

"Project Formulation Survey" under the
Governmental Commission on the Projects for
ODA Overseas Economic Cooperation
in FY 2013

Summary Report

Improvement of Wastewater Treatment System
and
Cyclic Use of Resource for Palm Oil Mill
in Malaysia

March, 2014

Joint Venture of Hanshin Engineering Co., Ltd.
and Mitsubishi UFJ Research & Consulting Co., Ltd.

The content of this report is a summary of the project formulation survey, which was commissioned by the Ministry of Foreign Affairs of Japan in the FY 2013 and is carried out by the consortium Joint Venture of Hanshin Engineering Co., Ltd. and Mitsubishi UFJ research & consulting Co., Ltd.. It does not represent the official view of the Ministry of Foreign Affairs.

I. Description of the current situation and development needs of the concerned development issues in the surveyed country

■ Position of the Palm Oil Industry in Malaysia

Thanks to the increase in consumption in the global market, the palm oil industry in Malaysia has been growing and now the country's key industry. Its export in 2011 was 80.3 billion RM (increased by 65.4 billion RM or to 438.9% compared to the amount in 2000), which occupied 61.8% of the total primary industry exports.

The number of palm oil mills in operation in the country is 433 (in 2012). The production capacity of those mills in total amounts to 102,342,400t-FFB/year.

■ Issues of the Palm Oil Mill Effluent -- Laws and Regulations

The Department of Environment (DOE), which is under the Ministry of Natural Resources and Environment, has made it a policy to reinforce the application of the Environmental Quality Act 1974 (by more strict application of the effluent standard), strengthening control (by monitoring compliance), and improving water quality (by cleaning up rivers, etc.) to promote advanced treatment and recycling of the wastewater from palm oil mills.

The Environmental Quality (Prescribed Premises) (Crude Palm-Oil) Regulations 1977, which is a subsidiary legislation of the Environmental Quality Act 1974, requires an application of a nation-wide river effluent standard of 100mg/L BOD. (BOD is one of the representative environmental indices.) The DOE grants operating permits according to this standard. In the Ipoh area in Perak State, which is near Sabah State, a habitat of orangutans, and a people's drinking water source, a more strict standard (lowered to 20 mg/L) has been introduced as prior efforts.

According to a hearing of the DOE, they are in the process of reviewing the regulations on the palm oil industry. As of November 2013, the DOE has completed a draft and submitted it to the Environmental Quality Council for review. Then according to recommendations and revisions advised by the Council, the DOE director will coordinate a final draft, which will be finalized by the Minister of Natural Resources and Environment, and promulgated in the third quarter of 2014. The DOD is proposing tighter effluent regulations that use BOD concentration as a major index (i.e. lower than a current BOD of 100 mg/L). However, they did not mentioned specific numbers because of possible amendments.

■ Issues on Wastewater from Palm Oil Mills -- Compliance to the Regulations

The DOE is conducting inspections and sampling analyses at the palm oil mills every quarter to check compliance to various laws and regulations. In 2011, a total of 1,311 inspections were performed and many indications were made including non-compliance to the effluent standard.

Table 1 : Number of Indications on the Environmental Quality Act 1974 in Palm Oil Industry

Indication Category	2009	2010	2011
Directives	191	195	223
Notices	364	135	151
Compounds	118	77	66
Court Actions	132	95	92
Licence Suspensions	0	2	1
Amount of Fine(Total in Malaysian Ringgit)	1,742,000	948,000	1,102,800

The Japanese Research Group collected water samples at each mill and sent it to an analysis laboratory for BOD measurement. The BOD at many mills were around 500 mg/L, which is significantly exceeding a standard of 100 mg/L at the final discharge point. Since the performance of aerobic fermentation treatment changes according to the activities of bacterium and the load to the wastewater treatment facilities varies depending on production status, it is difficult to maintain BOD within the standard.

Table 2: Water Quality of the Palm Oil Mill Effluents (in BOD for 3 Days)

	Processed Water Input (mg/L)	Inlet to an Aerobic Treatment Pond (mg/L)	Final Discharge Point (mg/L)
Mill A	17,100	2,490	N/A ※
Mill B	56,925	1,572	507
Mill C	73,350	800	540
Mill D	24,450	1,164	661
Mill E	21,000	N/A	114
Mill F	36,500	739	340

* Results of analysis by a local laboratory of the samples collected by the Japanese Research Group in November 2013

* N/A indicates a result that is determined to be abnormal. There might be a problem in collection method.

II. Possible applicability of the SME's products and technologies, and prospects for future business development

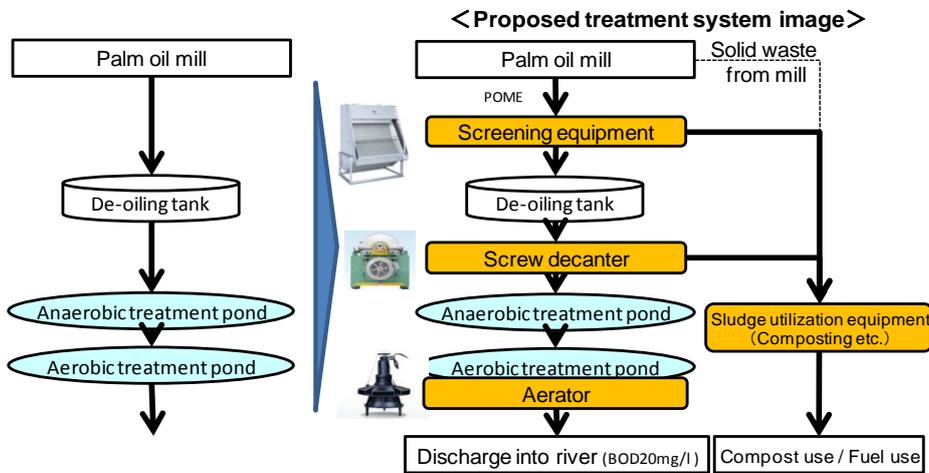
■ Outline of the Proposed Technological Application

Our technological proposal is a wastewater treatment/circulation system for palm oil mills that is adaptable to the enforcement of effluent control in Malaysia (especially strengthening BOD to 20 mg/L).

Most palm oil mills operate simple wastewater treatment facilities with multi-stage open lagoons, which cannot achieve a BOD of 20 mg/L. Our system constantly attains a BOD of 20 mg/L by effectively removing solid organic waste such as contaminants and suspended substances (SS) with a screening device or a Decanter (e.g. screw decanter) before and after treatment to alleviate pollutant load on the later stages, and performing aerobic treatment (activated sludge process) in an aeration stirring facilities in the last stage before discharging to rivers.

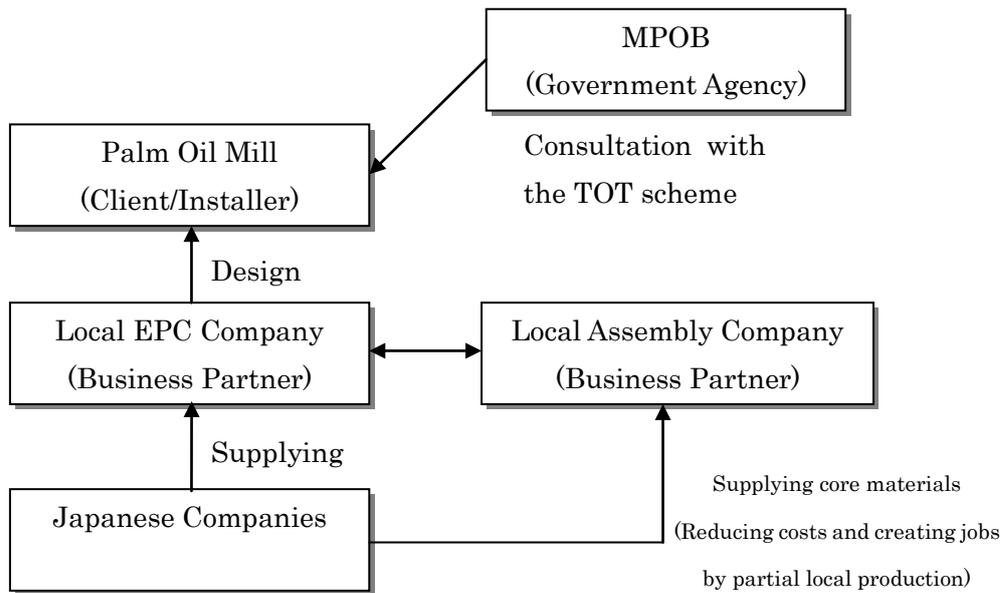
Moreover, facilities for composting (or to be fuel) solid organic substances separated with the Decanter is introduced to convert biomass residue to useful substances. Organic waste is returned to palm farms where it is used for soil amelioration. The system aims to achieve model recycling facilities.

Proposed system image



■ Business Operations

For local business operations, partner ship and cooperation with local companies (EPC companies and assembly companies) are effective. We are planning to use “Transfer of Technology (TOT)” scheme by MPOB as much as possible. This enables the client palm oil mills to receive technological support and Japanese companies to explore business relationship.



Target customers include large companies, especially semi-governmental enterprise, that operate several mills and are technologically advanced. The first priority candidate is the FELDA Group that has the largest number of mills in Malaysia. We would like to promote introduction of our equipment to a showcase factory. Following this case, we will increase in-store share in the FELDA Group and other large companies, then expand our system to more mills in cooperation with MPOB.

III. Verification of adaptability of the SME's products and technologies to the surveyed country (Demonstration and pilot survey)

- Activities for Verifying Local Adaptation including Introduction and Trial of Products and Technology, and Various Tests

To verify local adaptation, we conducted flow tests during a field survey and analyzed samples collected in the field. The results of the analysis confirmed that the pollutant load on the pretreatment can be reduced and the sludge is suitable for converting to fuel.

Aquarator simulation

As the target of the final discharge point of Mill C and D (BOD₃ = 540mg/L , BOD₃ = 661mg/L), we did a simulation of the model and number of Aquarator to achieve the BOD 20mg/L regulation by using the Activated Sludge Method.

Results of the simulation, the model and number of Aquarator satisfying the amount of oxygen required for BOD \leq 20mg/L is as follows:

Mill C : F-55(5.5kW) 2 Aquarators (1 for each tank)
※FFB=40t-FFB/h(POME=737m³/d),BOD_{3in}=540mg/L

Mill D : F-75(7.5kW) 2 Aquarators (1 for each tank)
※FFB=40t-FFB/h(POME=737m³/d),BOD_{3in}=661mg/L

Screening Equipment Test (Flow Test)

Mixed wastewater from the sludge pit has properties suitable for screening. TSS reduction of approximately 26% was observed with 0.3 mm slits and 38% with 0.15 mm slits.

Centrifuge Equipment Test (Spin Test)

Using mixed wastewater from the sludge pit, sludge separation produces sufficient amount of dehydrated cakes. This proves that introduction of a decanter is effective for reducing BOD in later stages and recycling resources.

Test on Equipment for Converting Sludge into Fuel (Simple Analysis of Sludge Components and Heat Quantity)

As the sludge is rich in volatile components, it has a high calorific value. It is effective to use the sludge for fuel from the viewpoint of recycling resources.

■ Holding a Technology Introduction Seminar

MPOB held a technology introduction seminar for the engineering staff of four palm oil mills, introducing our system and exchanging opinions.

IV. Expected development impact and effect on business development of the proposing SME(s) in the surveyed country(ies) through proposed ODA projects

■ Applications in Malaysia

The survey has revealed that, in palm oil mills in Malaysia, our technology can be applied by adding equipment to the existing wastewater treatment facilities. We think that the following three system configurations are effective not only for regulatory compliance due to cost increase but also for creating valuables and recycling resources.

System Proposal (1)

Pretreatment with a Decanter, Post-treatment with an Aerator, and Converting Separated Sludge into Fuel

This proposal introduces a Decanter in the pre-process to remove solid matters and oil, which reduces pollutant load by 96% or more. The wastewater with low pollutant load is fed to an Aerator in the post-process, which attributes to the achievement of 20 mg/L BOD.

The sludge (solid matter) separated with the Decanter is partially dehydrated with a dryer and fed to a carbonizer where it is converted to biochar (fuel in a state before carbonization that conserves heat quantity).

The advantage of Proposal (1) is that pollutant load is minimized in the pre-process, and it can make the most use of oil and sludge removed. On the other hand, the initial investment is relatively high due to the introduction of a decanter, oil separator, dryer, and carbonizer. And the system consumes additional energy.

System Proposal (2)

Pretreatment with a Screening Device, Post-treatment with an Aerator, and Converting Separated Sludge into Compost

This proposal introduces a screening device in the pre-process to remove solid matters and oil, which reduces pollutant load by approximately 40%. The wastewater with lower pollutant load is fed to an aerator in the post-process, which attributes to the achievement of 20 mg/L BOD.

The sludge separated with the screening device is mixed with long fiber chips made of Empty Fruit Bunch (EFB). The mixture is fermented and moisture-controlled for 60 days at a composter.

Proposal (2) is an alternative solution for effectively use sludge in cases where there is no need for fuel production. However, it requires 60 days to compost sludge and approximately 2,000 tons of compost is generated in a batch, which require a large storage space.

■ Effects of Development in Malaysia under ODA

It is expected that the promotion of the Pilot survey for disseminating SME's Technologies has the following results:

- A showcase mill selected by MPOB, mill of major organizations in Malaysia, will produce ripple effects on the entire palm oil industry. The demonstration of the effects of wastewater treatment and recycling resources produced in the process is especially promising.
- The projects will contribute to the improvement of environmental responses in Malaysia by enhancing wastewater treatment of the whole palm oil industry and

reuse of resources which has been limited.

- In Malaysia, where industrial development the still the first priority, advanced wastewater treatment tends to be disregarded. The distinctive feature of this proposal is that while satisfying the basic needs for palm oil companies to respond to more strict regulations and enjoying profits by recycling resources. It contributes to purification of wastewater and improvement of public waters.

V. Proposals for formulating ODA projects

■ Assumed ODA Scheme

For the proposed a model mill with an advanced wastewater treatment and recycling system, the scheme of the Pilot survey for disseminating SME's Technologies is used to assume a demonstration project for introducing equipment to the model mill.

■ Specific Cooperation

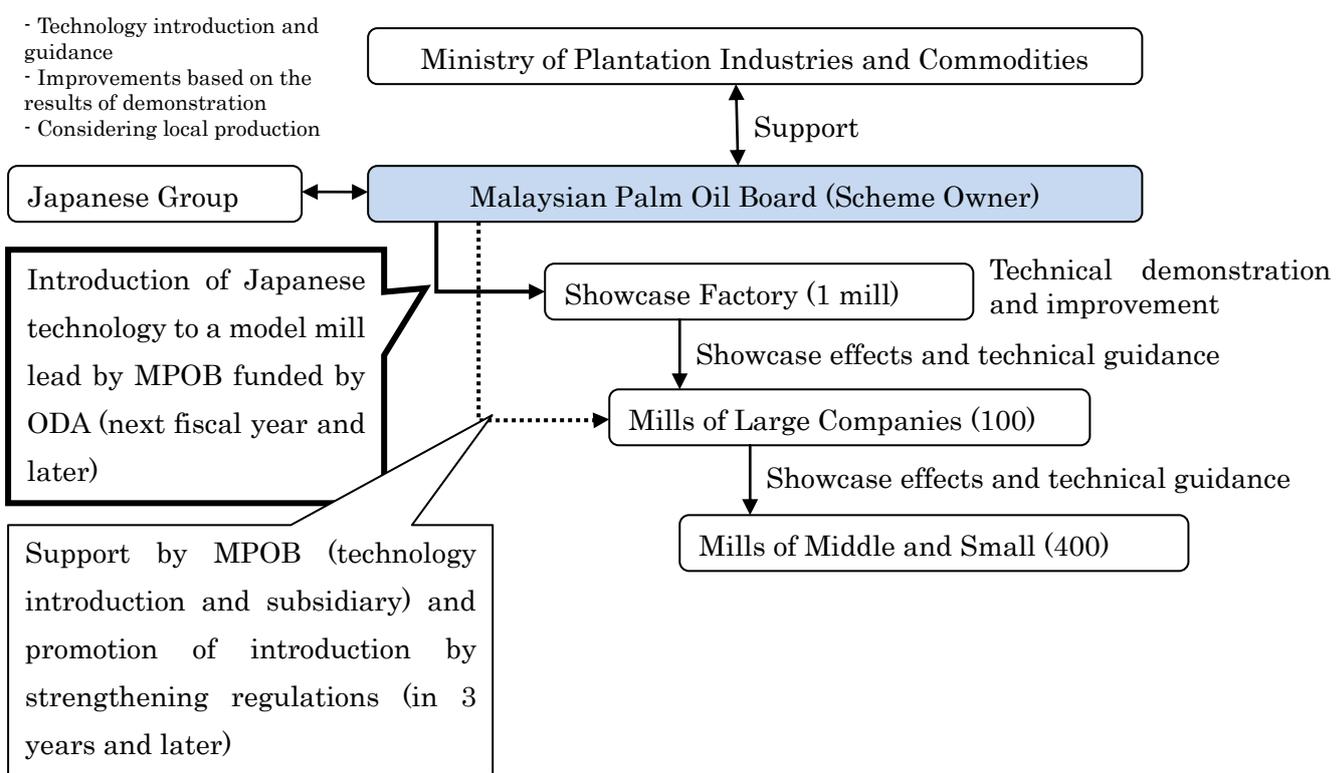
The assumed counterparts in Malaysia include the Malaysian Palm Oil Board (MPOB) under the Ministry of Plantation Industries.

The missions of MPOB are to supervise palm oil mills and conduct research and development for the palm oil industry. They show a keen interest in development and introduction of the technology that enables conformance to effluent standard. They also have a "Transfer of Technology (TOT)" scheme to palm oil companies. It is expected that they will play a major role of promoting research and development through technology introduction and demonstration.

The mill that conducts demonstration will be selected by MPOB. Those we surveyed are included as candidates. By the first quarter of 2014, when a demonstration mill is chosen, the system for introduction will be proposed.

And MPOB has been nominated for the mill of FELDA.

FELDA has about 70mills in the country. It is a semi-governmental enterprise that leads introduction of technology into the country in cooperation with MPOB. In this proposal, they will provide a place for installing Japanese plants, operate demonstration by engineers under the technical guidance by MPOB, and share and review the results of demonstration.



Project Formulation Survey Malaysia / Improvement of Wastewater Treatment System and Cyclic use of Resource for Palm Oil Mill

SMEs and Counterpart Organization

- Name of SME : Hanshin Engineering Co.,Ltd.
- Location of SME : Osaka , Japan
- Survey Site ▪ Counterpart Organization : Selangor, Johor c/p Malaysian Palm Oil Board(MPOB)

Concerned Development Issues

- Concern of the environmental impacts of effluents from palm oil industry, which is the major industry of Malaysia
- Lack of stable performance technology, while drainage regulation for palm oil mill effluents is strengthening (toward BOD 20mg / l)
- Lack of incentives for palm oil factory for advanced wastewater treatment

Products and Technologies of SMEs

- Contribution to compliance with regulation by combination of proven processing equipments
- The proposal system is
 - ✓ Aerator - Proven in sewage treatment in Japan
 - ✓ Decanter / Screen - Solid-liquid separation in the previous step
 - ✓ Carbonizer / Composter – New products from separated sludge

Proposed ODA Projects and Expected Impact

- As a MPOB initiative project, Japanese technology will be installed to the model mill using “Pilot survey for disseminating SME's Technologies” to demonstrate the performance and to use as a "showcase" for the other mills.
- Through this project, we aim to spread of the technology (It also produce revenue), lower the BOD, and reduce the impact on the river water.

Future Business Development of SMEs

- Transfer the technology effective to palm oil companies by MPOB cooperation
- Localization of technology (Response to local specific needs, cost reduction through local assembly etc)

