

EcoTAGZ Plant - A Revolutionary Technology that Removes Suspended Solids, Recovers Oil and Reduces BOD of Raw Sludge before Discharge to Ponds

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INTRODUCTION

In the palm oil industry, mills discharge 3%-6% organic solids derived mostly from mesocarp pulp into effluent ponds during processing. In addition, solids are generated during the anaerobic digestion of the effluent, and this precipitates to the bottom of the digestion ponds and after a period of time there is a solid build-up within the ponds. The solid build-up if left unchecked will result in significant reduction in the capacity of the effluent ponds, leading to a reduction in the hydraulic retention time of the effluent. Current process technology does not offer a continuous removal of sludge from the ponds and this

poses problems to the mill management, as the mills find it difficult to keep the biological oxygen demand (BOD) of the discharge within 100 ppm. Now, with the proposed new ruling on the maximum BOD at below 20 ppm, the mills are concerned about how to implement the new demands by the Department of Environment (DOE). Failure to comply with the new requirement will result in compounding by the DOE.

There is also about 0.8%-1.5% of palm oil still residual in the raw sludge because the oil is in fine droplets or in an emulsion state and current milling technology is unable to recover it. Any amount below 1.0% is traditionally accepted by the industry as unrecoverable oil loss.

Many mills now also recover oil from empty fruit bunch (EFB) and this has resulted in EFB liquor contributing to 5%-10% more effluent. This is accompanied by an increase BOD from 25 000 ppm to 40 000

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ppm. Wax recovered from EFB and added to the crude palm oil (CPO) is also a big problem for the refineries.

TECHNOLOGY

Our cutting-edge patented technology provides the first real breakthrough to basically remove all suspended solids and recover all residual oil from raw sludge at the oil room before discharging into the effluent ponds with reduced BOD. Raw sludge consisting of decanter heavy phase, light phase sludge, steriliser condensate and/or EFB liquor is fed continuously into EcoTAGZ Plant for processing (Figure 1).

EcoTAGZ plant removes water (filtrate) from raw sludge and concentrates it into a slurry which is similar to the underflow of the mill clarifier. It has about 3%-5% residual oil, 7%-9% solids and 86%-90% water. The actual quantity of oil depends on the original amount in raw sludge.

Slurry is pumped back into the clarifier underflow sludge tank. There will be about 30% extra sludge for the mill decanter to process.

Filtrate is water with dissolved solids, which is mostly organic, giving a clear tea-like colour filtrate with less than 10 ppm oil

and 200 ppm suspended solids, with about 30% of original input BOD. It is discharged into the effluent ponds for further treatment.

INSTALLATION AND MODULE SIZE

The EcoTAGZ plant is installed at the mill oil room where the decanter heavy phase and steriliser concentrate are pumped into EcoTAGZ plant. TAGZ reactors are built in modules of 15, 22.5 and 30 t FFB hr⁻¹ capacity and the numbers and capacity of TAGZ reactors required in the plant will depend upon the mill capacity or fresh fruit bunch (FFB) processed.

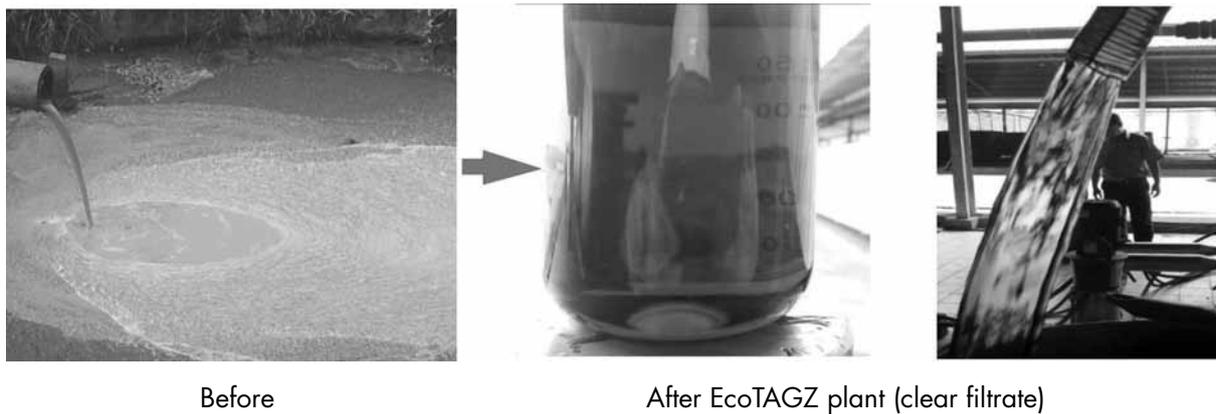
Typically systems are built-up as multiple modules e.g. 45 t hr⁻¹ mill are configured with 2 x 22.5 t hr⁻¹ TAGZ reactors; 60 t hr⁻¹ mill with 2 x 30 t hr⁻¹ and 90 t hr⁻¹ mill with 3 x 30 t hr⁻¹ TAGZ reactors, etc. The system operation is fully automated and controlled by programmable logic controller (PLC).

ADVANTAGES

The answer to solid build-up in ponds can be deduced by solving the problem upstream – stop the suspended solids from going into the ponds. EcoTAGZ plant ensures that no more suspended solids are discharged from the mill to the ponds, so that ponds do not get solid build-up too frequently. However,



Figure 1. Effluent digestion ponds.



Before

After EcoTAGZ plant (clear filtrate)

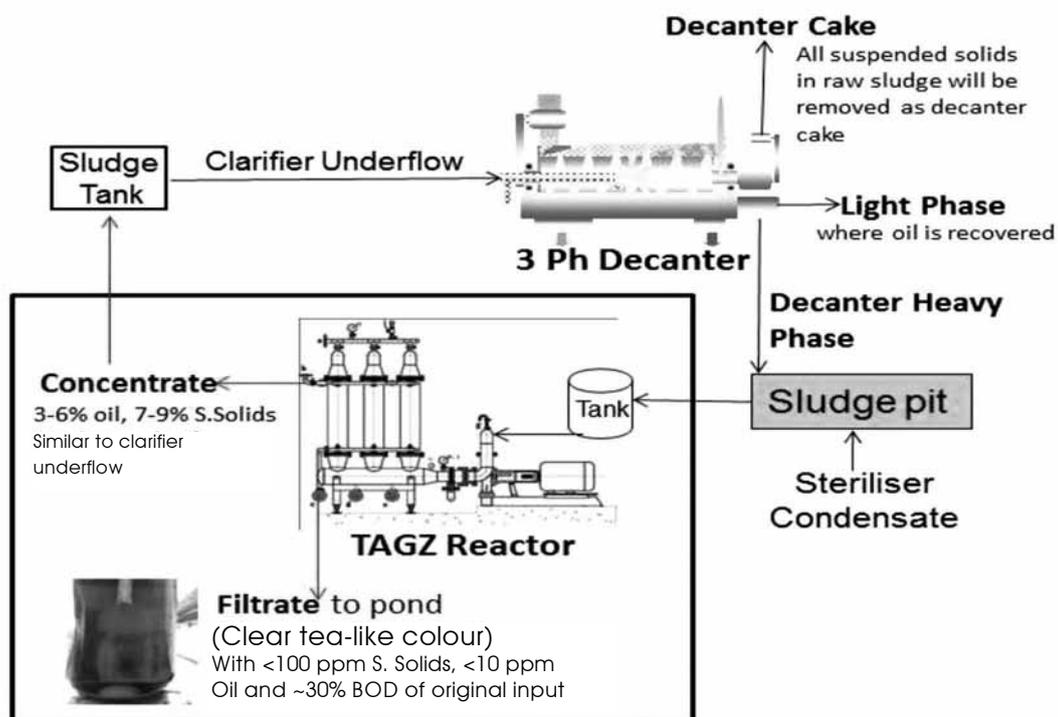


Figure 2. EcoTAGZ flow process for palm oil mill to remove suspended solids and recover oil in raw sludge.

solids will still be generated by the effluent ponds during anaerobic digestion. Mills can have substantial savings by desludging cost and pond operation costs.

The dissolved organic solids can easily be digested by microbes. Thus, it is easier for the mill to treat the clear filtrate with

reduced BOD and bring down BOD level to below 20 ppm for effluent discharge to comply with DOE requirements.

The EcoTAGZ plant will also remove wax from EFB liquor as well. The wax is similar to 'candle wax' and is not easily digested by microbes. It promotes sludge

TABLE 1. COST COMPARISON BETWEEN ECOTAGZ AND POLISHING PLANT

For a 60 t hr ⁻¹ mill	EcoTAGZ plant	Polishing or 3 ^o plant	Remarks
Investment (RM)	-	2 000 000	
Yearly return (RM)	2 950 450	0	Revenue from oil recovered at RM 2350 t ⁻¹
Yearly operating cost			
Electricity at RM 0.15 per kWhr	648 000	81 000	Power consumption of systems
Operation and main	24 000	36 000	EcoTAGZ is 18 hr and polishing 24 hr
Net return (RM)	2 278 450	(117 000)	
Annual desludging cost (RM)	0	(150 000)	No solid going into ponds anymore
Annual net return (RM)	2 278 450	(267 000)	
Return over 5 years	11 392 250	(1 335 000)	Return based on 1% oil loss in sludge
Net return		(3 335 000)	

TABLE 2. LABORATORY ANALYSIS RESULTS

Type of test ^a	Test method ^b	Results	
		Filtrate	POME
pH value	APHA 4500-H ⁺ B	4.69@25.6°C	4.73@25.6°C
Biochemical oxygen demand (BOD) (3 days @ 30°C), mg litre ⁻¹	DL-LAB-TM01 (based on MN Method 8-22)	12 410	48 100
Chemical oxygen demand, mg litre ⁻¹	DL-LAB-TM02 (based on MN Method 0-26; 0-28; 0-29)	19 500	78 000
Ammonical nitrogen (NH ₄ -N), mg litre ⁻¹	DL-LAB TM03 (based on MN Method 0-05)	12	70
Total nitrogen, mg litre ⁻¹	DL-LAB TM04 (based on MN Method 0-88)	28	590
Oil and grease, mg litre ⁻¹	DOE (M) Reference Method	3	13 812
Suspended solids, mg litre ⁻¹	DOE (M) Alternative Method	31	24 600
Total solids, mg litre ⁻¹	APHA 2540 B	20 760	49 750

Note: ^aSample for BOD was initial on December 2013.

Note: ^b(1) APHA: American Public Health Association, *Standard Methods for the Examination of Water and Waste Water*. 21st edition 1995.

(2) DOE Method: *Revised Standard Method for the Analysis of Rubber and Palm Oil Mill Effluent*. 2nd edition 1995.

(3) MN Method: *Test Method of Discharge Nagel Manual for Nonocolor Spectrophotometer*, 2010.

ND: Not detected.

TABLE 3. RESULT OF ANALYSIS

Parameter	Result			Test method
	Raw POME	Concentrate	Filtrate	
Oil and grease mg litre ⁻¹	-	-	11	APHA 5520 B
* Oil and grease, % (wet basis)	1.1	2.4	-	APHA 5520 E
* Moisture content, % (wet basis)	94.1	92.2	97.0	AS 1289 B1.1
* Non-oily solids (NOS), % (wet basis)	4.80	5.40	3.00	By calculation–referring O&G and moisture contents

Parameter	Result			Test method
	Decanter cake	Heavy phase	Light phase	
Oil and grease, mg litre ⁻¹	-	-	-	APHA 5520 B
* Oil and grease, % (wet basis)	4.2	1.6	34	APHA 5520 E
* Moisture content, % (wet basis)	71.7	93.0	61.8	AS 1289 B1.1
* Non-oily solids (NOS), % (wet basis)	24.1	5.40	4.20	By calculation–referring O&G and moisture contents

Note: *Denotes not SAMM accredited.

(-) Denotes this parameter is not tested for this particular sample.

APHA denotes Standard Methods for the Examination of Water and Wastewater, 21st Edition (2005) by APHA, AWWA and WEF.

formation within the effluent ponds at an accelerated pace.

EcoTAGZ plant can generate revenue to pay for itself (shown in *Table 1*) from the oil recovered, while treating the effluent to remove solids and reduce BOD for discharge into the effluent ponds for treatment. Most of the technology for effluent treatment, once installed will require operation and maintenance cost on top of the initial investment cost without generating any revenue.

DISCUSSION

The EcoTAGZ plant provides an immediate solution for palm mills facing effluent discharge problems. Once the EcoTAGZ plant is installed in the mill, there will also be no more sludge oil in the effluent ponds, as only clear filtrate with oil of less than 10 ppm and suspended solids of less than 100 ppm will be discharged to the pond. The clear filtrate can easily be digested by microbes to bring down the BOD for discharge.