Prospecting for Green Technology in POME Treatment

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One of the greatest issues encountered in the palm oil industry has been the quality of treated palm oil mill effluent (POME) when discharged into the watercourses and local ecosystem, and the emission of methane gas from the POME treatment plant. Palm oil millers are desperately searching for a green technology that can bring the BOD (Biological Oxygen Demand) level of treated POME at final discharge to less than 20ppm to meet the requirements set by the Department of Environment.

A technical visit to Bangalore has been most fruitful. A suitable green technology in POME treatment was uncovered which can be applied directly to the palm oil industry in Malaysia and Indonesia. This new system of treating POME does not use any treatment ponds and there is practically no emission of methane gas from the system. The treated water can be used for land irrigation and cleaning purposes.

INTRODUCTION

The palm oil industry is the single largest agro-based industry in Malaysia, and it has been contributing effectively to the growth of our country. However, the industry has been closely associated with claims of pollution and environmental destruction by the foreign media for a long time now. One of the biggest issues highlighted has been the discharge of POME into the watercourses and local ecosystem.

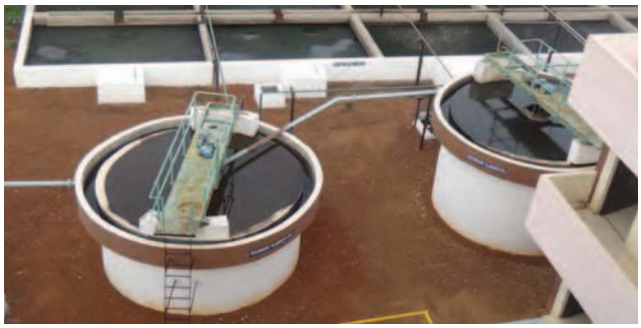
The conventional POME treatment system in Malaysia, Indonesia and other oil palm growing countries is based on the retention pond system with a hydraulic retention time (HRT) of more than 120 days. POME is discharged daily from the mills depending on the operating capacity of the palm oil mill. About 0.8 m^3 of POME is produced for every 1.0MT of FFB (fresh fruit bunch) processed by the palm oil mill. The estimated amount of POME discharged by the mills (operating at 22 hours per day) is presented in Table 1.

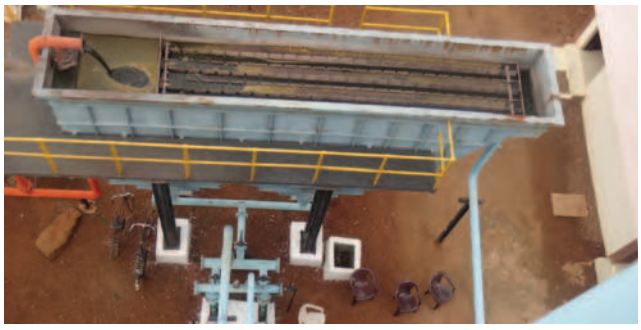
Table 1: Mill capacity and amount of POME produced

Capacity (MT/Hour)	Volume/per hour (m^3)	Volume/per day (m^3)
20	16	352
30	24	328
45	36	792
60	48	1056
90	72	1584
120	96	2112

The treated POME is discharged to the watercourses at BOD levels ranging from 20ppm–100ppm on a daily basis. The land irrigation method is also being practiced to reduce the final discharge volume to the watercourses and ecosystem. The issues surrounding the final discharge of POME are:

i) The final volume of POME being discharged.
ii) The BOD level of POME at final discharge.
iii) The natural colour of POME at final discharge (due to the tannin).
iv) Pollution of river water and ecosystem.
v) Release of methane gas from the POME plants.





The Department of Environment is encouraging the industry to install the POME polishing plant into their POME treatment system to reduce the BOD level of POME at final discharge to less than 20ppm and to utilise all treated water for land irrigation. The ultimate objective in POME treatment is to minimise the amount of treated POME being discharged into the watercourses and ecosystem. A technical visit to the southern part of India was carried out by the author from 8-12 August 2011 with the aim of prospecting for an appropriate green technology in POME treatment for application in the Malaysian palm oil industry.

GREEN TECHNOLOGY IN POME TREATMENT

The visit provided an opportunity to see the rapid growth and development of palm oil related technologies in the palm oil industry in India. The author visited two palm oil mills in the South Indian state of Andra Pradesh to see the zero ponds and higher biogas generation projects that were undertaken there. In contrast to the open lagoon (pond) systems that pollute the underground water and emit methane gas into the atmosphere, this technology overcomes both of these environmental problems, thus making it a totally green technology. The following are brief descriptions of the POME treatment processes which consist of four main components, namely, (a) Pre-treatment, (b) Anaerobic treatment, (c) Aerobic Treatment and Tertiary Treatment.

(a) Pre-Treatment of POME

Depending on the topography of the site, the raw effluent is conveyed to the treatment site using a suitably designed channel or a closed pipe. POME enters a screen chamber which removes floating materials, and then enters an oil-grease trap to remove the free oil. After that, it enters the equalization tank (EQT) for the purpose of equalisation and surge control. The POME from the EQT is then pumped into the plate heat exchanger (PHE) to reduce the temperature.

(b) Anaerobic Treatment of POME

The Stirred Anaerobic Reactor (SAR) is a non-media, continuously stirred tank reactor. It operates best within the mesophillic temperature range of 36°C to 39°C. The foundation of the tank is designed according to the soil type at the location. On soft ground, a floating type foundation that can ensure equal settlement is preferred. The tank reactor is fabricated at site using mild steel plates and structural members, conforming to internationally accepted engineering design codes. The inside of the reactor is sand blasted and painted using chlorinated rubber paint. The external surface of the tank reactor is wire brushed, cleaned and painted using synthetic enamel or aluminum paint.

Raw POME is introduced into the tank reactor from the top. Recycled sludge is also added from the top of the reactor. The mixed liquor travels downward through the central shaft in which an agitator provides an adequate mixing of raw waste and recycled sludge. The mixed liquor flows out of the central shaft into the reactor near the bottom of the tank. A set of agitators is located equidistant along the circumference of the reactor to mix the liquor thoroughly. The constant agitation helps to maintain the active bacteria in suspension while the bacteria utilise the organic matter present in the wastewater to produce biogas.

At the outlet of the reactor, the solids are separated from the liquids using the Lamella Clarifier and are pumped back into the system. The recirculation of settled solids helps to maintain an adequate population of active bacteria inside the reactor. The reactor is designed with the following accessories to ensure the efficient performance and safety of the reactor:

- Overflow point that serves as pressure breakers in case of emergencies.
- Pressure breaker and vacuum breaker, if pressure exceeds the operating range.
- Flare stack to flare the biogas generated if it is not used.
- Gas flow meter to record the quantity of gas generated.

The treated effluent of the reactor is discharged from the top of the reactor and the head available can be utilised. Biogas is produced by the anaerobic digestion inside the reactor and is collected from the reactor roof. This biogas is then transferred to a floating type gas holder which is fitted with all the essential safety equipment such as breather valve, flame arrestor, etc.

(c) Aerobic Treatment of POME

The overflow from the Lamella Clarifier enters into a Conventional Aeration Tank (CAT). In the CAT, the microorganisms degrade the soluble organics aerobically. To provide the required population of bacteria in the CAT, a specific concentration of the mixed liquor suspended solids (MLSS) is maintained. This is done to maintain the requisite MLSS and food to micro-organisms ratio (F/M). Some of the settled sludge from the clarifier is re-circulated back to the aeration tank. A fixed surface aerator is used to provide oxygen to the bacteria.

The mixed liquor from the CAT enters the central well of the Lamella Clarifier, and separates the sludge and the liquid. The clarifier is a hopper bottom circular tank with a centrally driven clarifier mechanism, and the solids settle at the hopper bottom after passing through tube settlers. The supernatant from the clarifier overflows the peripheral launder uniformly. Part of the sludge from the clarifier is re-circulated back to the aeration tank while the balance of the sludge is dried for disposal.

The overflow of the clarifier enters the Extended Aeration Tank (EAT) in which the microorganisms degrade the soluble organics aerobically. As in the CAT, the requisite MLSS and F/M is maintained, and part of the settled sludge from the clarifier is re-circulated back to the aeration tank. A surface aeration system is used to provide oxygen to the bacteria.

The mixed liquor from the EAT enters the central well of a second clarifier to separate the sludge and the liquid. As previously mentioned, the solids settle at the hopper bottom and the supernatant overflows the peripheral launder. Part of the sludge is re-circulated back to the aeration tank while the balance is dried and disposed of.

(d) Tertiary Treatment of POME

A chlorine solution is added to the treated affluent for disinfection and is adjusted to maintain a residual chlorine concentration of 0.5ppm-1.0ppm. A baffled wall channel constructed in RCC M-20 is provided. The chlorinated effluent is then pumped to a multi-grade filter to remove the suspended solids. The multi-grade filter consists of a

cylindrical mild steel vessel with dished ends while the filter media is in the form of sand and gravel.

The effluent is then pumped from the multi-grade filter to an activated carbon filter to remove the suspended solids, colour, odour, etc. The activated carbon filter consists of a cylindrical mild steel vessel with dished ends and the filter media is in the form of activated carbon.

The treated effluent is temporarily stored in a storage tank and can be used for crop irrigation, as well as gardening, floor washing, and other cleaning purposes. The sludge is sufficiently mineralised in the aerobic digestion and does not need any further treatment before dewatering and disposal. Sand filtration drying beds is used to dewater the sludge which is then sun-dried. Sludge drying beds are constructed in brick masonry with a sand media supported by a gravel bed and suitable under-drainage arrangement.

CONCLUDING REMARKS

The technical visit to Bangalore has been most fruitful. A suitable Green Technology in POME treatment was uncovered and it can be applied directly in the palm oil industry in Malaysia and Indonesia. This Green Technology is widely being used in India in the sugar refineries, distilleries and breweries industries for more than 15 years and has recently been adapted for use in the palm oil industries over the last 5 years. This new system of treating POME does not use any treatment ponds and there is practically no emission of methane gas from the system. The treated water can be used for land irrigation to reduce final volume of discharge to natural water resources.

The future of Waste Water Technology should emphasize on the followings:

i) Reduced volume of treated waste water discharge. This could be done at upstream level by reducing water usage in the recovery process too.
ii) Reduced BOD / COD / Suspended Solids as per to allowed level without great fluctuation to maintain stable discharge quality.
iii) Capture of methane gas and firing into existing boilers or gas engines to produce green power and reduce dependency on fossil fuel.
iv) Avoid conventional earthwork pond system to protect ground water quality and avoid contamination. Glass coated or steel tanks to be used to reduce land usage.
v) To build high technology waste treatment plants and operated by educated Environmental Engineers and not by ordinary operators.

All industry waste must be reduced, recycled and treated to required quality in line with green technology guidelines to preserve our environment. ■