OER and Total Oil Losses

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INTRODUCTION

The use of oil extraction ratio (OER), as a tool to measure performance has created a lot of problems for the estates and mills. This is because OER on its own does not tell us where the problem is. Whenever OER is low, the estates point their fingers at the mills and *vice versa*. In reality, OER is in *no man's land* and both parties do not want to be held responsible for something that is not within their control. Such *finger-pointing* will continue as long as OER is looked at in isolation without making any cross reference to oil losses. This paper proposes the incorporation of *oil losses* into the OER equation to complement the existing method of assessing estate and mill performances. Once the fresh fruit bunches (FFB) are weighed in, the mill must be held responsible for all oil losses within the perimeters of the mill. The estate, on the other hand, takes ownership of *total oil*, which is OER plus oil losses. For the system to work, *all areas* of oil losses must be quantified and subject to regular independent checks. The focus is on oil as the same can be drawn up for kernels.

TOTAL OIL

Barring security problems, the total oil coming into the mill from the estate is the sum total of what the mill recovers, which is OER plus whatever the mill loses in the process. This can be represented by the equation:

Total oil = OER + oil losses

Rearranging the equation, we have:

Total oil – oil losses = OER

This equation takes away the ambiguity surrounding OER and directs the responsibilities to the respective parties. This means that the estate will be responsible for the total oil going into the mill while the mill must provide an accurate account of whatever oil they lose from reception of FFB onwards. This, in effect, means that OER is the joint responsibility of both the estate and mill. If both parties operate within their own satisfactory limits, it doesn't take a genius to conclude that there will be a net increase in OER.

While OER can be accurately determined and is subject to audit, the same cannot be said of oil losses. There is an urgent need to review, expand and improve the monitoring of oil losses so as to capture the *total* oil losses in the mill to complement its use with OER. To be used effectively as a management tool, these oil losses need to be carried out or *audited* by a third party at regular intervals.

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LOW OIL EXTRACTION RATIO (OER), WHO IS RESPONSIBLE?

The hypothetical OERs are tabulated below:

	Estate		Mill		Management	Responsibility of
	Total oil	–	Oil losses	=	OER	
Case 1:	20%	–	2%	=	18%	Estate
Case 2:	23%	–	5%	=	18%	Mill
Case 3:	21%	–	3%	=	18%	Estate and mill

In all cases, the OER is 18% and there are no clues as to why it is low? With the inclusion of oil losses, we can infer in the first case, that the estate is the cause. The second case points to milling problems while in the last case; both the mill and estate are jointly responsible for the low OER. It is obvious here that finger pointing between estate and mill will continue if we choose to look at OER in isolation. Nobody wants to acknowledge responsibility for low OER and even if they know they are the cause, it is unlikely that they will announce it. The inclusion of oil losses will take away the finger pointing and zero in on the cause. Oil loss is the missing link that must be quoted in all discussions on OER.

ESTATE AND TOTAL OIL

The estate plays a critical role in ensuring high total oil in FFB at the time of harvesting. The adage *oil is made in the fields and lost in the mills* appropriately describes such a situation. The key to high total oil starts right in the field with a correct harvesting policy.

Total Oil and Harvesting Policy

A harvesting policy is chosen to maximize oil recovery in the field and it is influenced by two factors namely: harvesting rounds, HR (days between harvest in the same field) and minimum ripeness standards, and MRS (minimum number of detached fruits per bunch). For a given HR, selecting a MRS will fix the total oil in FFB of that harvest. There is, however, a danger of lowering MRS too much so that it borders bunches without detached fruits. *Table* 1 shows the sharp difference in oil content in bunches with and without detached fruits. They were harvested from one palm on the same occasion.

TABLE 1.

Bunch ripeness*	Oil to bunch (%)
Black bunch, yellow mesocarp	13.6
Black bunch, red mesocarp	15.2
Red bunch, red mesocarp	20.8
Bunch with 31 loose fruits	22.3

Source: * Woods, B J *et al.* (1984). *Proc. of the Symposium on Impact of Pollinating Weevils on the Malaysian Palm Oil Industry.*

Harvesting

It is common knowledge that in order to maximize oil recovery, the estate has to ensure the following are adhered to:

- strictly maintaining the prescribed HR;
- cutting only ripe bunches that is laid down in the policy;
- making sure no ripe bunch is left behind; and
- picking up all loose fruits.

It is of utmost importance that once a policy is adopted; the estate's role is to ensure its compliance to the latter.

Harvesting, the Practice

In reality, there are a host of practical issues affecting harvesting. They are:

Cause	Effect
Insufficient harvesters	Extended HR – Departure from harvesting policy – Rotten bunches
Insufficient LF pickers	Poor loose fruits collection
Poor supervision	Black and unripe bunches High unharvested bunches High uncollected loose fruits High trash in FFB

The Impact of Labour Shortage/Poor Supervision

Low total oil in FFB is a direct result of selecting the wrong harvesting policy, cutting black or unripe bunches and leaving behind loose fruits. Missing out on ripe bunches result in rotten bunches in the next round. The impact on total oil is summarized (*Table* 2) and it is important to consider them from an economic standpoint in decision-making on issues related to harvesting practices.

TABLE 2.

Unripe bunches	: A harvest with 5% of each category of unripe bunches without loose fruits will depress the total oil to bunch by close to 1%.
Poor LF collection	: For a 20 kg bunch, every 10 LF left uncollected lowers the total oil to bunch by about 0.2%.
Trash	: Bringing in 5% non-oil bearing tissues artificially decreases total oil to bunch by 1%.

MILLS AND OIL EXTRACTION

The mill's role is to extract maximum oil from the FFB with minimum oil losses. Unfortunately, process control monitoring in the mill is aimed at quantifying *controllable* losses, where adjustments can be made to reduce them. No emphasis is given to determine total oil losses. It is our opinion that priority must now be given to quantify *all oil losses* within the perimeter of the mill.

New Mills, Old Mills

Most discussions on oil losses or OER invariably end up on whether an old mill gives a lower OER when compared to a new mill. The relevant question should be *How efficient are the mills in recovering oil from the fruits it receive*?

	Mill A	Mill B
(i) Oil losses	1.93	2.50
(ii) OER	20.80	21.20
(iii) Total oil [(i)+(ii)]	22.73	23.70
(iv) Oil milling efficiency [(ii)/(iii) x 100]	92%	89%

If we were to base our assessment on OER, we will conclude that Mill A is an inefficient mill. In actual fact, Mill A is more efficient in recovering oil from the fruits as it has a higher oil milling efficiency. Age of the mill does not come into the picture and is of no consequence in oil recovery. An inefficient mill, whether old or new, will show up as having high oil losses and has a low oil milling efficiency. The real need is for the *oil losses* to be accurately quantified before making the comparison.

Process Control Measurements

The starting points for measuring total by-products produced are as follows:

By-product	What is measured?	How it is measured?
Empty bunches, (EB)	A sample of FFB is weighed for sterilization.	The EBs recovered from the FFB are weighed after threshing.
Unstripped bunches, (USB)	Visual count of the number of USB produced.	Calculating difference between theoretical and physical recovery.
Nuts	Total nuts produced.	Basculator/flow estimation.
Fibres	None.	Derived from fibre to nuts ratio.
Sludge	Total sludge produced.	Basculator/flow estimation.
Effluent	Total effluent produced.	Basculator/flow estimation.

It is imperative to use accurate flow meters and weighing equipment to quantify by-products being produced. The lack of emphasis and the absence of suitable measurement equipment coupled with the inherent difficulty in measuring have led some mills to estimate these measurements.

Bulk Densities

An example is given here to highlight the inherent difficulty in quantifying fibres. A 30 t FFB hr^{-1} mill operating for 16 hr will produce 62 t of fibres. Installing a weighing equipment to measure this is not practical as it is equivalent to weighing 34 lorry loads of fibres daily (calculated from a bulk density of 130 kg m^{-3} and a lorry volume of $14m^3$). In such a case, the total fibre is determined by weighing the total nuts produced for the day and then using the fibre to nut ratio test to quantify the total fibres produced. It is clear that nuts have to be accurately weighed. The environment and the type of weighing machines used play a part in its effectiveness in such measurements.

Sampling and Testing

Most mills have comprehensive documents on how these should and must be done and the documents will not be elaborated here. The importance of adhering to proper sampling procedures, techniques for sub-sampling and testing of the by-products cannot be overemphasized here because in the final analysis, *the test results are only as good as the samples taken*.

Oil Losses in the Mill

An example of process control monitoring of oil losses in a mill is listed below:

Source of oil loss	Oil loss on FFB
Sterilizer condensate	0.16
Empty bunches	0.56
Fruit loss in empty bunches	0.03
Unstripped bunches	0.02
Press cake fibre	0.55
Nuts	0.06
Sludge/decanter	0.46
Washings/spillages	0.09
Oil losses	1.93%
OER	20.80%
Total oil (1.93 + 20.80)	22.73%
Oil milling efficiency (20.80 / 22.73 x 100)	92%

The bulk of the oil losses are in empty bunches, press cake fibre and sludge. A critical and often neglected area where losses can be high is in the recovery of unstripped bunches. Poorly sterilized bunches can run up as high as 40% and they have to be manually recovered for re-sterilization. Losses from poorly recovered unstripped bunches have been shown to be as high as 0.5% on FFB.

Oil Losses Not Measured

The areas of oil losses not measured in process control are:

- dumping of fruits on hopper top;
- loose fruits dropping between hopper grates;
- fruits spilled and crushed in the marshalling yard;
- drainage of process tanks;
- oil overflows from tanks;
- desander discharges;
- tank washings;
- purifier and centrifuge flushing; and
- oil spillages.

The bulk of these losses are generally recovered and recycled. Some of these losses are small and may appear inconsequential, as they do not happen all the time. Nonetheless, they have to be identified and measured and included in to cover all areas of losses within the mill.

The Need for Quantifying Total Oil Losses

However small the oil losses are, they have to be determined because they have already been accounted for when the FFB were weighed in.

There could be inherent difficulties in measuring some of these by-products. If they are proven to be burdensome, then constants should be used to signify that there are also other areas of oil losses that are not included in the process control oil loss assessment.

Practical Constraints in Quantifying Oil Losses

Having stressed the importance of determining total oil loss in a mill, there are also practical limitations in getting such measurements. How does one go about quantifying oil losses at the hopper top? In the process of pushing the fruits into the hopper, the tractor runs over some fruits crushing them and leaving the oil on top of concrete surface and on the tractor tires. Even if one can find a way to quantify them, how accurate can such measurements be? Then again, this measurement cannot be carried out on a daily basis without disrupting mill processing.

Dumping of FFB on the hopper top must be avoided at all cost. It is prudent to invest in more cages or hoppers to avoid such oil losses and end up with quality problems. If it must be dumped, then a series of tedious tests are required where the FFB are weighed before and after dumping on the hopper top. The difference in weight can be multiplied against fixed oil in fruits constant and adjusted for moisture loss. Such readings should be applied each time the FFB is dumped on the hopper top.

CONCLUSION

Interpreting OER on its own without mentioning its associated oil losses can be erroneous and can lead to inaccurate conclusions. With the inclusion of total oil losses, the responsibilities of both estate and mill are clearly defined putting an end to finger pointing when OER is low. It is necessary for such important assessment to be carried out by an independent party. There is also an urgent need, however, to review and improve the existing methods of measuring oil losses in the mill. In addition to this, all oil losses that occur within the confines of the mill from the time the FFB is weighed in must be accounted for. It may be a mammoth task but it is one, which has to be carried out if one is serious about improving estate and milling efficiencies. ■