because there will be fewer blow downs. The TDS build-up is only from the water. Chemical dosing can contribute up to 50% of TDS build up in boiler, depending on the water quality.

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**TABLE 1. MEAN VALUES OF WATER PARAMETERS FITTED WITH BACCOMBER**

<table>
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<th>Blow down water</th>
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<td>pH</td>
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REFERENCES


Status and Developments of Palm Oil Mill Technology

N Ravi Menon*

SYNOPSIS

This topic is indeed a long one and probably can be written as a complete book if an attempt is made to cover all aspects of oil palm development in detail. In this paper, the author purposely wanted to unveil to the palm oil community a glimpse of the historical past on the development of the industry. Many countries for which oil palm was totally foreign have now emerged as giants of the industry making the countries from where it originated fade into oblivion during the past few decades. In the beginning, oil palm was only considered to be a decorative palm meant for gardens but today it has become a formidable commercial crop growing very fast throughout the world. A glimpse of the latest technologies of recent origin is also in this paper, although it is possible some others could have been left out. Palm oil development in recent times had been quite rapid and probably in a decade or two, faster development is anticipated in the field of biodiesel, oleochemicals and some health products.

HISTORICAL BACKGROUND

The centre of origin of the palm oil is the tropical rain forest region of West Africa mainly in a 200 – 300 km wide western coastal belt stretching from Gambia to Angola. The oil palm is indigenous to Africa and palm oil extraction dates back to about 3000 B.C. It grew on its own accord without being cultivated at the sites of homesteads that generally followed the trade routes and settlements of slaves. The Deli Dura was introduced into the Southeast Asia in 1875.

STAGES IN PLANTATION DEVELOPMENT

The development of the oil palm industry in Peninsular Malaysia can be divided into three stages:

First Stage

This stage spanned 1875 to 1916 when oil palm seeds were introduced in Singapore (Zeven, 1965) and the government conducted studies on the suitability of oil palm cultivation in Malaysia and the planting of oil palm for decorative purposes. From 1903 onwards, the Department of Agriculture imported seeds to Batu Tiga Experimental Plantation and to the Public Gardens in Kuala Lumpur. The testing of oil palm was transferred to the Experimental Plantation where 6 ha of oil palm were planted in 1912 with seedlings selected from the Public Gardens. The origin of the seeds was not known except that of the Deli type as recorded by Milsun (1921). Three varieties from Nigeria – Microsperma, normal Dura...
and Mantle fruited were also planted in the Experimental Plantation in 1914 (Jouge, 1952).

In 1911, Henri Fauconier, a Frenchman, visited Tanjong Morowa Kiri Tobacco Estate near Medan in Sumatra, purchased Deli seeds. The seeds were planted at Rantau Panjang Estate near Kuala Selangor. In 1912, he obtained more seeds from the same source with the help of Adrian Hallet, a Belgian who selected the seeds from the best selected palms. The seeds were planted at the Rantau Panjang Estate entrance and the Rantau Panjang Estate bungalow known as La Mansion des Palmes. Oil palm and rubber; however were introduced into Malaya at the same time and Malaya became the largest world producer of rubber, but the oil palm industry has yet to grow on a commercial scale probably due to its lesser world demand at that time.

At the same time in Netherlands East Indies, commercial planting of oil palm started a decade earlier mainly due to the efforts of Adrian Hallet, who set the oil palm industry going. Malaya had to wait until 1917 when Henri Fauconier, a friend of Hallet, planted the oil palm in Tennamaram Estate in Selangor, having obtained the seeds from Rantau Panjang Estate. While Fauconier was planting oil palm in Rantau Panjang Estate for decorative purposes, Tennamaram Estate, nearby, was being opened up for coffee planting. The coffee experiment was a failure and as a result oil palm was tried out as an alternative having brought the seeds from Tanjong Rantau Estate. Thus, Tennamaram Estate became the first commercial oil palm plantation in Malaya marking the beginning of its oil palm industry.

Second Stage

This stage comprises a long period stretching from 1917 to 1961 considered to be an exciting stage which laid the foundation for the rapid expansion in the 1960s. The second commercial oil palm plantation was developed at Elmina Estate. It was opened up in 1919 and the first 6 ha planted in 1920, growing to 2331 ha in 1922 and 8087 ha by the end of 1923. The progress was slow because of the renewed demand for rubber in 1925 following the introduction of the Stevenson Scheme for promoting rubber. However, there was a marked increase in oil palm cultivation from 1926, when large areas of land (8000 ha) in Johor were alienated for oil palm cultivation on very generous terms. This area in Johor expanded to 50 000 ha in 1930 and three years later to 63 000 ha. In 1940, the total hectares was 77 000 ha. Despite the low palm oil prices, the expansion in oil palm cultivation continued, although not dramatically. In 1940 - 1941, Malaysia exported 51 000 t of palm oil contributing 12% of the world production, and was the fourth largest producer. The Japanese occupation from 1941 to 1945 resulted in neglect of the crop, but picked up after the war as the palm oil prices soared to four to five times higher than that of pre-war days. This further encouraged the cultivation of oil palm in Malaysia and by 1960, the total area under oil palm cultivation was 135 000 ha.

Third Stage

The need for crop diversification was emphasized by the World Bank Mission and Malaysia continued its expansion programme of oil palm cultivation until what it is today (2005), with oil palm land of over 4 million hectares producing about 15 million tonnes of palm oil a year.

PROCESSING MILESTONES

This will be discussed in three stages. The first stage covers from time immemorial until the technology received colonial attention for mechanization which form stage two of the development. The third stage covers the current rapid technology modernization.
Stage 1. Production Technology - 5000 years

This technology for the production of two types of popular oils called hard and soft oils developed in Africa was presented in a paper by Nwanze (1942). For both soft and hard oils, FFB is cut into sections, watered, covered with leaves and left for two to four days to ferment. Both methods, since the very early days, used crude hand or foot methods to extract oil and kernel. The kernels are separated and sun dried. After drying the nuts, they are hand cracked and the kernels hand picked and sun dried again. These crude palm oil extraction methods, probably originated 5000 years ago, still continue in some part of Africa until the present day. The oil serves as parts of the staple diet. The oil is not used as a frying medium but consumed as an additive to rice, garri or pounded yam and for this, the free fatty acid (FFA) must necessarily be high. For example, in the Delta area of Nigeria, the bangga soup requires an oil of over 10% FFA while in Sierra Leone the taste of the palaver soup depends on an oil of over 20% FFA. These were probably the equivalents of KFC, McDonalds, Coca Cola or Pepsi Cola in those days!

Soft oils. The fruits are hand plucked (stripping) and boiled in water for 4 hrs (digestion) and boiled fruits pounded (pressing) in pits or drums. The oil is then skimmed out (clarification) and heated again in shallow pans to remove (purification/drying) the moisture. Product quality: FFA: 5% - 12%, extraction efficiency: 40% - 50% (suitable for bangga soup).

Hard oils. The hand plucked fruits are placed in a long canoe, covered with leaves and left for three days. Fruit is vigorously trodden with foot (pressing) and left for three days to allow oil to flow out. Water is then added and a second treading done (double pressing) and oil skimmed off (clarification), followed by further skimming and heating (dryer) in shallow pans to remove the moisture. Product quality: FFA: 30% -50%, extraction efficiency: 20% - 30% (suitable for palaver soup).

Both these methods were very labour intensive requiring 420 man days for the production of 1 t of soft oil and 133 man days for the production of 1 t of hard oil. This includes harvesting, fruit preparation, de-pulping, extraction and others. Although this system is still practiced in some places, the screw press has been accepted by the small scale processing industry mainly due to the savings in labour.

Stage 2. Mechanization of Processing Technology

The first screw press, (Miller press or the Deutscher press as it was known) was introduced into palm oil processing in 1930. It comprises a central screwed steel shaft, permanently fixed in the centre of a base plate. The ram head and the turning arms are attached to the central shaft and are free to move vertically. The cage is a circle of wooden laths about 3 mm apart banded with two steel rings. Macerated fruit is fed to the cage and oil is expressed as pressure is exerted by screwing the ram head down. The press is essentially of the curb type normally used for the extraction of juices from soft pulpy fruit. Limitations on the working press make it unsuitable for efficient oil extraction of palm oil and its extraction efficiency seldom exceeds 65%.

The hand operated screw press was superseded by the oriental press which was used from the time of the Greeks and the Romans until the 17th century. This single screw press, essentially similar to the cage press was used in the 17th and 18th centuries after which period it was replaced by the hydraulic press for oil pressing, first patented by Joseph Bromah in 1795. Both these methods are still in use.

The manually operated hydraulic press was designed for pressing small quantities of fruit. One such press designed by the Dutch was tested by the West African Institute for
Oil Palm Research (WAIFOR) which gave it an extraction efficiency of 90% to 98%. The press combined with locally designed and fabricated ancillary equipment gave an overall efficiency of 85% to 90%. However, the average throughput was limited to 0.625 t hr⁻¹. The maximum throughput attained so far in a mill using hand operated press at the Nigerian Institute for Oil Palm Research (NIFOR formerly WAIFOR) was a press with a capacity of 4.7 t per day (Nwanze, 1942). The equipment used were three open fired sterilizers with a capacity of 1 t of cut-up bunches each, two stripped-fruit heating drums (capacity 2 t of sterilized fruit) and two macerated fruit re-heating drums. Bunch boiling usually commences on Saturday evenings and continues until Sunday mornings. In this process, the losses were as follows:

sterilization oil loss
0.51%

clarification oil loss single drum
3% - 5%

clarification oil loss double drums
0.8% -1.0%

moisture/dirt content
0.01%/0.01%

The hand press mill provided is an efficient replacement for the inefficient manual, non-mechanized systems used in developing countries. It is a useful milling aid for the early years of new plantations before full harvesting and setting of mill proper. If the fruit supply is irregular the hand press is the ideal system for processing. The maximum processing capacity of mills equipped with hand presses is about 2000 t per annum if pre-processing equipment is also installed in the mill.

The mechanical milling of oil palm started in Africa before the First World War. The mills were far from perfect. At that time, the development of a de-pulping system was the main focus resulting in a delay in the progress of designing large size processing plants using existing system until 1919. This was when a large power-operated mill was set up in Sumatra, followed later by Malaysia. The first power driven machinery for cracking nuts was reported to have been introduced into West Africa in 1877 by A C Moore of Liverpool (Ministry of Agriculture, 1966), being devised by Mather and Platt Ltd of Salford. In 1901, a German colonial committee wanting to develop a good machinery for palm oil extraction awarded the assignment to the firm of Haake of Berlin leading to the erection of plants at Mamfe and Victoria in West Cameroon. At the same time, a French firm set up a plant at Contonou to press the fruit as whole. This was the precursor of the present milling concept. Two pressing methods slowly evolved from the Contonou concept.

The fruits, after stripping were sterilized for 15 to 30 min by steam heating, followed by hydraulic pressing. Double pressing was done with inter-stage heating, with nut separation done in a rotating drum followed by nut cracking in a centrifugal cracker. This plant was constructed by the firms of Louis Labarre and Paulmier while Paulmier designed the press and Poisson the nut cracker.

Digestion was first undertaken in a stamping mill in a plant of German design in Togoland. The entire spikelets were cut off and subjected to digestion so that fruit loosening and pulp crushing were done in one operation. The digested mash was pressed and the nuts cracked in a Haake centrifugal cracker.

The second method of press extraction was developed by Haake. Even though the hydraulic press was doing a good job, many German, British and French firms continued stubbornly to persist in developing the de-pulping technology. Haake’s system was the outcome of the development of pressing after de-pulping. The de-pericarper consisted of a shaft carrying triangular metal blades rotating within a cylinder, which was
itself rotating in the same direction have differential speeds. British companies, like Culley Expressors Ltd and Manlove, Alliot of Nottingham also supplied machinery for this plant.

Meanwhile, Lever Brothers in their Zaire (now Congo) and other concessions in Africa was also actively engaged in the development of processing plants but its progress was not publicised. Lever Brothers used centrifugal extraction developed by Manlove, Alliot and Co. in their Zaire mill in 1916.

Apart from these, the only pre-war mill of any size was built at Maka in the Cameroons for the Syndikat fur Oelpalmen Kultur by German firms. This mill consisted of six hydraulic presses for pressing before de-pulping. Stripping was done by hand. The capacity was 525 t of FFB per week with 24 hr operation. The OER was 18.5% with KER at 6.9%. The press was manufactured by Krupp.

Centrifuge extraction proved well suited for the African grove fruit with its thin layer of mesocarp. It also became the standard extracting equipment in Malaya during the first 10 - 15 years of its industry’s life. The first Manlove type mill was constructed at Tenamaram Estate in 1923. But by early 1930s, the hydraulic press was beginning to displace the centrifuge in Malaya even though the centrifuge was entirely a new modern method of extracting oil from fruit or seeds which was considered to be a highly successful invention. In Sumatra, the first mills followed the Maka pattern and the hydraulic press developed by Konrad Loens, Krupp and later by Gebr.

Stork of Amsterdam was also active in developing palm oil extraction technology. It set-up a large mill at Pulu Radja Estate in 1921. It was designed by Dr Fickendey and constructed by Krupp.

The present milling technique took its shape after the First World War after the idea of depericarping was thrown out of favour. Following that, centrifuges and hydraulic presses dominated the industry and most of the installations in Africa were done by Lever Brothers and its successor Unilever Ltd. In the early mills, steam engines transmitted the power by long transmission shafts driving the individual machinery by pulley and beltings, a practice that continued in Malaysia until about 1978.

Stage 3. Modern Technology

It is now in the hands of Malaysians and the Indonesians to pursue further innovations in milling technology to keep pace with technologies used in other food-based industries, especially as the supporting infrastructures like computer based-technologies have developed rapidly. The vast gap between the techniques still employed in the milling process and other food processing industries makes the oil palm industry look very primitive and obsolete although the millers may not be able to see this. Even though there is no denial that the palm oil industry has made some strides in terms of improving the processing capability of mills, there are still some shortcomings in terms of improving process efficiency besides developing a viable system for reducing labour requirement. Any innovation for the industry must take into consideration current processing problems faced by the industry. Right now they are:

- labour shortage;
- low oil extraction rate; and
- necessity to improve product quality due to increasing world demands.

MPOB’s research projects as well as that of big players in the industry on milling innovations are based on the objective of fulfilling the industry’s requirements.
Unfortunately, the progress in adoption of new technologies by the industry appears to be rather slow probably due to favourable palm oil prices. We shall look at the whole scenario and discuss the achievements as well as the weaknesses in the industry under each section.

**FFB RECEPTION AND CAGE FILLING OPERATION**

This does not seem to have made any inroads for the past three decades in terms of progress except for the introduction of a long conveyor that now fills the cages at only one or two points. The continuous sterilization system in combination with the conventional sterilization system requires bypassing FFB from the FFB conveyor to the continuous sterilization feed line as in the case of Palm Oil Mill Technology Centre at Labu, Negeri Sembilan. For mills where only continuous sterilization is in use, the FFB can be directly fed into the continuous sterilization plant. The old system of manual loading into individual cages from every hopper is labour intensive but now this can be done without the need for any operator. This satisfies the present day requirement of labour reduction.

**CONTINUOUS STERILIZATION**

This concept of continuous sterilization has its origin in the Mongana trials way back in 1952 and this is well documented in the research report published in 1953, although the project did not take off the ground. They tried out prolonged storage of fruit bunches under water at high temperature and found that spikelets stripped completely, and they used this property for designing the continuous sterilizers. Mongana trials also established some fundamental characteristics related to bunch stripping viz. (a) bunches soaked in hot water at 100°C for approximately 1 hr virtually did not strip at all, and (b) spikelets treated the same way stripped completely. The reason was that the air occluded in the bunches slowed down the heat transfer rates. Heat penetration also could be improved further by de-aeration or increased sterilization temperature. Soaking of bunches in water under a pressure of 1.5 kg cm² for 90 min also had led to a stripping efficiency of 98%. Addition of surfactants likewise allowed a faster degradation of the bunches resulting in better heat transfer.

Using these findings, Mongana designed a continuous sterilizer in the form of a giant U-tube filled with hot water injected at the bottom of the U-tube so that the pressure at that point was about 1 kg cm² capable of a temperature of 120°C. The U-tube branches had a height of 10 m and 0.6 m diameter. The water was pumped from the top through two heat exchangers to the bottom and the temperature varied from 98°C at the top to 115°C at the bottom of the columns. Complete stripping could only be achieved after 2 hr and 45 min. Bunches were transferred to the column using a conveyor with a flow rate of 180 to 300 bunches per hour. This would mean that a 10 t per hr mill requires 50 formidable U-tubes extending to 10 m high. As you can see, the equipment was clumsy and not practical. Nut cracking was found to be more effective than if the bunches were sterilized with live steam at atmospheric pressure. Whatever the reasons, the project was not accepted commercially. Anyway, this was the precursor of the successful continuous sterilizer developed by MPOB after a period of nearly half a century!

The Mongana scientists did not attempt to crush the bunches and subject them to sterilization even though they knew that heat transfer and stripping was better if they sterilized the spikelets and not the bunches as a whole. The present continuous sterilization system is the outcome of a combination of many trials with the important addition of making the system continuous. The system comprises a bunch crushing operation followed by sterilization by steam at atmospheric pressure in a closed chamber through which the crushed bunches travel at a very low velocity and...
return to the same level as the entry after making a U-turn at the end of the conveyor. In terms of bunch stripping, the sterilization performs satisfactorily as almost all bunches are stripped efficiently.

An interesting mill, probably the only one of its kind in the world, using the continuous sterilization principle is in operation in Riau Province, East of Sumatra in Indonesia. This mill built on a floating platform about 3 m deep is made up of 14 steel pontoons linked together giving a base dimension of 60 m by 17.5 m. The only land connection is the elevator that feeds EFB into the incinerators. This mill uses seven workers per shift and operates non-stop for 24 hr a day at 12 t hr⁻¹ throughput even though designed for 10 t hr⁻¹. Hardly any supervision is needed for its operation. In case some of you get excited and get a burning desire to build a mill on a pontoon, please take note that this mill was so built because the entire plantation covering some 80 000 ha is located on deep peat soil and the thousands of kilometres of canals replace the plantation roads there. The FFB cages sitting on pontoons are towed to the mills by motor boats.

Looking at this peculiar mode of FFB delivery, I must admit that I did get some funny (or stupid?) brain waves. If the width of the mill foundation pontoon is reduced to say 10 m, the mill will be able to sail through the large canals that are 26 m wide leaving sufficient room for other boats to travel along. Then the mobile mill can travel to the estates rather than the other way round. A number of such mills could travel to whichever field that has the crop ready for processing. The only infrastructure needed is the incinerator at each milling port. Another advantage is that the effluent can also be discharged to different fields. This will solve the problem of having to discharge the effluent into the canals as is the practice now.

The problem associated with the slightly high oil loss in the fibre is not a big issue as some conventional mills also give the same results mainly due to operational defects like improper digester drainage. The mills having good digester drainage system are unlikely to face this problem. An additional digester also would improve oil recovery in which case most of the oil bearing cells can be ruptured before pressing. One important advantage in adopting this system is the ease with which the operation can be automated.

**VERTICAL STERILIZERS**

This again is an offshoot of the Mongana trials. The system tried out in Mongana had serious shortcomings like dropping fresh fruit bunches from a height without anything to cushion the free fall. Unloading was not only slow but required a great deal of labour. The latest vertical sterilizers use a very different concept capable of full automation. According to the manufacturers, the 20 t vertical vessel fitted with automated hydraulically operated doors can be charged or emptied in about 20 min unlike the Mongana trial units. The slanting bottom hidden within the chamber poses no problem for bunch discharge through the small chamber outlet and bunch discharge is aided by a motor driven augur with its shaft running along the free vacant space to the drive system located outside the chamber wall. The augur has a large diameter to ensure efficient bunch evacuation needing no labour. A complete 30 min sterilization cycle including charging and evacuation is reported to be about 70 min and cooking is done at 3 barg pressure. At this pressure, bunches are conditioned sufficiently for efficient kernel recovery operation. No further treatment is necessary as the fruits are well cooked, similar to the conventional system.

The secret of effective cooking and stripping using low sterilization cycle in this system is the complete and efficient evacuation of air or the creation of a partial vacuum in the chamber. This is accomplished by filling up the chamber.
with water and as bunches fall into the chamber they displace the air within bunches. The fall also is well cushioned by the water. Once the chamber is filled with bunches and water the air bubbling out is effectively removed. After closing the feed door, the water is drained off from the bottom enabling the chamber to have a partial vacuum. Now when steam is injected, the heat transmission is more effective in the absence of air which is a constant curse in conventional sterilizers. In theory, the system is technically very sound but we do not have any trial data to assess its performance in real life. This system is in operation in some mills in Kalimantan. It is rather unfortunate that most of the innovations done in Malaysia find actual application elsewhere. The weakness of the industry in Malaysia is its tendency to shy away from anything new.

**AUTOMATION OF FFB CAGE HANDLING - THE INDEXER SYSTEM**

Although well-known to other industries, this system is relatively new to the palm oil milling industry. It is all a question of an automated system for the continuous movement of the cages in and out of the sterilizers. It is indeed a surprise why it took the industry this long to adopt it as the technology has been well established and tested in a number of industries. The winches, ropes, tractors etc. moving all over the place on a sterilization bay must be very homely to some millers who like to maintain that culture like keeping vintage cars but some daring millers with good foresight ventured out and set-up useful systems. The indexer system is one of them capable of reducing labour to a great extent. No high-tech invention is involved in this except putting together some hydraulic components with a few mechanical components. Boustead has already installed this system in some mills and the feedback is very positive like very clean mill, much reduced labour force, no breakdowns fully automated system etc.

This is system dependant and hence, is more reliable and comprises the following:

- hydraulic power packs;
- indexer frame with rollers;
- hydraulic slave cylinders;
- electrical systems, sensors; and
- PLC/microprocessors and related equipment.

This can be used for sterilizer draw bridges, transfer carriages, tippers, sterilizer doors and for any other operation. The different operations can be interlocked for safety, e.g. sterilizer charging/discharging operation linked to drawbridge and the indexer operation. Cage marshalling can be done more efficiently including mechanical attachment and detachment of cages. The indexer system offers a number of useful features that will help implement mill-wide automation leading to a significant reduction in labour. The actual data on installation cost, maintenance cost etc. are not yet available to make a comparison.

**MILL-WIDE AUTOMATION TRIALS IN POMTEC**

It has been the dream of the millers for nearly half a century to automate the processing operation not merely for labour reduction but for improving process efficiency. The current research in mill automation which focussed mainly on process monitoring from a control room only allows process operation activation and alarm circuit activation. The system developed is a precursor to mill-wide automation in the absence of a feedback loop or any power aided slave mechanism for controlling the individual process machinery. A CCTV system is also used to monitor operations for the mill security surveillance, but they are yet fully functional. The present system is designed to operate the whole mill with just two operators and a maximum crew of eight field operators, and their inter communication gear will be walkie-talkies. In addition, a Communication Network
interconnects all work stations and PLC systems enabling communication between systems in accordance with 10/100 Mbps Ethernet protocol.

The HMI/SCADA (human-machine interface/supervisory control and data acquisition) software communication with the installed PLCs and has features for historical data analysis, statistical process control and formatting of printed reports. The CCTV system used in the mill is designed to facilitate monitoring using computers connected to the same network as the SCADA system together with four analogue PTZ cameras, 33 analogue fixed cameras and four network video servers to provide a comprehensive CCTV solution.

It is difficult to cover all the related activities in this paper and if anyone is interested to gain in-depth knowledge on POMTEC automation trials, they are requested to read papers presented in the National Seminar of Palm Oil Milling - Promotion of Automation in Palm Oil Mills held on 7 - 8 March 2005.

RENEWABLE ENERGY

In future, palm oil mills may have to be renamed as Palm Oil Milling and Green Energy Plants as the vast renewable energy resource available at the mill may be converted to electricity for grid connection. I am sure that the current spiralling of fossil fuel prices do make an impact on all of us. At the current pricing probably it is not serious enough but if the price of crude petroleum reaches RM 10 per litre, then renewable energy production in Malaysia is likely to start quite fast. At any rate, the day may not be far off and we have to make an effort to develop the best technology to face any impending fuel crisis. There are many methods available for energy conversion from biomass to electricity and it is not possible to cover all of them in this paper.

Bio-methanation technology deals with the conversion of any organic matter into biogas comprising mainly methane and carbon dioxide. Once in gas form it can be used in internal combustion engines like gas engines or external combustion plants like boilers or gas turbines. If all the biomass is converted to biogas in a converting plant, the gas can be used for a number of purposes.

Methane production from effluent digestion ponds is also gaining momentum and there are various technologies available for harnessing it for green energy production. There is also a fund available from GEF administered by UNDP for harnessing and power production of methane generated by the effluent ponds. One plant in Malaysia had been producing it for more than 20 years and is used as a fuel in boilers. The conversion of methane to carbon dioxide can reduce the harmful effect of methane as a greenhouse gas by 21 times! There is much potential for millers to pursue methane tapping and energy conversion as at the same time, additional benefits are obtained as part of clean development mechanism (CDM) under the Kyoto Protocol when methane is converted to less harmful carbon dioxide.

ALFA LAVAL DECANTER AND SEPARATOR SYSTEM (ALDASS)

Any technology that can reduce water consumption during processing will be most welcome to the milling industry as there are two distinct advantages. The first one is the reduction in the effluent production and the second one simplification of milling process. It has to be noted that whatever water added during the processing has to be eventually removed at the end of the processing operation. Hence, the less the water added, the simpler the operation.

The conventional separators suffer from the problem of high water usage except for the Stork-based designs that could operate satisfactorily with less water. This new ALDASS decanter design by Alfa Laval is reported to cater for the specific requirement of the press liquor with the winning point
that no water addition is necessary. It makes use of the water present in the processed material itself together with whatever water is added upstream like during sterilization and clarification. The system essentially comprises a three phase decanter and a nozzle separator with a small clarifier. The heavy phase is claimed to have oil loss in the region of 8% similar to that of the clarifier underflow. The heavy phase is again subjected to high G-force centrifugal separation in a nozzle separator. The light phase oil does not have to be purified further and may be channelled straight into a vacuum dryer.

**NUT CRACKING MACHINES**

Nut crackers have undergone significant changes in recent years. The centrifugal crackers have more or less become extinct now for no apparent reasons. These crackers demanded only one extra condition for efficient nut cracking, *i.e.* drying nuts before cracking. This of course required large nut silos but the millers somehow were quite unanimous in disposing of the silos and embrace ripple mills, which were not satisfactory in many ways compared to the centrifugal crackers. The large quantities of kernel churned by these crackers were not detected as it was not easily detectable. The millers believed these crackers were doing a fine job and remained comfortable. Thereafter, new versions of the crackers made their debut in the industry; some with minor changes while others deviated widely from the original cracking principle of ripple milling.

Machine evolution must be based on clear and well-defined objectives like improving the product quality or efficiency. If there are no improvements, then the new design is a waste of time. In the case of Rolek, the objective was the driving force behind the design, *i.e.* production of shell-free or least shell kernel with minimum kernel breakage. This will improve the quality of kernel cake that may command a higher price. Another objective was to be able to crack all the hard *dura* nuts that the millers were finding it difficult to crack using conventional crackers.

The Rolek crackers have three cracking rings within the same machine. The outer cracking pair of rods can handle the large nuts such as *dura* and the inner ones for medium and small nuts. The cracking is performed by the interaction of a pair of rods; one stationary and the other dynamic. The high wearing rods are sleeved so that the base rods remain intact. In addition, the inter-gaps can be customized for cracking nuts of any size. The full cracking and kernel recovery system comprises three nut graders, three winnowing columns and associated Rolek crackers for dealing with all types of nuts including dry separation columns for cracked mixture separation.

**THE FUTURE**

It is not possible to cover everything in this paper but the major ones were discussed. Looking at the future, there is a lot more to be done. This is just the beginning of a long journey towards perfection. As you can see, the present achievement is still rudimentary in nature. In the future, you may be able to assess the exact OER of a specific lorry load of FFB using computer analysis backed by sophisticated instrumentation that can conduct accurate analysis of the crude oil after a set time lapse co-relating to the specific FFB load.

It is difficult to visualize what is in store for us in the future in terms of process evolution. Perhaps the whole load of FFB can be churned into a paste and a combined oil extruded in a simple plant and the oil fractionized into different grades that can be re-combined according to customer requirement. This idea is not new as this concept was a widely discussed hot topic at one time but somehow did not take off due to resistance. It is possible it may yet reappear when the time is ripe as the concept.
is good. This system allows the option to remove the harmful fractions as defined by the nutritionists from time to time on the harmful effects of certain fractions of edible oils

REFERENCES


Indonesia Aims to Build Eight Biofuel Factories

The Industry Minister Fahmi Idris said that the Indonesian Government intends to set up eight biodiesel factories each with a capacity ranging from 3000 t to 6000 t. The site selection will be handled by the local administrators. The construction cost estimated at RM 649,000 to RM 703,000 will be financed from the 2006 national budget. The factories will be operated by the local authorities aided by enterprises, local cooperatives or other business units. The preferred location for the factories is marginal areas so that the biodiesel areas can grow.

United Kingdom’s Biofuels Corporation to Expand Biodiesel Production

The demand for biodiesel is likely to grow. United Kingdom’s Biofuels Corporation, one of the largest producers of biodiesel in the United Kingdom has increased its biofuel production from 145,000 t to 162,500 t (58% to 65% of the targeted annual capacity of 250,000 t). This company began producing biodiesel from imported rapeseed oil, soyabean oil and palm oil at its first plant in Teesside in February 2006. The company managed to sell all their biodiesel at the targeted price. The expected production of 75,000 t for 2006 has also been sold indicating good demand for the product. The current plant is able to meet 25% of the United Kingdom’s transport fuel obligation target of 5% biofuel blend by 2010 - 2011. The European market for biodiesel in 2005 was 3.02 million tonnes and is rising fast and expect to reach 9 million tonnes by 2010. It is likely that the company may expand to tap the future potential for biofuel.

Golden Hope to Produce 400,000 t of Biodiesel by 2008

The group’s Chief Executive Officer, Datuk Sabri Ahmad said that Golden Hope intends to produce 400,000 t of biodiesel by 2008 during the visit of the Indonesian President, Susilo Bambang Yudhoyono to the company’s biodiesel plant at Teluk Panglima Garang Industrial Estate at Klang. He expects a total of 20 biodiesel plants to be operational in Malaysia by next year.

Malaysian Palm Biodiesel Hub

The palm oil industry has been identified as a key growth sector in the South Johor Economic Region Development and in this respect, the Prime Minister Dato’ Seri Abdullah Badawi said after the launch of the Carotino palm biodiesel plant that Pasir Gudang would be further developed to become a leading centre for palm biodiesel in Malaysia and the world. He also said that Pasir Gudang would now become part and parcel of the dynamic Johor palm oil industry and Johor would experience rapid economic development in this sector. Johor now has 69 palm oil mills, 17 refineries, six oleo-chemical plants and four bulking installations.

Earlier, the Prime Minister launched the Tanjung Langsat Port and officiated the ground breaking ceremony of Kulim (M)
Bhd’s Nexsol (M) Sdn Bhd plant. According to a statement, Nexsol (M) and Nexsol Pte Ltd were formed by Kulim and German partner, Peter Cremer (S) Pte Ltd to produce and market palm-based biodiesel. Kulim will hold 51% stake in Nexsol (M) and 49% stake in Nexsol (S) according to Kulim managing director, Ahmad Mohamad. Kulim entered into a RM 152 million joint-venture agreement with Peter Cremer earlier this year to set-up the two biodiesel plants to produce biodiesel and other downstream derivatives.

Asean Fibre Technology Conglomerate

Production of fibre from palm oil biomass is growing in prominence with participation from Thailand and Singapore with Australia even opening its doors for the finished products. Known as the ASEAN fibre technology conglomerate, Malaysia is contributing its home-grown palm fibre technology for the venture. Singapore manufactured the equipment and Thailand provided the site for the plant at Karbi and Bangkok. Sabutek, which specialises in palm oil waste derivatives, is the company which took the lead in this establishment of the palm oil fibre conglomerate. According to its engineer, Dr Shahir, Indonesia, Vietnam and Australia were keen to support this venture and the Sabutek plant has now expanded four times from 300 t last year.


Shell Malaysia’s Chairman, Saw Choo Boon agrees with the Malaysian Government’s stance on biofuels but does not see the use of crude palm oil as a viable feedstock in the long-term. “Our belief is that biofuels made from food sources are not sustainable in the long-term because they compete with the food chain. We believe that biofuels made from cellulose waste and biomass are the fuels of the future” he told the Financial Daily recently. He said that cellulose waste comprised things like weed and paddy stalks and leaves while biomass was made up of matters such as wood chips. He said that the Shell group is investing in research on both types of biofuels and in the case of biomass, hopes to have a pilot plant in operation by the end of the decade. His view is shared by many international experts.

RWE Considers Converting a UK Power Plant to Use Palm Oil as the Fuel

A British subsidy of Germany’s RWE AG may convert an oil-fired power plant in south eastern England to burn palm oil after it evaluates the cost and technical issues. “The company has conducted trials using the fuel at the plant and has not decided whether to switch”, Leon Flexman, a spokesman for RWE’s Npower Unit said recently. RWE will make its decision based on the fuel’s performance and availability according to Flexman.

Malaysia and China Team-Up for Biofuel R&D

Malaysia has teamed-up with China in a bilateral research on development (R&D) cooperation to further develop biofuel and biomass production technologies. MPOB and the Department of High-Tech Development and Industrialization of China’s Ministry of Science and Technology have entered into a memorandum of understanding aimed at exploring new biomass technologies. The Minister of Plantation Industries and Commodities, Datuk Peter Chin said that a study would be conducted to set out the scope of cooperation and the possible
joint R&D projects relevant to biofuel and biomass technologies. The minister said that the collaboration was significant as Malaysia was now embarking on the commercialization of biodiesel. “As you are aware, the development of biofuel is not necessarily confined to the production of biofuel only. It also includes bioethanol, which could be potentially harnessed from palm-based biomass”.

**Palm Oil May Lose Edge if Prices Keep Rising**

The Minister of Plantation Industries and Commodities, Datuk Peter Chin Fah Kui said that it is a worrying factor that the price of palm oil may rise due to the new interest in palm oil as a source of biofuel. If the price reaches RM 1900 per tonne, it may pose a problem for the development of biodiesel from palm oil. The average price this year had been about RM 1500 t⁻¹ up 7.6% from 2005 and is expected to rise by 10% by 2007 to RM 1600 according to the counter’s economic report.

Malaysia and Indonesia have set aside 40% of their palm oil production for the biodiesel industry. This is precisely the reason that the holders of the licences for producing biodiesel are cautious about embarking on its production.

The Minister said that the government has so far issued 52 licences for the production of biodiesel. He wants genuine and committed investors and objects to those, who are not serious or have the intention to get the licences and sell it for a commission.

If palm oil price rises to higher than the normal diesel, Malaysian companies who have invested in biodiesel plants may not like to continue production knowing fully well that they are going to incur heavy losses by producing it. But some multinational companies may still want to continue biodiesel production due to global obligations and established markets. These companies probably would ensure sustainable production of biodiesel.

**IOI Buys 70% Stake in Rinwood Pelita Miri**

The IOI Corporation Bhd has acquired a 70% stake in Sarawak-based Rinwood Pelita Miri Plantation Sdn Bhd (RP Miri) from Rinwood Oil Plantation Sdn Bhd (ROPP) to have the way for biodiesel development in the state. Following completion of the share sale agreement between the two companies in Kuching, IOI now has 9.1 million shares valued at RM 21.3 million, in ROPP.

**Golden Hope in Biodiesel Joint Venture with Korean Firm**

Golden Hope Plantations Bhd said that it plans to jointly produce biodiesel with Korea’s H-Plus Bio Ltd. The two firms will set-up a plant in Yeosu, South Korea with a capacity to produce at least 150 000 t of biodiesel a year, using palm-based products as the primary feedstock. Golden Hope has started commercial production of biodiesel from its first plant in Malaysia and is building two more biodiesel plants in the country and one in the Netherlands.

**RM 300 Million Palm Oil Complex Joint-Venture in Kuching**

Four plantation companies are teaming-up with Assar Refinery Services Sdn Bhd and Sarawak Timber Corp (STIDC) to develop a RM 300 million integrated palm oil downstream complex in Tanjung Manis,
Mukah Division in central Sarawak. The companies are Tradewinds Plantations, Rimbunan Hijau Group, Multi Maximum Sdn Bhd (a subsidiary of Ta Ann Holdings Bhd) and Bintulu Lumber development Sdn Bhd (a subsidiary of BLD Plantations Bhd).

Under the proposed joint-venture project, a palm oil refinery together with a kernel crushing plant will be built. They also intend to build a petroleum storage terminal, an oil and gas jetty, a petrochemical and oleochemical park to serve the central region.

The development of other palm oil downstream facilities like biodiesel and oleochemical plants is likely to take place later when there is an abundant supply of crude palm oil in the central region.

Tanjung Manis, which has a deep sea port and houses the country’s largest integrated timber complex, is strategically located and blessed with natural draft of 11 m to 13 m to take in vessels of up to 15 000 t dead weight.

**Pushing the Case of Envodiesel**

Refined liquid palm oil (RLPO) has proven itself as capable for fuelling diesel engines giving no problems based on years of field trials. A 5% blend of RLPO in commercial diesel should therefore be fully acceptable but car engine manufacturers are hesitant to extend their engine warranties on cars using Envo Diesel basically because in Europe their blend uses biodiesel (methyl or ethyl ester) and not just vegetable oil. The reason could be political or to safeguard the interest of the petroleum industry.

The palm oil industry will benefit tremendously through the Envo Diesel project as it would use up to 500 000 t of palm oil annually. Reduction in the annual import of 500 000 t of diesel because of displacement by 5% palm oil in the Envo Diesel means the country will save more than RM 1 billion in foreign exchange and the added benefit is the potential from selling the carbon credits.

**Jatropha Cultivation for India**

With the oil price surging, the lowly jatropha is experiencing a renaissance of sorts - as a potential source for fuelling trucks and power stations. The Indian Government has identified 39.2 million hectares of land where jatropha can be grown, hoping that it can replace 20% of the diesel consumption in five years.

All across Asia, governments are searching for crops that can help them offset dependence on imported oil that can only skyrocket as their economies soar. Palm oil and sugar cane are the dominant crops in the region, but everything from coconut oil to castor oil to cow dung is being tested for fossil-fuel alternatives such as ethanol and biodiesel.

**Biodiesel to Drive up the Price of Cooking Oil**

As agricultural product prices typically fluctuate with supply levels, the vegetable oil shortage could cause food prices to rise. “The popularity of biofuel from vegetable matter instead of fossil fuels will tighten the supply of vegetable oils”, William Camp, the Chief Executive Vice President of Archer Daniels Midland said during a presentation at the Think Equity Partners Growth Conference in San Francisco. According to Camp, “part of the problem is the amount of oil required. It takes 7.5 pounds of oil to make one gallon of biodiesel”.

Archer Daniels Midland has already sufficient installed capacity to produce 511 million litres of biodiesel in Europe and in the US. It plans to open a plant to turn
soybean oil into biodiesel in Missouri and one to turn canola oil into biodiesel in North Dakota. Oils currently exported for food will get consumed as fuel, Camp predicted.

Biodiesel Manufacturing Licenses on Hold

The Minister of Plantation Industries and Commodities said that the government has put on hold the issuance of new manufacturing licenses for biodiesel. The move was to safeguard the oil palm industry as a whole, he told the reporters after officiating the Oils and Fats International Congress 2006. “We have put aside 6 million tonnes of crude palm oil for biodiesel production but at the same time we have to make sure there is enough supply for increasing demand for food production,” the minister said.

To date, 52 manufacturing licenses have been approved, reflecting a great deal of interest in the investment of biodiesel. Out of these, only four have started producing biodiesel and exporting the commodity. According to sources, 10 companies would be ready to produce biodiesel this year and another 10 companies next year.
# Year of Planting and Oil Content

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Notes:
Compiled by Ravi Menon by merging two sets of data.

* MOPGC [1990].
* Calculated figures assuming an extraction efficiency of 0.94.
ADVERTISEMENT

The advertisement cost is RM 600 per issue for an A4 size page of black and white, whereas the cost for colour is RM 800. 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>
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<th>Issue</th>
<th>Quarter</th>
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REPLY-SLIP

Dr. Lim Weng Soon/Ir. N. Ravi Menon
Engineering and Processing Division
Palm Oil Engineering Bulletin
MPOB
P. O. Box 10620
50720 Kuala Lumpur
Malaysia

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Company:

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E-Mail:  Tel. No.:  Fax No.:  

Contact Person:  

Issue No.:

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4. Thank you.

________________________ (Signature)  __________________________ (Date)

* 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 Vendors 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 Vendors’ 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, P. O. Box 10620, 50720 Kuala Lumpur, Malaysia.

We wish to advertise in the MPOB Palm Oil Engineering Bulletin

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Please find enclosed a crossed cheque No.: Bank: for RM: [Ringgit Malaysia]

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
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- Belts
- Castings
- Cleaning - general
- Civil engineering
- Condition monitoring
- Control/automation/spares
- Conveyors/elevators
- Consultancy services
- Diesel eng./services/spares
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- Electric motors
- Expansion joints
- Fabrication works
- Filter cloth/materials
- Fluid control system
- Gaskets/packing materials
- Gear boxes
- Hardware - health & safety products
- Laboratory analysis
- Laboratory equipment
- Lubricants
- Mill machinery spares
- Nut crackers
- Palm oil mill consultants
- Pollution control systems
- Pressure vessels
- Pumps
- Purifiers
- Screw press/parts
- Scrubbers
- Sludge separators/decanters
- Steam turbines
- Sterilizer/parts
- Storage silos
- Vacuum pumps
- Valves
- Water treatment
- Welding equipments
- Waste water treatment
- Weighing machines wheel loaders/spares
- Others (specify headings)

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Signature: ____________________________
Name: ________________________________
Date: ________________________________

Company chop
From: ____________________________

Address: ____________________________

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Question/Comment:

Signed: ____________________________ Date: ____________________________

(We have enclosed this form to assist you in sending to us any questions or comments)
Chairman
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Palm Oil Engineering Bulletin
Malaysian Palm Oil Board
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50720 Kuala Lumpur
Malaysia