

Challenges Facing the Palm Oil Industry

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INTRODUCTION

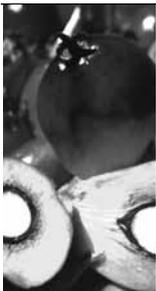
It has been said many times that there will hardly be any drastic change in palm oil milling technology if mills continue to receive and process the FFB in its present form. The experience of past 50 years or so can testify this. However, it is justified to put on record here that there were many incremental improvement and changes in various unit operations, but these were hardly revolutionary in nature. The palm oil mills still rely on the massive heavy and huge steel vessels like sterilizers, cages and threshers to handle the fresh fruit bunch (FFB). Large quantities of steam and water are required to sterilize the FFB, either in full set or crushed form, and to dilute the crude oil slurry for oil recovery in the clarification process. The recent trend to reduce the water usage in the process has not been very encouraging. Most of the water used in the milling process, except the steam blow-off and exhaust-steam, ended up as palm oil mill effluent (POME) which has to be treated to comply with the Department of Environment (DOE) discharge standards.

Till today, the palm oil mill's key performance indicator is still the oil extraction rate (OER). It is a ratio of the crude palm

oil (CPO) produced to the FFB processed by the palm oil mill. It is taken for granted that the higher the OER the more efficient is the mill. In many instances, the OER has been misused to penalize palm oil mills as being operated inefficiently, thus, resulting in low OER. It must be remembered that the oil is made in the field, not in the mill. If for whatever reasons the FFB contains less oil than expected, there is nothing the mill can do except getting lower OER. Of course if a mill is not run efficiently, more oil will be lost. This will also result in low OER. This can be easily checked by conducting oil loss analysis on the waste streams of the mill. It is also true that, a mill suffers from high oil loss will also produce high OER. This is because the FFB has high oil content.

The dilemma faced by the palm oil mill is that the palm oil mill does not know how much oil is received. The oil is contained in the FFB or fruits. The palm oil mill only knows the weight of the FFB received with the oil in it. Many attempts have been made to measure the oil contained in the FFB, but so far it has not been successful. There is no direct method to gauge the efficiency of the mill. Unlike the refinery where every kilogram of the oil can be accounted for, what a palm oil mill can do is to strive to reduce the oil losses as much as possible. As a good process control indicator, an oil loss of 1.5% to 2.0% to FFB is considered as good.

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There are many factors contributing to oil content in FFB. It is beyond the scope of this article to deliberate on it. However, there is no question that ripe FFB or ripe fruits contain maximum oil and ripe fruits will detach from the bunch by themselves. No outside force is needed to detach fruits from the bunch. Unfortunately not all the fruits ripen at the same time. The ripe fruits at the lower part of the bunch (nearer to the ground), when detached from the bunch will drop to the ground. The fruits at the upper part of the bunch are retained by the bunch (or more precisely, the spikelets) until the bunch is cut, then the bunch will drop and fruits will scatter on the ground.

As regards when to cut the FFB depends on the ripeness standard of individual company. Obviously, the oil content in the FFB follows the ripeness standards. The ripe FFB contains more oil. Thus, a palm oil mill receives high percentage of ripe FFB will yield more oil and subsequently higher OER provided the oil loss is under control, *i.e.* under 2% to FFB. This is the department that harbours the endless arguments between the estates and the mill when the OER is low. The estates claim to have harvested the ripe FFB for the mill and it is the mill that is not operated efficiently, thus, getting low OER. Similarly, the mill claims otherwise. Nobody can have the right answer. The problem is that no one knows how much oil is in the FFB. Worst still the degree of ripeness is different for each FFB. Every consignment of FFB to the mill invariably contains different categories of FFB including over-ripe, ripe, under-ripe, unripe, rotten and long stalk, *etc.* Generally, ripe and under-ripe categories form the majority (>80%) of the FFB consignments.

It is clear that under-ripe fruit will not yield maximum oil, thus, oil is lost if under-ripe FFB with under-ripe and unripe fruits is harvested. The full potential of oil yield from the estates can never be realized with the current practice of harvesting by the estates. No one has ever estimated the amount

of financial loss in harvesting and processing the under-ripe and unripe fruitlets in the FFB. It amounts to billions of ringgit. At the current scenario, a 0.5% loss in OER (assuming the palm oil mills process 90 million tonnes FFB per annum) means a loss of 0.45 million tonnes of CPO. This amounts to RM 1125 billions assuming a price of RM 2500 t⁻¹ of CPO.

As mentioned earlier, only ripe fruits yield maximum oil. Ripe fruits will detach and fall to the ground. Thus, if the estates can only harvest the ripe fruits for processing, then the full potential of oil yield from estates and the whole industry can be realized.

It is proposed here that the estates should not cut the FFB until all fruits on the lower part of the FFB have detached and dropped to the ground. The remaining fruits retained by the now half-empty FFB can be collected when it is cut as usual. But it must be mentioned here that loose fruits should be collected daily and sent to the mill for immediate processing.

Obviously this is easier said than done, because breaking out of old mindset is very difficult (painful). It is the bottle-neck of the palm oil industry. Collecting loose fruits is a very tedious job and nobody wants to do it. The problem is compounded by an acute shortage of labour. As a result, estates, in order to reduce the number of loose fruits uncollected, tend to harvest more under-ripe FFB so that no fruits will detach from the bunch. This will result in more oil lost. This trend will continue if the labour problem is not solved.

Notwithstanding that the industry should look seriously into this problem. The present R&D effort on loose fruits collection should be intensified. The loose fruit collection device should be made more user-friendly to entice more people to do the job. This should be done with utmost urgency

because the sustainability and profitability of the palm oil industry to a large extent depend on the success of this endeavour.

There are many tangible advantages if the palm oil mills only receive and process loose fruits:

- the transport vehicles can be more productive by transporting fruits only without the non-oil bearing bunch stalks;
- the throughput and productivity of the mill will be enhanced. This is because the mill needs only to process the ripe fruits with maximum oil and not together with the unproductive bunch stalk. The bunch not only carries no oil, it will also absorb oil during sterilization and threshing of the cooked FFB thus resulted in more oil loss;
- the raw empty bunch stalks are left in the field. The mill will no longer be burdened to dispose of the empty fruit bunch (EFB);
- for the same oil output, a mill requires a smaller loading ramp to store the fruits and smaller number of sterilizer cages to transfer the fruits for sterilization;
- no thresher is required;
- the subjective FFB grading is no longer required; and
- most important of all, the full potential oil yield from estates can be realized as only the ripe fruits contain maximum oil.

These are just a few obvious advantages that can be easily realized at no cost to the palm oil mill. The most dramatic change to the palm oil industry will be the potential

evolution of a green and sustainable palm oil milling technology as discussed below.

Over the last decade the palm oil mill has been beset by an array of environmental adversities like air, water, noise and odour pollutions. Lately the LCA study (Vijaya *et al.*, 2008) has demonstrated that palm oil mill is one of the chief contributors to global warming. This is due to the emission of biogas during the anaerobic digestion of POME. Biogas consists of about 65% methane and 35% carbon dioxide, both are greenhouse gases; methane is 21 times more potent than carbon dioxide in terms of global warming.

Large amount of water is required in the palm oil milling process. Most of the water used, except the steam exhaust from the sterilizer during FFB sterilization, ended up as POME which requires rigorous treatment to comply with the DOE's stringent discharge standards. This is the main cause of water pollution.

Environmental impact is the key factor determining the sustainability of palm oil production in future. A holistic and effective approach is required to address the environmental issues caused by the palm oil industry. In this context, a new and green palm oil milling process has to be developed. The new process should aim primarily to reduce energy consumption (*i.e.* more energy efficient), reduce black smoke emission and to reduce drastically water consumption thus eliminating the production of POME and biogas.

Vigorous response to a crisis often requires a profound shift in thinking. A dramatic change in the current milling process is urgently required as the palm oil industry is under tremendous environmental pressure to survive. Never before did the industry face such a prolonged assault by the





critics except the anti-palm oil campaign in the 1980s. It was on the health and nutrition issues. It lasted only a couple of years.

To develop a green technology for the industry is a formidable task. When the palm oil industry is in a comfort zone, many potentially green technologies have been rejected before they were fully evaluated.

The main objectives of sterilization are to supply heat to (1) detach the fruits from the FFB stalks, (2) stop the enzyme reaction that causes the free fatty acids (FFA) in the oil to rise and (3) condition the nuts for subsequent cracking. Currently large quantity of steam is used to do the job and prolonged steaming is necessary to allow sufficient heating of the inner layers of the bulky FFB. To complete a sterilization cycle 70 to 90 min are required. Almost half of the steam used is exhausted during the sterilization cycle, the remainder steam ends up as sterilizer condensate and it forms part of the POME.

It has been demonstrated by Chow and Ma (2009) that microwave heating is able to achieve the objectives of the conventional sterilization. A very short time (3 min to 5 min) is required. However, it works only for the outer layer of fruits on the FFB or spikelets of fruits. The microwave is not able to penetrate into the inner layers of the FFB to achieve the objectives and prolonged heating will severely damage the fruits and kernels.

Microwave heating can certainly be applied to treat individual palm fruits. A single layer of fruits can be conveyed through a microwave tunnel for efficient heating to stop the enzyme reaction. At the same time, the fruits are sufficiently dried to further protect the oil from enzyme attack. The heating time can be optimized to condition the nuts for subsequent cracking. This is a dry process. No effluent is generated.

The dried fruits now are in perfect condition for solvent extraction. Solvent extraction is employed to extract oil from oilseeds like soyabean, sunflower, rapeseed, corn, *etc.* It was also used to extract palm kernel oil. It was phased out as it was found less costly to press out the palm kernel oil using screw press.

In view of the pressing environmental concern on greenhouse gas emission and the much talked about global warming, the palm oil industry has no choice but to compromise for a clean technology, *i.e.* the solvent extraction technology whereby palm oil is extracted using a food grade solvent or supercritical fluid like supercritical carbon dioxide. CPO (or a branded palm oil) is recovered by evaporating the solvent. The solvent is recovered for reuse. As the solvent extracted oil does not contain any fruit debris or sludge, no clarification is necessary and therefore no water is needed as in the conventional clarification process. This also makes the whole range of machinery in the clarification room redundant. There will be no more separator sludge and POME will be totally eliminated. Thus, there will be no POME to be treated, no biogas generated and no global warming to worry about. The green image of palm oil industry will be greatly enhanced.

The main concern of this new technology is the quality of the CPO thus produced. This has to be thoroughly investigated before the palm oil industry would consider adopting the solvent extraction technology. The solvent extracted CPO must be at least comparable if no better than the conventional CPO in terms of all quality parameters as well as its refinability.

Palm fruit is also known to contain an array of valuable vitamins other than carotenes and vitamin E. Some are water soluble and some are not. Since no water is used in the solvent extraction process, all these minor components should remain in the oil if

they are solvent extractable. This will add value to the oil or they can be extracted from the oil like carotenes and vitamin E.

The palm oil industry should seriously consider this proposal. This will overhaul the whole palm oil business, from A to Z of the industry. The extra revenue earned will be tremendous. It can easily increase the OER by 3.5%, *i.e.* 1.5% from the process loss and easily 2% from the oil yield from ripe fruits. From the similar calculation above, this amounts to an increase of 3.15 million tonnes of CPO per annum or a hefty RM 7.875 billion per annum which is much more than the total research cess collected by MPOB over the last 30 years. This can

pay for all the investments needed for R&D. The success of the endeavour will ensure a profitable and sustainable palm oil industry.

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