Feature Article

Significance of Oil Extraction Rate (OER) Efficiency in a Palm Oil Mill

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THE OER ISSUES

The other day, a mill manager contacted us to say that his boss was always finding fault with him when the oil loss was on the high side. His boss, the General Manager, was a planter by profession but was vested with the mandate to monitor mill operations as well. As the General Manager was always finding fault with the mill manager and turned a deaf ear to his explanations, he was contemplating on resigning and taking up a job overseas. We told to him to hold on and find out a way to make him understand the factors involved. This could be a tough job as another factor called ego also played a vital role in this. If the General Manager said that the total mill process loss should have been below 1.5%, it should have been applicable in all the mills. He had a point there, but not a valid one as there were other factors he had overlooked.

As this issue is widespread among the organisations, where the plantation managers take charge of the mills, we thought perhaps we should make some clarifications for the planters to carefully consider the relevant reasoning behind the rational that oil losses are a function of the oil extraction ratio. Surprisingly, even the mill engineers are not aware of this simple truth. In order to justify this statement, some definitions would be of help.

MISSING LABORATORY ANALYSES

In some mills, certain oil loss analyses are not carried out and they assign a value of 'zero' for that. This is a wrong way of computation that can mislead the top management.

OER DEFINITIONS

Mechanical Machinery Extracted Oil Extraction Ratio

This is the ratio of the oil extracted from a known weight of fresh fruit bunches (FFB) to the corresponding weight of the FFB, using mechanical oil extraction plants and machinery.

Solvent Extracted Oil Extraction Ratio

This is the ratio of the oil extracted from a known weight of FFB to a corresponding

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weight of the FFB using chemical solvents like hexane.

Process Oil Losses

This refers to the oil losses incurred during the flow of FFB through the series of process steps. It is represented as a percentage of the weight of the oil lost to the weight of FFB that is subjected to the process steps.

Table 1 gives the normally accepted losses at different process steps during mechanical processing. Process losses are always higher during mechanical processing than during the solvent extraction. Solvent extraction is not environment-friendly as a considerable quantity of hexane evaporates during the solvent extraction process. In *Table 1,* all the likely losses during mechanical processing are listed out. If in a mill, a particular loss like oil loss in EFB is not done, an arbitrary figure (usually accepted by the industry) must be assigned instead of a zero value. The mill may use the figures given in *Table 1.*

Total Oil Losses

This is the sum of all the individual oil losses at the different process steps. If we follow *Table 1* the total oil loss is 1.77% and for the purposes of our analysis of oil extraction efficiency, we shall adopt this figure as the average value.

OIL EXTRACTION EFFICIENCY

As oil extraction efficiency is seldom highlighted by the millers as well as the researchers, they do not know about its importance in monitoring process performance.

Oil Extraction Efficiency

It is the ratio of the declared mill: oil extraction rate (OER) (E%) to the sum of the declared mill OER (E%) and the percent total oil losses (L%) = E/(E+L)%.

The following benchmarking assumes that the optimum process parameters are adhered to and the worn out machinery parts are replaced when due. At low process temperatures, the oil loss will tend to rise.

Assuming that the six mills under a particular plantation group get the data shown in *Table 2* during the first year of its operation when the mills want to benchmark its oil extraction efficiency soon after commissioning the mills.

Tables 3 to *8* demonstrates that the total oil losses will rise up in tandem with the mill OER when mill efficiency remains unchanged as in most cases. Note that (E+L) was derived from (OE/efficiency) and oil losses computed by subtracting *E* from it.

TABLE 1. APPROXIMATE OIL LOSS IN PALM OIL MILLS

Source	% on loss/fresh fruit bunches
Fruit trapped in empty fruit bunches (EFB)	0.02
Un-stripped bunches (USB)	0.05
Oil absorbed on the surface of EFB	0.45
Condensate from sterilisation	0.10
Nut surface after pressing	0.05
Fibre after pressing	0.55
Sludge from separator	0.45
General oil spillages or washing from tanks	0.10
Total milling losses	1.77

Source: Ng, S B (1993).

TABLE 2. BENCHMARKING OIL EXTRACTION EFFICIENCIES OF THE MILLS IN THE GROUP

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
A	18	1.5	19.5	92.3
B	19	1.5	20.5	92.7
C	20	1.5	21.5	93.0
D	21	1.5	22.5	93.3
E	22	1.5	23.5	93.6
F	23	1.5	24.5	93.9

Note: OER – oil extraction rate.

TABLE 3. MILL A: EXPECTED OIL LOSS AT VARYING OIL EXTRACTION RATE (OER) AND FIXED EXTRACTION EFFICIENCY

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
A	18	1.50	19.50	92.3
A	19	1.58	20.58	92.3
A	20	1.67	21.67	92.3
A	21	1.75	22.75	92.3
A	22	1.83	23.83	92.3
A	23	1.92	24.92	92.3

Note: Refering to *Table 3*, despite the low OER at 18% the milling efficiency is the same as when the OER is high at 23%. The same is demonstrated in *Tables 4, 5, 6, 7* and *8*.

TABLE 4. MILL B: EXPECTED OIL LOSS AT VARYING OIL EXTRACTION RATE (OER) AND FIXED EXTRACTION EFFICIENCY

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
B	18	1.42	19.42	92.7
B	19	1.50	20.50	92.7
B	20	1.57	21.57	92.7
B	21	1.65	22.65	92.7
B	22	1.73	23.73	92.7
B	23	1.81	24.81	92.7

TABLE 5. MILL C: EXPECTED OIL LOSS AT VARYING OIL EXTRACTION RATE (OER) AND FIXED EXTRACTION EFFICIENCY

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
C	18	1.35	19.35	93.0
C	19	1.43	20.43	93.0
C	20	1.51	21.51	93.0
C	21	1.58	22.58	93.0
C	22	1.66	23.66	93.0
C	23	1.73	24.73	93.0

TABLE 6. MILL D: EXPECTED OIL LOSS AT VARYING OIL EXTRACTION RATE (OER) AND FIXED EXTRACTION EFFICIENCY

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
D	18	1.29	19.29	93.3
D	19	1.36	20.36	93.3
D	20	1.44	21.44	93.3
D	21	1.51	22.51	93.3
D	22	1.58	23.58	93.3
D	23	1.65	24.65	93.3

TABLE 7. MILL E: EXPECTED OIL LOSS AT VARYING OIL EXTRACTION RATE (OER) AND FIXED EXTRACTION EFFICIENCY

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
E	18	1.23	19.23	93.6
E	19	1.30	20.30	93.6
E	20	1.37	21.37	93.6
E	21	1.44	22.44	93.6
E	22	1.50	23.50	93.6
E	23	1.57	24.57	93.6

TABLE 8. MILL F: EXPECTED OIL LOSS AT VARYING OIL EXTRACTION RATE (OER) AND FIXED EXTRACTION EFFICIENCY

Mill name	OER: E (%)	Total losses (L) %	E + L (%)	Efficiency (%) E/(E+L)
F	18	1.17	19.17	93.9
F	19	1.23	20.23	93.9
F	20	1.30	21.30	93.9
F	21	1.36	22.36	93.9
F	22	1.43	23.43	93.9
F	23	1.49	24.49	93.9

A NOTE TO THE MILLERS

We would like to advise the millers to benchmark the oil extraction efficiency of their mills. This should be done when all the machinery are in a good condition and the process parameters are at optimum level. By doing this, the millers can check whether at any time the mill oil losses are a cause for concern. Higher oil losses do not reflect the poor performance of a mill.

REFERENCE

NG, S B (1993). Measurement of oil extraction rate (OER) and milling losses. *Proc. of the National Seminar on Palm Oil Extraction Rate: Problems and Issues*. PORIM, Bangi. p. 99-104.