TRASH REMOVAL SYSTEM FOR FRESH FRUIT BUNCHES IN PALM OIL MILL

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In the oil palm industry, food safety and quality cannot be compromised, especially when 85% of palm oil is being used in food applications (Choo, 2013). Food safety concerns related to 3-monochloropropanediol esters (3-MCPDE) and glycidyl esters (GE) in processed palm oil (PPO) continue to increase, and one of the contributing factors is the contaminants entering the mills along with fresh fruit bunches (FFB).

The contaminants of trash in FFB (*Figure 1*) also contributes to the depression of mill's oil extraction rate (OER) (Che Rahmat, 2018) and the deterioration of crude palm oil (CPO) quality (Farahida *et al*., 2017). Furthermore, the presence of trash may cause frequent choking of process flow as well as serious wear and tear of process machinery, resulting in high maintenance cost.

The diverse nature of the trash (stones, sands, leaves, *etc*.) present in FFB (Ayat *et al*., 2009) complicates most separation systems. It is more difficult to minimise the loss of loose fruits along with the trash. At present, the calculation of OER is adversely affected by the additional weight of FFB contaminants, which is included as total weight of FFB processed. Consequently, the OER declared by the mill is lower than its actual value.

Figure 1. Foreign materials and debris mixed with FFB and loose fruits at hopper.

THE TECHNOLOGY

The Trash Removal System (TRS) is a mechanical device for palm oil mills to remove sand, stones and other trash embedded to oil palm fresh fruit bunches (FFB). Instead of end-pipe solution to address the existence of contaminants in the milling process, *e.g*. using sand trap and de-stoner, the TRS is located in line with the FFB loading ramp prior to the sterilisation process. In this way, mills will be benefited in reducing wear and tear and minimising the loss of oil absorbed into vegetative materials.

The TRS consisted of two-stage operations; the first stage (TRS 1) is to remove sands and small stones prior to sterilisation, while the second stage (TRS 2) is located after the thresher drum to remove big stones and stalks. The TRS 1 and TRS 2 were designed with different clearance gaps to cater for different sizes of trash and were equipped with motorised rod to expedite the separation of trash via vibration mechanism. The actual set up of the TRS 1 and TRS 2 at the palm oil mill is shown in *Figures 2* and *3*, respectively.

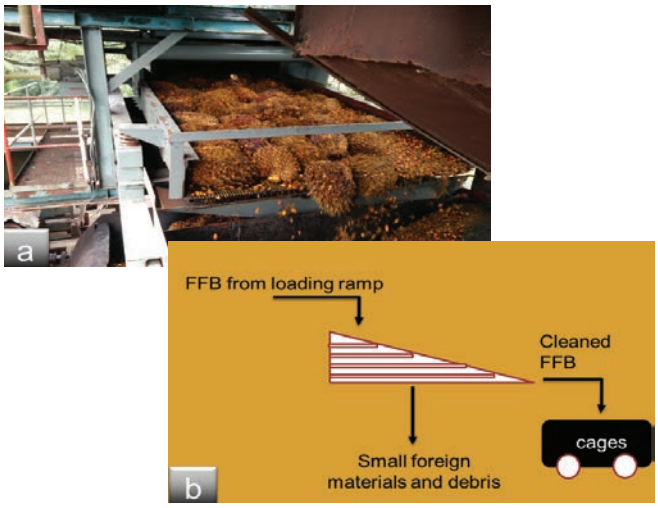

Figure 2. (a) TRS 1 installed after loading ramp hopper, (b) diagram of trash (sand and small stones) removal mechanism.

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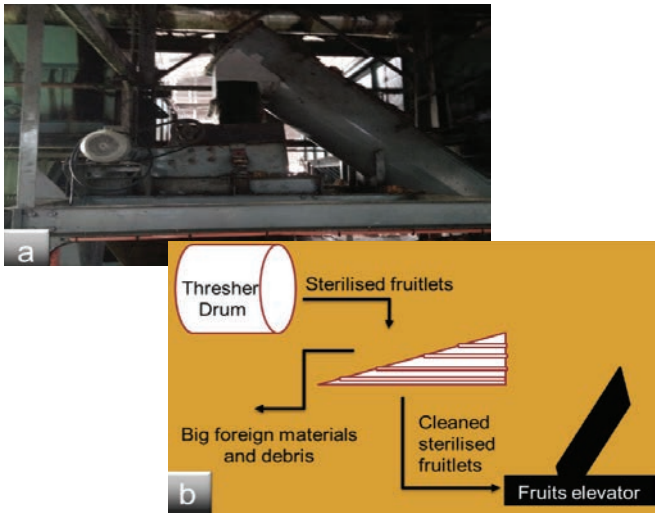

Figure 3. (a) TRS 2 installed after thresher drum, (b) diagram of trash (big foreign materials) removal mechanism.

FIELD TRIAL AND FINDINGS

A field trial has been carried out in a palm oil mill in Teluk Intan, Perak. *Table 1* shows the performance of TRS 1 in removing trash from the FFB consignment. About 1.13-1.43 t of trash were removed, which constituted of sand, small stone, leaf, grass and other (small) foreign material *(Figure 4)*. This was equivalent to 5.66-7.08 kg of trash removed for every tonne of FFB received.

While TRS 1 removed small-sized trash (sand, debris and small stone), the remaining trash that did not pass through the first-stage screening, such as big stones, long stalks, empty bunch and other vegetative matters, was carried over to the subsequent process. Therefore, the TRS 2 was designed and installed after the thresher drum as the second-stage trash removal mechanism. It was observed that the TRS 2 was capable of removing bunch fibres, long stalks and empty bunches. *Figure 5* shows that the vegetative materials removed at this stage, besides contributing to high load to pressing system, contained wax materials which may deteriorate the quality of the oil produced.

ECONOMIC FEASIBILITY

The summary of economic feasibility study on using the TRS is shown in *Table 2*.

TABLE 2. ECONOMIC EVALUATION

Economic analysis*	Value
TRS capital cost	RM 280 000
Oil recovery (0.03% t^{-1} FFB = 54 t CPO)	RM 99 900
Saving on maintenance cost (RM 0.15 t^{-1})	RM 27 000
Payback period	2 years and 3 months

Note: * for 30 t hr^{-1} (180 000 t yr^{-1}) FFB processed and assume CPO price = RM 1850.

BENEFITS AND ADVANTAGES

The segregation of trash in FFB consignment has not yet been practised in mill. Therefore, TRS assists the millers in reducing the FFB processing weight by 0.65% and achieving efficient trash separation of 91.35%. This will consequently increase the oil extraction rate (OER) due to the deduction of the contaminant's weight as well as reduce the operational costs due to lesser maintenance. A significant quantity of trash has been prevented from entering the processing line, thereby reducing the wear and tear of the mill machineries. Additional oil recovery is also expected as the mill can reduce oil losses which are usually foreign vegetative materials.

TABLE 1. QUANTITY OF TRASH IN FFB DELIVERED TO PALM OIL MILL

Day	Number of cage	Trash removed (kg)	Cumulative total (kg)	FFB (kg t^{-1})
1	20	1 262.24	1 262.24	6.31
2	20	1 415.60	2 677.84	7.08
3	20	1 131.62	3 809.46	5.66
4	20	1 270.23	5 079.69	6.35
5	20	1 131.86	6 211.55	5.66
Total	100	-	6 211.55	-

Figure 4. Foreign material and debris collected after TRS 1.

Figure 5. (a) Long stalk, (b) empty bunch, (c) other vegetative matters collected after TRS 2.

INTELLECTUAL PROPERTY AND COMMERCIAL LICENCES

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- This technology is licensed to Hur Far Engineering Work Sdn. Bhd.

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