Feature Article

Coalescing Clarifier for Crude Palm Oil Clarification

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FUNDAMENTALS

When oil passes through interspaces between the coalescence plate separator plate, it imparts shear forces to the small oil particles causing them to agglomerate, thereby preventing the formation of emulsion. As a result, the diameter of the oil particles become large and separation efficiency improves.

BASIS FOR SIZING AND SELECTION

For liquid-liquid coalescers, as with any process equipment, successful sizing and selection is always a combination of empirical observation/experience and analytical modelling.

Of the three steps in coalescing, *i.e.* droplet capture, combining of the collected droplets and gravity separation of the enlarged droplets – the first and the last can be modelled with good accuracy and repeatability. The modelling of the middle and the actual coalescing step is a complex function of surface tension and viscous effects, droplet momentum and the dynamics of sizes of the droplets in the dispersion.

Two units were designed for a 60 t FFB hr^{-1} palm oil mill that used a conventional vertical clarifier tank as shown in *Figures 1* and *2*. The material used for the construction of the coalescence separator was stainless steel SS 316 inserts, in a mild steel casing with insulation thermal control and flow control equipment.

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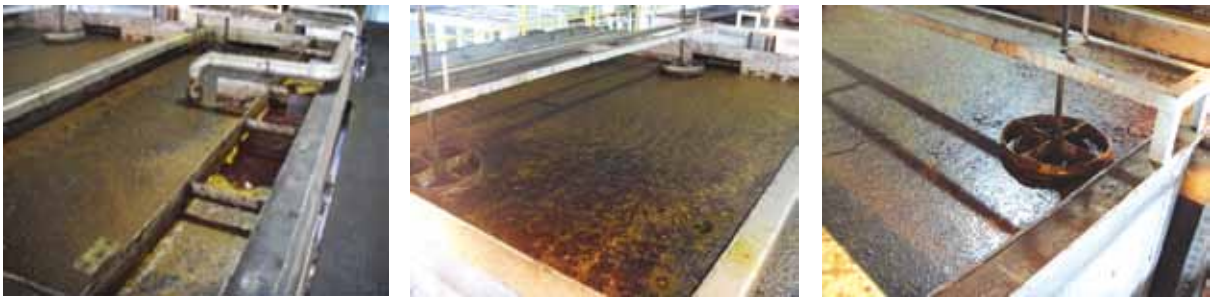

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Figure 1. Coalescing clarifier (OILSEP) – first generation (Indonesia).

Figure 2. Coalescing clarifier (OILSEP) at Vichitbhan oil mill – second generation.

OILSEP DEVELOPMENT HISTORY

Years	Events
2000	R&D with MPOB. Tested pilot unit at Krau Palm Oil Mill.
2002	First units installed in a mill in Indonesia. First generation.
2005 – 2008	Three units in operation in Thailand.
2009	Two units installed in Thailand for mill upgrading.
2009	Discussion with interested parties: Univanich (Thailand), Papua New Guinea, Keck Seng (Malaysia), West Africa.
2010	Planning to conduct testing on OILSEP without dilution.

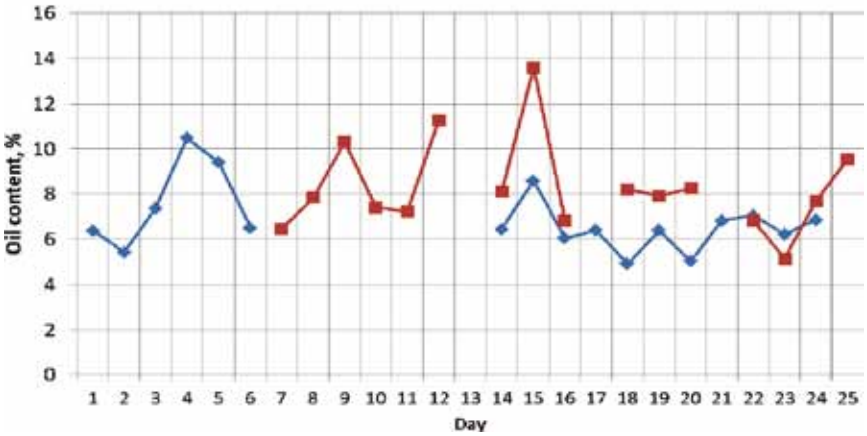


Figure 3. Oil in underflow of coalesce clarifier – Vichitbahan oil mill.

TYPICAL PERFORMANCE OF A SLUDGE SEPARATOR

Average flow rate: 11 800 kg hr^{-1} with 1.8 mm nozzle showing a strong correlation between oil content in feed and the oil content in the centrifuge heavy phase.

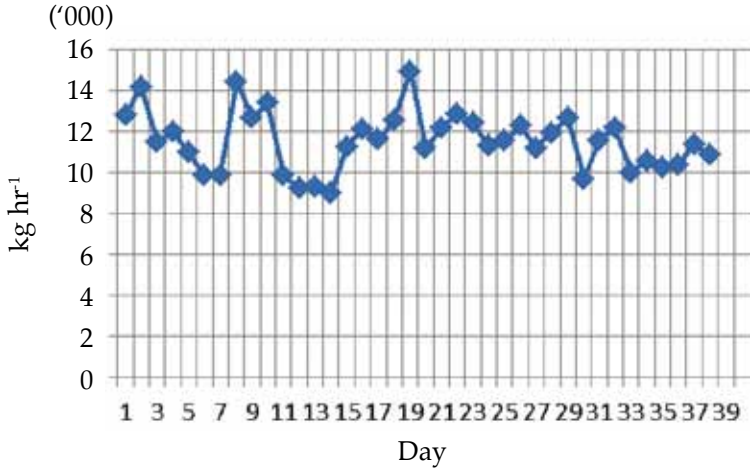


Figure 4. Average material flow into centrifuge.

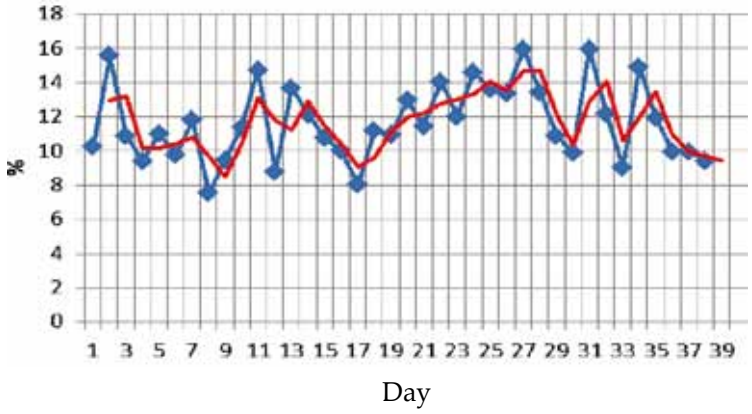


Figure 5. Infeed oil content – conventional clarifier.

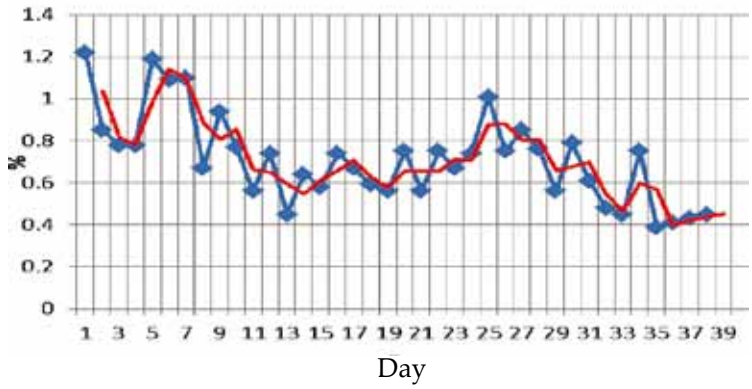
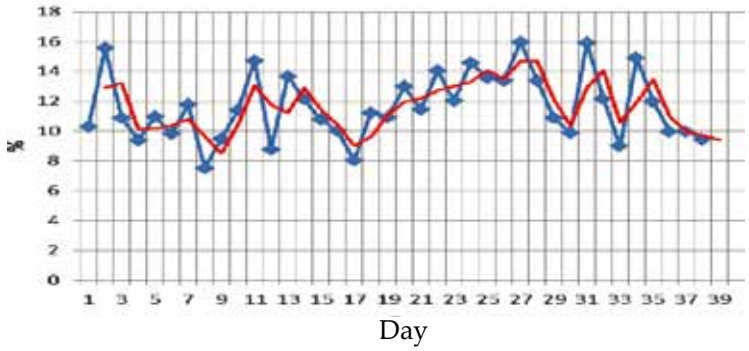


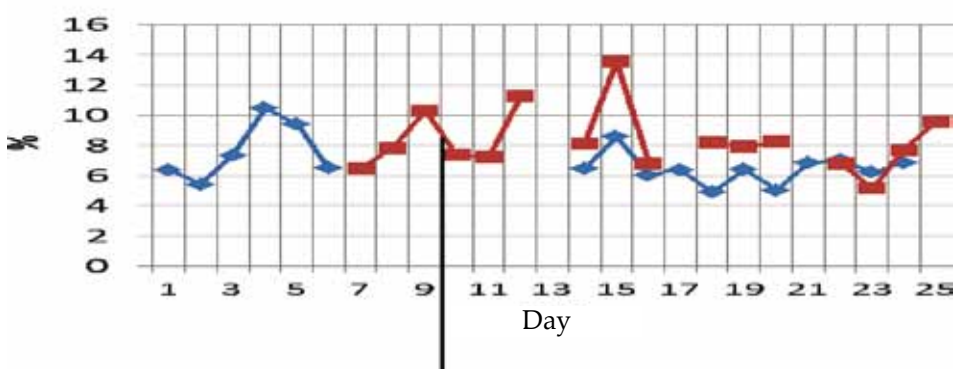
Figure 6. Centrifuge heavy phase oil content.

COMPARISON OF OIL CONTENT IN THE UNDERFLOW OF THE OIL CLARIFIER



Average 11.7%

Figure 7. Infeed oil content – conventional clarifier.



Average 6.82% *Average 7.72%*

Figure 8. Oil in the underflow of the coalescer clarifier – Vichitbahan oil mill.

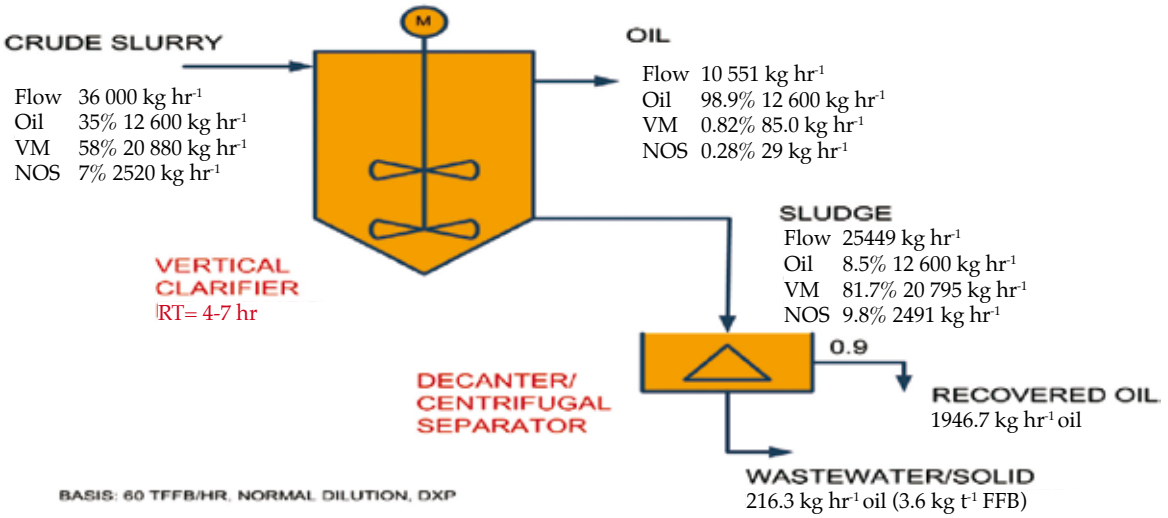


Figure 9. Material balance of conventional crude palm oil clarifier.

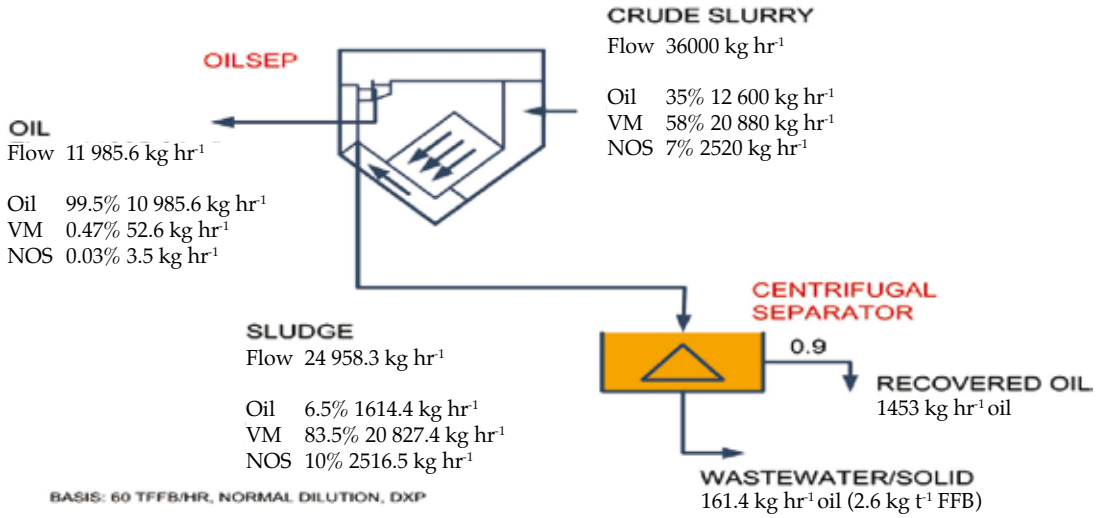


Figure 10. Material balance of coalescing clarifier (OILSEP).

Figures 3 and *6* give the performance of the sludge separated, while *Figures 7* and *10* give the performance of the coalescing clarifier (OILSEP).

PERFORMANCE COMPARISON

Tables 2 and *3* show the performance data of the oil separator (OILSEP) and the vertical clarifier. OILSEP seems to outperform vertical clarifier in almost all activities except in the cost which is more than double.

CONCLUSION

OILSEP utilises coalescing principle to enhance stokes gravity settling. This device also helps to agglomerate small oil droplets formed during emulsification of crude oil slurry resulting in better oil recovery in a short oil retention time. The process also complies with good milling practices as all parts in contact with oil are made of stainless steel.

TABLE 1. COMPARISON BETWEEN OILSEP AND VERTICAL CLARIFIER

Description	OILSEP	Vertical clarifier	Remarks
Oil recovery	12 438 kg hr^{-1}	12 383.7 kg hr^{-1}	54.9 kg hr^{-1}
Oil content (underflow)	5% - 7%	8.0% - 12%	OILSEP very consistent
Feeding and temperature control	Automatic 90°C ± 2°C	Normally non-auto 95°C – 98°C	Low temperature minimise quality deterioration
Oil quality	DOBI 2.6 – 2.8	DOBI 2.0 – 2.5	Consistent
Retention time	1 – 1.5 hr	4 – 7 hr	Oil flow out within 45 min
Footprint for oil room	9 m x 6.5 m x 6 m (H)	Much bigger	Depends on tank size
Material of construction	Housing – 304 SS Inserts – 316 SS	304 SS lining	Complies with CoP of mills Long life

Note: DOBI – deterioration of bleachability index.
CoP- code of practices.

TABLE 2. COMPARISON BETWEEN OILSEP AND VERTICAL CLARIFIER

Description	OILSEP	Vertical clarifier	Remarks
Maintenance and cleaning	Very easy	Time consuming	High pressure water jet for inserts cleaning
Purification requirement	Not required	Yes	Cleaner oil
Automation	Fully auto, flow control, temperature control	Partial in some installation	Ensuring laminar flow for better oil coalescing
System performance	Dynamic constant shearing of crude slurry	Static, no barrier for solid movement	OILSEP is a dynamic system
Total surface area	150 m^2 surface for shearing action	No shearing surface	OILSEP surface area is equivalent to 200 t vertical clarifier

TABLE 3. COMPARISON BETWEEN OILSEP AND VERTICAL CLARIFIER

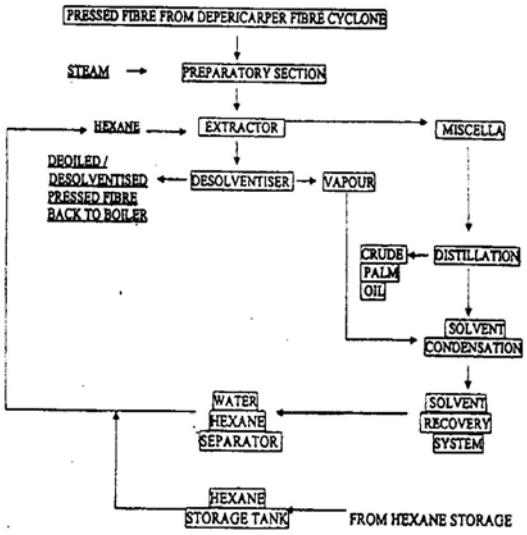
Description	OILSEP	Vertical clarifier	Remarks
Investment cost	RM 1.4 million	RM 600 00	RM 800 000
Return on investment	0.86 year new mill compared to vertical clarifier 1.52 years if installed in existing oil room	-	Overall oil recover = 54.9 kg hr^{-1} or 1098 kg day^{-1} at 20 hr day^{-1} or 1098 kg x 350 day yr^{-1} = 384.3 t yr^{-1} x RM 2400 t^{-1}= RM 922 320

WARNING NOTICE

Malaysia Patent No: MY 137253-A
Recovering Oil From Palm Mesocarp Fibre

THE TRADE AND PUBLIC are hereby informed EONCHEM TECHNOLOGY SDN. BHD. of PLO 525, Jalan Keluli 9, Pasir Gudang Industrial Estate, 81700 Pasir Gudang, Johor, Malaysia is the owner of Malaysian Patent No. MY- 137253 -A in respect of recovering oil from palm mesocarp fibres.

The Patent claims a process and assembly of apparatus to extract remaining oil from mesocarp fibres of oil palm after initial extraction of oil. Flow chart of the process is shown below:



NOTICE is hereby given that, any person who, or firm or company which imports, exports, manufactures, offers for sale, sells or uses the process and/or the assembly of apparatus as claimed in the MY-137253-A Patent which does not originate from EONCHEM TECHNOLOGY SDN. BHD. would be committing an act of infringement and legal proceedings will be taken against such persons, or firms or companies.

Parties interested in the MY-137253-A Patent should contact EONCHEM TECHNOLOGY SDN. BHD. at the following address:

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