Palm Oil Mill Effluent Treatment by Activated Sludge Process using Submerged Mechanical Aerator/Agitator

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INTRODUCTION

The environmental quality regulations for palm oil mill effluent (POME) has reduced the biological oxygen demand (BOD) level to 5000 mg litre^{-1} as the first generation discharge standard limit. However, the discharge limit was subsequently revised and drastically reduced to the present limit of 100 mg litre^{-1}. It is anticipated that the discharge limit will be further reduced to 50 mg litre^{-1}, and in places where wastes are discharged into rivers, the expected future limit will be at 20 mg litre^{-1}. The oxidation pond (lagoon) method has been conventionally employed for POME treatment for many years due to low construction and operation costs and easy maintenance. However, the anticipated new effluent discharge standard limits cannot be achieved by the oxidation pond process alone; therefore, an additional aerobe/activated sludge process (ASP) is recommended as a polishing treatment.

POME is pre-treated in an anaerobic lagoon until the BOD level is about 500-1000 mg litre^{-1}. It is then further subjected to BOD reduction by aerobic organisms (activated sludge). Efficient aeration and agitation during the aerobic reaction are essential to ensure significant BOD reduction. A surface aerator is normally employed as an air diffuser in the aeration tank. The air diffuser, if not properly operated could prevent stabilisation of BOD reduction. Instability of the aerobic organisms could occur due to excessive or insufficient aeration or deposition of sludge caused by insufficient agitation. A diffuser generates minute air bubbles and has high aeration efficiency in clean water. However, it is known to have a low vapour-liquid oxygen transfer rate in sewage. The reasons are because the diffuser only has an upward agitation stream and the oxygen retention time in the aeration tank is insufficient. The oxygen supply function is halted if the diffuser is clogged by some bubbles generated with the sludge, which does not occur in clean water. As sludge is deposited at the bottom of the tank, it is difficult to achieve a continuous stable aeration tank process (*Figure 1*).

Figure 1. Diffuser clogging.

When the water level is high, the agitation does not reach the bottom of the aeration tank and aeration cannot be controlled. The uneven agitation flow velocity will result in concentration gradient of activated sludge within the tank and sludge deposition will occur at the bottom of the tank. Sludge deposition reduces the actual aeration capacity (reaction capacity) and aeration stability in the aeration tank, as well as complicates the agitation. In addition, air diffusers have the same aeration and agitating functions; thus, efficient processing is not achieved in the aeration tanks. Despite using the ASP, the aeration tank which is used as the key device becomes unstable. As a result, ASP is unable to fully function and a continuous BOD processing cannot be achieved. To resolve these problems, an investigation on the aeration and agitation states by the diffuser was carried out to achieve a stable BOD processing in the aeration tank of ASP. For efficient aeration and agitation, any improvements in the aeration tank using submerged mechanical aerator and agitator separating the 'agitating function' and 'agitating diffusing function' were examined.

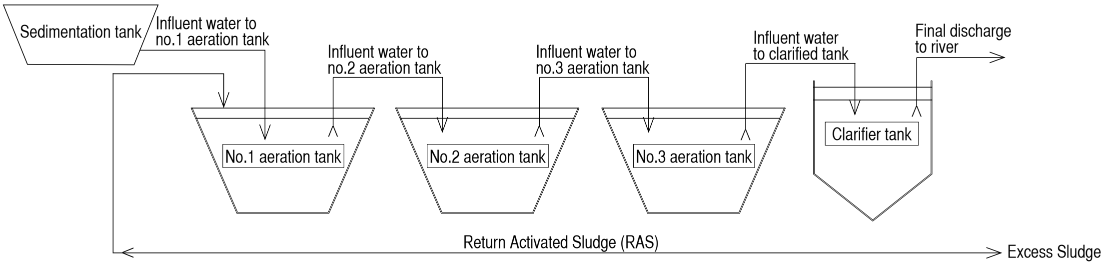

Figure 2. Specification of activated sludge method (ASM) for polishing plant.

CASE STUDY PROCEDURES

POME production of the polishing plant involved in the case study was 54 m^3 hr^{-1} (1296 m^3 day^{-1}), with hydraulic retention time (HRT) of 1.8 days. The aeration system served as a process flow of a standard ASP having three aeration tanks as shown in *Figure 2*.

Characteristics of POME were analysed and are presented in *Table 1*. The high BOD and chemical oxygen demand values of the final discharge proved that the biological activities of the ASP malfunctioned optimally. As for ammonium, the nitrification was not complete due to insufficient oxygen supply in the aeration tank. The total nitrogen content was reduced owing to denitrification reaction resulting from insufficient agitation and adsorption caused by sludge deposition. Mixed liquor dissolved oxygen (MLDO) values were as low as 0.13-0.39 mg $litre^{-1}$.

TABLE 1. CHARACTERISTICS OF POME SOURCES

Source of POME	BOD (mg $litre^{-1}$)	COD (mg $litre^{-1}$)
Influent water to aeration tank no. 1	349	1 320
Final discharge	228	843

Note: BOD – biochemical oxygen demand, COD – chemical oxygen demand.

DESIGN PARAMETER

A case study of submerged mechanical aerator and agitator was conducted. The aeration capability was examined for the POME parameters shown in *Table 2*. The submerged mechanical aerator/agitator has the advantage in terms of power source separation for two main functions of aeration - air supply and agitation/aeration. It is also able to operate with flexibility either for aerobic agitation or anaerobic agitation. With a simple design for the ponding system, this process prevents scattered wastewater/sludge and is free from noise/vibration.

TABLE 2. DESIGN PARAMETERS OF CASE STUDY FOR POLISHING PLANT

Parameter	Unit	Design value
Influent BOD	mg $litre^{-1}$	500
Effluent BOD	mg $litre^{-1}$	20
BOD removal rate	%	95
MLDO	mg $litre^{-1}$	2.0
MLSS	mg $litre^{-1}$	2 500
Operating temperature of waste water	°C	28
Aeration devise installation water depth (as water depth)	m	3.6

Note: Target tank specification was based on L1=18.5 m, W1=18.5 m (L2=11.3 m; W2=11.3 m), WD=3.6 m for 1 tank; Number of aeration tanks - 3 tanks; MLDO - Mixed liquor dissolved oxygen; MLSS - Mixed liquor suspended solid.

The mixed liquor suspended solid (MLSS) and flow velocity were measured in the respective aeration tanks using submerged mechanical aerator/agitator to investigate the actual states of agitation. The measurements in the aeration tanks, as well as at the surface, middle, and bottom of the tank, were carried out using Yellow Springs Instruments (YSI) 58 membrane DO probe and Iijima Electronics Corporation IM 100 P probe. For the ASP evaluation using submerged mechanical aerator/agitator, inflow BOD of 200 mg $litre^{-1}$ or higher was used as target. Comparative examination was performed with various water quality analyses, such as MLDO, BOD, COD, ammonium and total nitrogen (TN). The measurement of MLDO was taken at one point; the midway of the water depth in each of the aeration tanks no. 1-3. The measurements of BOD, COD, ammonium, and TN were taken at six points: influent, aeration tanks no. 1-3, after clarifier, and final POME discharge point. The measurements of suspended solid (SS) were recorded at two points: after clarifier and final POME discharge point. The aeration tanks in the polishing plants using ASP and diffuser were measured for their MLDO, MLSS and flow velocities at the surface and bottom of the tank to investigate their aeration and agitation.

TABLE 3. RESULTS OF DIFFERENT AERATION TANK CONDITIONS

Location	Aeration device	Measurement items		
		MLDO (mg $litre^{-1}$)	MLSS (mg $litre^{-1}$)	Average flow velocity (m sec^{-1})
M1	Diffuser	6.5 (Upper) 4.6 (Lower)	600 (Upper) 500 (Lower)	0.576 (Upper) 0.179 (Lower)
M4	Diffuser	7.42 (Upper) 0.11 (Lower)	120 (Upper) 40000 and more (All parts of lower)	0.143 (Upper) 0.091 (Lower)

Note: Location - polishing plant; upper - surface area; lower - bottom area.

FINDINGS

MLDO and MLSS, and Flow Velocity

The results of MLDO, MLSS, and flow velocity of the aeration tank are shown in *Table 3*. Using the diffuser which was measured at location M1, the values obtained were 4.5-6.0 mg $litre^{-1}$ MLDO, 500-600 mg $litre^{-1}$ MLSS, and 0.179-0.576 m sec^{-1} flow velocity. Although the oxygen required for aerobic biodegradation was efficiently maintained when the MLDO values were within the range from 1-3 mg $litre^{-1}$ by ASP, the aeration state of location M1 demonstrated that excessive aeration with inappropriate state was performed. As a result, MLSS values showed a very low activated sludge concentration indicating that the sludge balance was disturbed by the shortage of aerobic organisms. There was a gap of flow velocity, which possibly showed that stirring by the diffuser was not fully performed.

Measurements at location M4 using the diffuser showed that MLDO values were 0.11-7.42 mg $litre^{-1}$, MLSS value on the surface was 200 mg $litre^{-1}$, and flow velocity values were 0.091-0.143 m sec^{-1}. It was confirmed that excessive aeration was performed. The excessively low MLSS value was expected since ASP was not maintained. In addition, sludge decomposition of MLSS at 40 000 mg $litre^{-1}$ or higher showed no agitation flow velocity at the bottom of the tank. Apparently, stirring was not sufficiently performed which reduced the aeration capacity (reaction capacity). Agitation using submerged mechanical aerator/agitator on both the surface and the middle layer was conducted with MLSS values ranging from 1350-1630 mg $litre^{-1}$ as shown in *Figure 3*. Employing the submerged mechanical aerator/agitator, the interior of the aeration tank was entirely agitated since the concentration distribution at the bottom of the tank (MLSS 1460 mg $litre^{-1}$) was similar to those of the surface and middle layers.

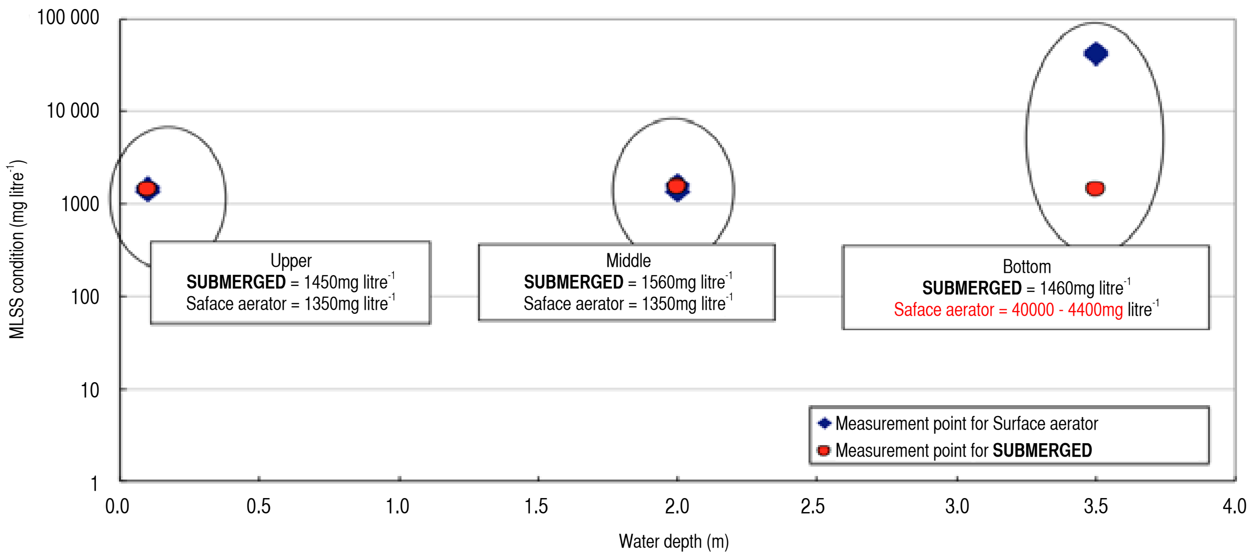

Figure 3. Comparison of mixed liquor suspended solid (MLSS) condition in aeration tank.

FLOW VELOCITY

The flow velocity distributions of the submerged mechanical aerator/agitator (*Figure 4*) were 0.296 m sec^{-1} for bottom layer (lower), 0.307 m sec^{-1} for middle layer and 0.320 m sec^{-1} for the surface (upper layer), with no significant difference. It was found that the entire liquid in the tank was agitated causing turbulence to each velocity waveform. It was therefore verified that there was no deposition of sludge at the bottom of the tank due to sufficient agitation.

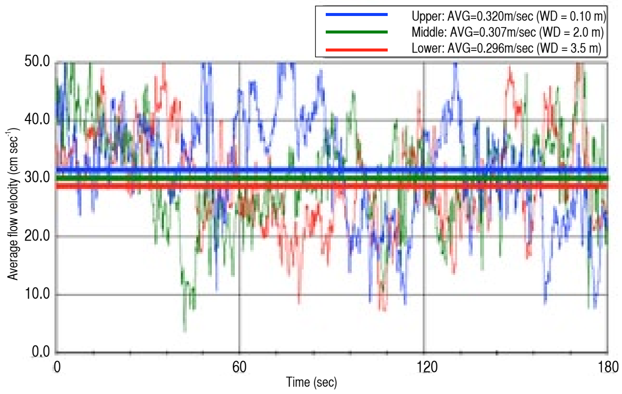

Figure 4. Flow velocity for submerged mechanical aerator/agitator in aeration tank.

The MLDO values for aeration tank no. 1 were 0.3 -0.98 mg $litre^{-1}$, 3.5-6.51 mg $litre^{-1}$ for aeration tank no. 2 and 6.0-7.59 mg $litre^{-1}$ for aeration tank no. 3 (*Figure 5*). In aeration tank no. 1, since oxygen consumption by biodegradation and nitrification reaction was in progress, MLDO values as low as 0.3-0.98 mg $litre^{-1}$ were obtained. The changes in MLDO values in aeration tank no. 2 and 3 presumably resulted from oxygen consumption by respiration of the activated sludge in the tanks and decomposition of organic matters with low reaction rates in Aeration tank 3. This showed that MLDO values were improved by aeration in the submerged mechanical aerator/agitator. Herein, the standard control ranges of MLDO values by ASP were usually 3.0 mg $litre^{-1}$ or lower. Submerged mechanical aerator/agitator can be managed by controlling the amount of air blown by the blower.

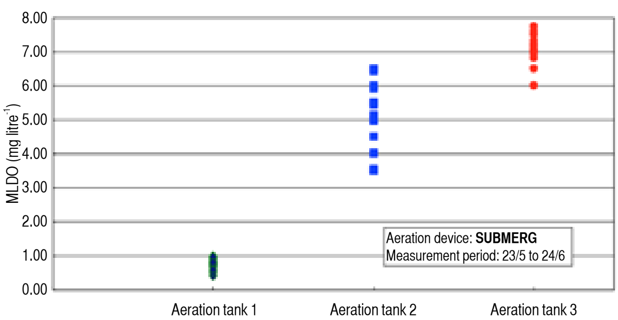

Figure 5. The variation of mixed liquor disolved oxygen (MLDO) concentration in aeration tank 1 to 3.

BIOLOGICAL OXYGEN DEMAND AND CHEMICAL OXYGEN DEMAND

The results for BOD and COD of POME after polishing treatment using submerged mechanical aerator/agitator are shown in *Figures 6* and *7*, respectively. Both the BOD and COD were found to be significantly reduced over time. Although the concentration of the influent was not constant, the results for BOD in the final discharge were in the range of 21-48 mg $litre^{-1}$, and for COD were 74-231 mg $litre^{-1}$. The BOD removal rate was greatly improved from 84.1% to 93.1%.

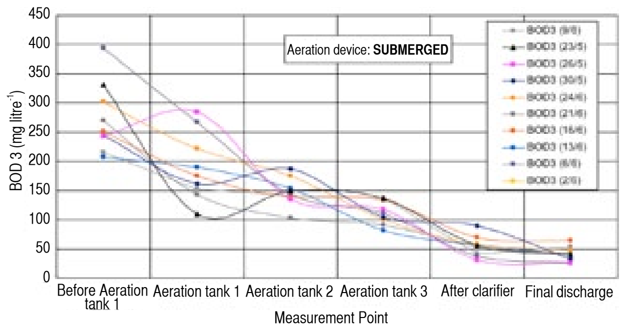

Figure 6. The variation of biological oxygen demand (BOD) concentration in aeration system.

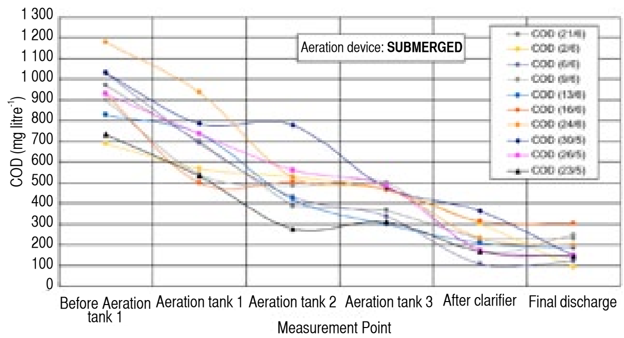

Figure 7. The variation of chemical oxygen demand (COD) concentration in aeration system.

Based on the 97% to 99% nitrification reaction in aeration tank no. 2, the oxygen supply seemed to be adequate (*Figures 8* and *9*). The concentration of TN was lower in the aeration tank although it was under aerobic conditions. This was probably due to denitrification reaction resulting from partial anaerobic and aerobic conditions taking place simultaneously in the tank caused by fluctuating MLDO values. High rates of nitrification and denitrification could be achieved where both oxic (aerobic condition) and anoxic (anaerobic condition) environments are present (Davood Nourmohammadi *et al*., 2013). Aerobic denitrification is also majorly affected by dissolved oxygen as revealed by Bin Ji *et al*. (2015). The inside of the activated sludge flocs was also partially under anaerobic conditions. Clifford *et al*. (2010) reported that denitrification of nitrate (or nitrite) may be found in deeper subsurface biomass (sludge) zones.

These results showed that oxygen required for nitrification reaction of ammonium content was insufficient with the surface aerator, but ammonium was greatly reduced from the viewpoint of oxygen supply. With the submerged mechanical aerator/agitator and separation of the 'agitation function' and 'agitation diffusing function', formation of a denitrifying atmosphere depending on the state of water quality was possible, while it was uncontrollable with the surface aerator. Therefore, it was considered that aeration performance which is suitable for the respective process could be produced.

Figure 10 shows that the SS concentrations of the treated effluents were 100 mg $litre^{-1}$ or lower which created

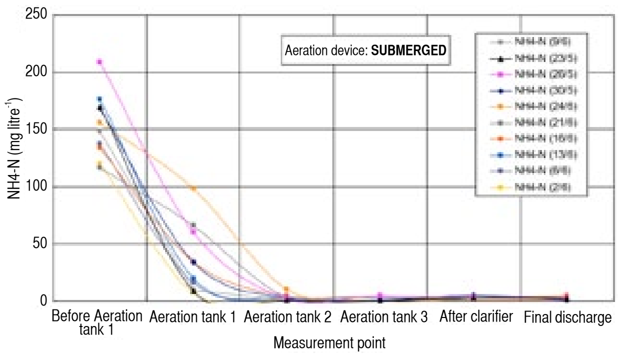

Figure 8. The variation of ammonium concentration in aeration system.

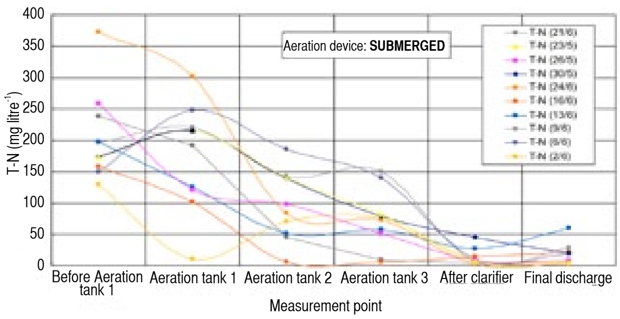

Figure 9. The variation of total nitrogen concentration in aeration system.

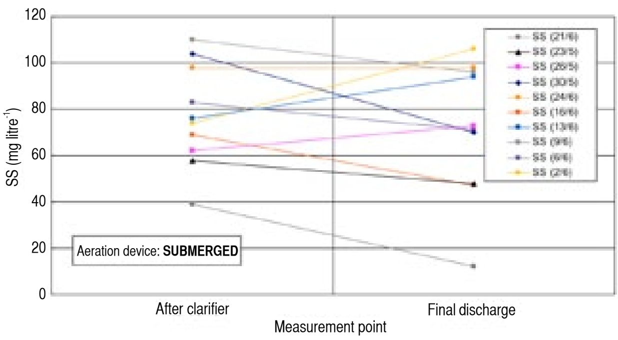

Figure 10. The suspended solid (SS) concentration of effluent.

a satisfactory sedimentation separation performance as well as functioning as clarifier.

MICROSCOPIC ANALYSIS

In order to confirm the state of activated sludge in the aeration tanks, the sludge was sampled and analyzed by microscopy (*Figure 11*). Although the flocs were rather small, the presence of protozoa such as *Vorticella, Arcella, Trochilia* and *Euglypha* was found in the flocs. The conditions of the treatment process were favorable for these protozoa. Madoni (2011) reviewed the occurrence of protozoa community in activated sludge plants and grouped the protozoans according to their species. The species of *Vorticella, Arcella, Trochilia* and *Euglyha* were commonly found in activated sludge.

With the presence of a variety of microorganisms which usually appeared when the process was successful, it was confirmed that sufficient degradation of organic matter took place along with nitrification. As the improvement in aeration was conducted by submerged mechanical aerator/agitator in which the 'agitation function' and the 'agitation diffusing function' were separated, BOD levels

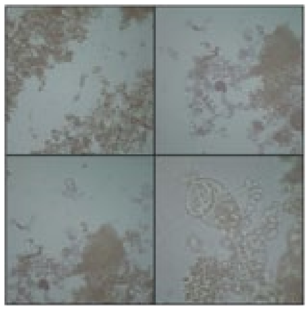

Figure 11. Microscopic image of activated sludge.

were improved by adding 'agitation diffusing function' to the 'agitation function' of the submerged mechanical aerator/agitator and MLDO in the aeration tank.

CONCLUSION

In this case study, optimal aeration state could not be controlled by the diffuser. The agitation state did not attain a complete state of mixing in the tank resulting in deposition of sludge at the bottom of the tank. Since these air diffusers had aeration and agitating functions performed by the same component, an efficient processing capability in the aeration tank could not be achieved. It was inferred that the aeration tank used as the core device was unstable even if ASP was employed, thus unable to continuously reduce the BOD. Using the submerged mechanical aerator/agitator in which the 'agitating function' and 'agitating diffusing function' were separated, optimum aeration and stirring were achieved. From the results of MLSS and flow velocity using the submerged mechanical aerator/agitator, the agitation state in the aeration tank was greatly improved. From the MLDO, the BOD reduction particularly improved from 34.7% to 93.1% as a result of accelerated removal rate by addition of the 'agitation diffusing function'. Although POME improvement was attempted, stable POME process required a controlled operation flow of the whole ASP including the aeration tank. Submerged mechanical aerator/agitator which controlled the 'agitation function' and 'agitation diffusing function' allowed for construction of a stable ASP including variations in the inflow load change, and seasonal variations that can contribute to the POME treatment process.

REFERENCES

Adonadaga, M (2015). Effect of dissolved oxygen concentration on morphology and settleability of activated sludge flocs. *J. Applied & Environmental Microbiology, 3(2)*: 31-37.

Alam, M Z and Fakhru'l-Razi, A (2002). Effect of agitation an aeration on bioconversion of domestic wastewater sludge in a batch fermenter. *J. Environmental Science and Health. Part A, Toxic/Hazardous Substances & Environmental Engineering, 37(6)*: 1087-1097.

American Public Health Association (APHA) (2005). *Standard Method for Examination of Water and Wastewater*.

Bin Ji; Kai Yang; Lei Zhu; Yu Jiang; Hongyu Wang; Jun Zhou and Huining Zhang (2015). Aerobic denitrification: A review of important advances of the last 30 years. *Biotechnology and Bioprocess Engineering, 20*: 643-651.

Busby, S J W; Thomas, C M and Brown, N L (2013). *Molecular Microbiology*. Birmingham: UK-Springer.

Clifford, E; Nielsen, M; Sørensen, K and Rodgers, M (2010). Nitrogen dynamics and removal in a horizontal flow biofilm reactor for wastewater treatment. *Water Research, 44(13)*: 3819-3828.

Damayanti, A; Ujang, Z; Salim, M R and Olsson, G (2011). The effect of mixed liquor suspended solids (MLSS) on biofouling in a hybrid membrane bioreactor for the treatment of high concentration organic wastewater. *Water Science and Technology, 63(8)*: 1701-1706.

Davood Nourmohammadi; Mir-Bager Esmaeeli; Hossein Akbarian and Mohammad Ghasemian, (2013) *J. Environmental and Public Health*, 2013: 1-6.

Ecos Environment Consultants Limited (2013). Wastewater Nitrification: How it works. [web log post] Retrieved from http://www.ecos.ie/wastewaternitrification-how-it-works/.

Flanders, K R; Reich, R; Himelreich, L E; Gary, G; James, W M and Harry, W H (1994). The impact of alpha on the feasibility of fine bubble diffusers in industrial wastewater. *Proc. of the 49th Industrial Waste Conference*. Purdue University.

Kumar, S R (2007). *Efficiency of Aeration System in Wastewater Treatment Plants*. Universiti Teknologi Malaysia.

Ibrahim, A H; Dahlan, I; Adlan, M N and Dasti, A F (2012). Comparative study on characterization of Malaysian palm oil mill effluent. *Research J. Chemical Sciences, 2(12)*: 3.

Ma, A N; Lee, K M and Choo, K C (1988). Full scale sequencing batch reactor treatment of palm oil refinery wastewater. *PORIM Bulletin*.

Madoni, P (2011). Protozoa in wastewater treatment processes: A minireview. *Italian J. Zoology, 78(1)*: 3-11.

MPOB (2017). Economic and Industry Development Division. Retrieved from http://bepi.mpob.gov.my.

Neyestanak, A A L; Tarybakhsh, M R and Daneshmand, S (2017). Study on the effect of jet velocity on mixing performance and sludge prevention in large scale crude-oil tanks by the CFD technique. *J. Chemists and Chemical Engineers of Croatia, 66(6)*: 229239.

Soh, K L; Mei, E L; Muzzammil, N; Weng, S L; Yuen, M C; Zhenjia, Z and Jumat, S (2013). Zero discharge treatment technology of palm oil mill effluent. *J. Oil Palm Res. Vol. 25(3)*: 273-281.

Winconsin Department of Natural Resources (2012). Advanced activated sludge study guide. *Wisconsin Department of Natural Resources: Wastewater Operator Certification*.

Guidelines and Recommendations for MeSTI Certification Preparation for Palm Oil Mills

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ABSTRACT

Crude palm oil (CPO) produced in the palm oil mills is mainly used as edible purposes after refined, bleached and deodorised. Thus, food safety assurance programs become mandatory pursuant to the Food Hygiene Regulations 2009. Food safety is the responsibility of the Industry (MeSTI) *is a free certification scheme to fulfill the minimum regulation requirements introduced by the Ministry of Health. Although the standard is lower than other food safety assurance systems,* MeSTI *is easily achievable by palm oil mills with minimum expenditures requirement.*

Keywords: certification scheme, edible, food safety, MeSTI, palm oil mill.

INTRODUCTION

In year 2018, Malaysian palm oil mills produced 19.52 million tonnes of crude palm oil (CPO) and exported 16.488 million tonnes of palm oil to worldwide market (MPOB, 2019). The CPO is refined to produce refined, bleached and deodorised (RBD) palm oil which is mainly used for edible purposes. Malaysian weather is optimal for bacteria growth such as salmonella which are manifested from unsanitary food preparation that causes foodborne diseases. The demand for safe food has led to food safety control. Thus, food safety assurance programs such as Good Manufacturing Practice (GMP), Hazard Analysis and Critical Control Point (HACCP) and ISO 22000 become mandatory pursuant to the Food Hygiene Regulations 2009. Most of the refineries have already acquired one or more food safety assurance systems recognition but palm oil mills have yet to do so.

Ministry of Health (MOH) has established Food Safety and Quality Division under Department of Public Health to ensure that the food processing activities are in compliance to the hygiene and safety requirements. The division is also responsible for food safety monitoring through the supply chain, including any food related hazards and frauds. Food safety standards practiced in Malaysia are Food Act 1983, Food Regulation 1985 and Food Hygiene Regulation 2009.

'*Makanan Selamat Tanggungjawab Industri*' (MeSTI) is a certification scheme to fulfill the minimum regulations requirement introduced by the MOH. Although the standard is lower than other food safety assurance systems such as HACCP and GMP as shown in *Figure 1*, MeSTI is easily achievable with no certification fee.

Although CPO is not an end consumer product, Food Safety and Quality Division of MOH has encouraged all the palm oil mills in Malaysia to apply for MeSTI certification recently as palm oil originated from CPO is widely used as food ingredient which forms a supply chain. The certification is also in line with the traceability effort.

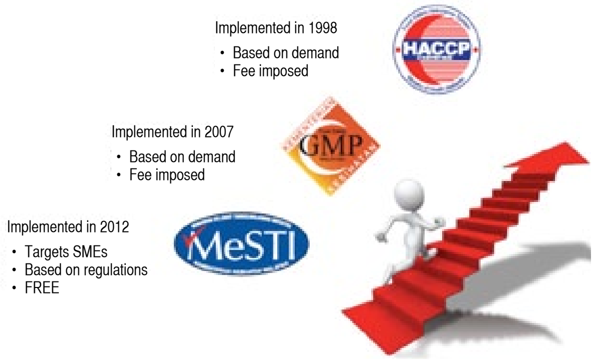


Figure 1. Various food safety assurance systems.

FOOD ACT 1983 (ACT 281)

Food act was gazette on 10 March 1983 and applies throughout Malaysia to protect public against health hazards and fraud in food preparation, sale and consumption, and for matters incidental thereto or connected therewith. The following are some interpretations relevant to palm oil mill.

Food includes every article manufactured, sold or represented for use as food or drink for human consumption or which enters into or is used in the composition, preparation, and preservation, of any food or drink and includes confectionery, chewing substances and any ingredient of such food, drink, confectionery or chewing substances. This is relevant to CPO.

Food premises means premises used for or in connection with preparation, preservation, packaging, storage, conveyance, distribution or sale of any food, or relabeling, reprocessing or reconditioning of any food. This is relevant to palm oil mill.

Package includes anything in which or any means by which food is wholly or partly cased, covered, enclosed, contained, placed or otherwise packed in any way whatsoever and includes any basket, pail, tray or receptacle of any kind whether opened or closed.

Premises include any building or tent or any other structure, permanent or otherwise together with the land on which the building, tent or other structure is situated and any adjoining land used in connection therewith and any vehicle, conveyance, vessel or aircraft and open space or place of public resort or bicycle or any vehicle used for or in connection with preparation, preservation, packaging, storage, conveyance, distribution or sale of any food.

Preparation includes manufacture, packaging, processing and any form of treatment.

Sell or sale refers only to sale for human consumption or use and includes barter and exchange, offering or attempting to sell, causing or allowing to be sold, exposing for sale, receiving, sending, conveying or delivering for sale or exchange or in pursuance of such sale or exchange, supplying any food where consideration is to be received by the supplier for such supply either specifically o r as part of a service contracted for sale, or having in possession any food for sale or exchange, or having in possession any food or appliance knowing that the food or appliance is likely to be sold or offered or displayed or exposed for sale or disposed of for any consideration, and includes electronic sale.

Vegetable substance means any plant or part of a plant, and includes stem, root, bark, tuber, rhizome, leaf, stalk, inflorescence, bud, shoot, flowers, fruit and seed, or an extract thereof.

If the CPO is further processed to produce palm oil to be used as edible ingredient, the application is under the food act jurisdiction and the following section should be taken concerning all Malaysian palm oil mills:

Director may order food premises or appliances to be put into hygienic and sanitary condition

1. The Director or an officer authorised by him in this particular respect may in writing, order the closure forthwith not exceeding 14 days of any premises preparing or selling food where the Director or the officer authorised by him in this particular respect is of the opinion that such premises is in a condition that fails to comply with the sanitary and hygienic requirements and such that it is likely to be hazardous to health, and the proprietor, owner or occupier of the premises who fails to comply with the order commits an offence and is liable on conviction to imprisonment for a term not exceeding five years or a fine or both.
2. (a) No manufacturer or distributor of, or dealer in, any food specified by the Minister shall sell such food to any vendor unless a written warranty or other written statement is given that the food complies with the provisions of Act 281 or any regulation made there under.
   (b) Any person who contravenes the provisions of subsection (1) commits an offence and is liable on conviction to imprisonment for a term not exceeding three years or a fine or both.

Food Hygiene Regulations 2009

The regulations were made under provision section 34 of the Food Act 1983 (Act 281) on 28 February 2009. Palm oil mills should take concern the following regulations.

Food premises to be registered

1. (a) An application for food premises registration shall be made to the Director in such form and manner and

be accompanied with such information and particulars as specified.

(b) The Director may request orally or in writing the applicant to submit additional documents, information or particular as considered necessary for the registration purpose at any time after receiving the application.

2. (a) After considering an application under sub regulation 4(1) and on being satisfied with the information and particulars submitted, the Director may issue a registration certificate for food premises as prescribed in the Second Schedule.

   (b) The fee for the registration certificate issued under sub regulation (1) shall be RM30.
3. A registration certificate for food premises shall be valid for a period not exceeding three years from the issuance date.
4. Application for certificate renewal for food premises shall be made in accordance with regulation 4 at least 30 days before its expiry date.
5. Food premises proprietor, owner or occupier shall provide and make available a food safety assurance programme in the food premises.
6. Food premises proprietor, owner or occupier shall provide a food traceability system in the food premises which is able to identify one step back from where the food came and one step forward to where the food went at any specified food chain stage from production to distribution.
7. Food premises proprietor, owner or occupier shall:
   - Ensure that the food premises comply with all requirements;
   - Not employ or allow any food handler to work in the food premises unless the food handler has undergone a food handler training and has been medically examined and vaccinated by a registered medical practitioner as required under regulations 30 and 31 respectively;
   - Maintain and be made available for inspection a training record, medical examination and vaccination certificate of every food handler employed by him or working in the food premises; and
   - Maintain and be made available for inspection all records pertaining to food cleaning, packaging, processing, storing and distributing.
8. Food premises shall be located away from contamination sources including aeration ponds, septic tanks and waste disposal sites.
9. Food premises shall be designed and constructed as such to facilitate cleaning and disinfection.
10. Adequately protected potable water supply against any contamination.

Food premises cleanliness.

1. (a) Food premises proprietor, owner or occupier shall keep the food premises free from any pest at all times.

   (b) On becoming aware of any pest presence in the premises, food premises proprietor, owner or occupier shall forthwith take all practicable measures to destroy the pest and to prevent re-infestation.

   (c) A pest control treatment shall only be carried out by using a suitable chemical, physical or biological agent and without posing threat to the food safety.

Proper refuse disposal.

1. All floors in food premises shall be:
   - maintained in good condition, easily cleaned and where necessary, disinfected;
   - of impervious, non-absorbent, washable and non-toxic materials unless the food premises proprietor, owner or occupier can satisfy the Director or an authorised officer that other materials used are appropriate; and
   - adequately drained.
2. (a) All walls in food premises shall be:
   - maintained in a good condition, easily cleaned and where necessary, disinfected; and
   - of impervious, non-absorbent, washable and nontoxic materials and require a smooth surface up to a height appropriate for a food process unless the food premises proprietor, owner or occupier can satisfy the Director or an authorized officer that other materials used are appropriate.

   (b) All angles between a wall and a floor in a food premises shall be sealed and curved to facilitate cleaning, where necessary.
3. Adequate natural or artificial lighting.
4. Suitable and sufficient ventilation.
5. All ceilings or where there is no ceiling, the interior roof surface and food premises overhead fixtures shall be constructed and in finished form which is able to prevent dirt accumulation and particles shedding and to reduce condensation and undesirable mould growth.
6. All doors in food premises shall be:
   - easily cleaned and where necessary, disinfected;

- of smooth, non-absorbent surface and self-closing.

7. (a) All furniture, fittings and food contact surfaces used or to be used for the preparation, serving, storage, conveyance or distribution of food in any food premises shall be well maintained and kept clean at all times.
   (b) All furniture, fittings and food contact surfaces used or to be used in any processing area of food premises shall be of impervious material and easily cleaned.
8. Proper food storage.
9. Changing room shall be provided where necessary in food premises for the food handlers' usage.
10. Adequate separate wash-basin for hand washing and food washing.
11. Toilet room not directly open to any room or compartment used for food storage, production and serving.
12. Adequate drainage facility.
13. Food handler training requirement.
14. Food handler medical examination and health condition.
15. Clean, suitable and proper clothing for food handler.
16. Food handler personal hygiene.
17. Food handler shall ensure that food premises where the food is handled are kept clean and free from rubbish, pest, dirt or soot, sweepings, ashes, wastes and cobwebs at all time.
18. (a) Food handler shall handle food and use food appliances and food containers in accordance with to the guideline requirements.
   (b) Food handler shall cause all defective appliances to be discarded and removed from food premises.
   (c) Food handler shall not keep, carry, spread or use any toxic substance that may expose any food for sale to the contamination risk.
   (d) Food handler shall ensure that chemical additives used in preventing equipment and containers corrosion are used in accordance with good practice. (MoH, 2009).

FOOD SAFETY IS THE RESPONSIBILITY OF THE INDUSTRY CERTIFICATION SCHEME

MeSTI certification scheme is applicable to all food manufacturing premises in Malaysia in order to comply with the requirements prescribed under the Food Hygiene Regulations 2009. The food manufacturing premises must be licensed by the local authority, registered with the Companies Commission of Malaysia and registered with the Ministry of Health through food premises registration. Prior to obtaining recognition, the food manufacturing premises will be coached in the development and implementation of the Food Safety Assurance Program. Technical coaching by the Ministry of Health is free of charge.

Field audit is inspection carried out by an auditor who is a Food Safety and Quality Division officer to assess the readiness level to comply with elements as shown in Table 1 on the respective premises.

TABLE 1. MeSTI CERTIFICATION ELEMENTS

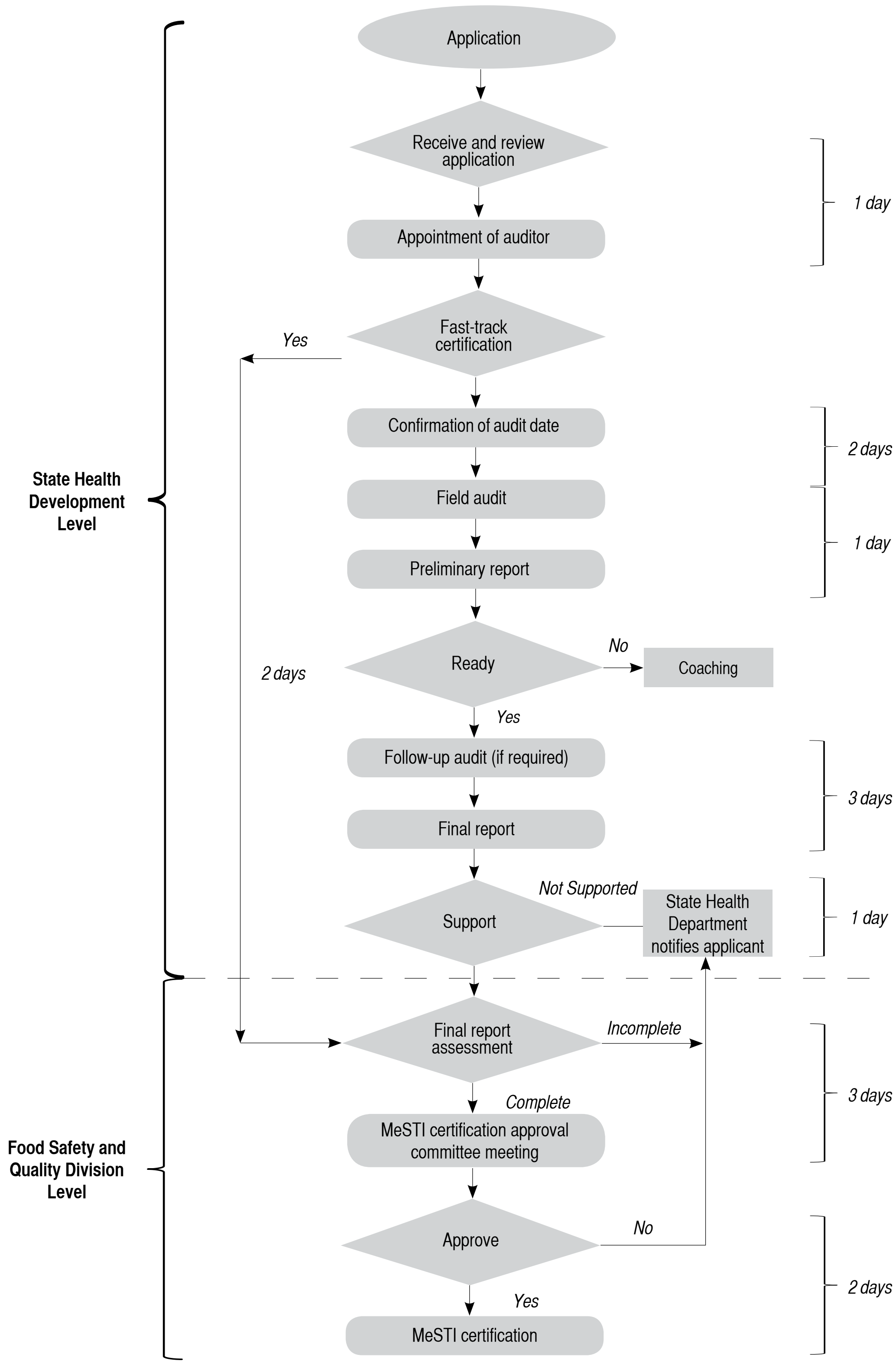
Element	Particular
1.	Design and Facility
2.	Food Handler
3.	Training
4.	Maintenance and Sanitation
5.	Raw Material Control
6.	Process Control
7.	Packaging Control
8.	Storage Control
9.	Transport and Distribution Controls
10.	Traceability Controls

Coaching in form of technical guidance will be given if applicant is found to be less prepared so that the Food Safety Assurance Program could be developed within six months. Corrective actions need to be taken for each non-conformance, recorded in the corrective action request form (MeSTI-1/14) and handed over to the applicant after the audit. Feedback shall be submitted within three months from the field audit date for follow-up audit.

Follow-up audit is inspection carried out within three months of the assessment audit when all non-conformances must be closed out within the period stipulated before certification is granted. Photographs or supporting documents evidence to justify the corrective actions taken need to be obtained.

After all the certification elements have been complied, final report will be prepared which should include the audit form (MeSTI-4/12-02), the verified processing flow chart, the corrective action request form (MeSTI-1/14) if any and evidence for corrective actions taken. The final report will be tabled during the MeSTI Certification Committee Meeting.

MeSTI CERTIFICATION APPROVAL (NEW/RENEWAL) FLOW CHART



Note: Normal certification = 13 days (excluding coaching process)
: Fast- Track certification = 7 days
: The coaching process is not included in the certification process period.

Figure 2. MeSTI certification approval flow chart.