Improvement of POME Treatment System at Palm Oil Mills, Malaysia

Executive Summary

March 2006

Pacific Consultants International

(1) **Project Information**

■Project Summary and Background Information

Purpose of the project

This project aims to replace an open-lagoon POME (palm oil mill effluent) treatment system, which is currently adopted in 13 of palm oil mills, with high-efficient methane-free POME treatment plants, which avoid methane emission from the open lagoons and also contribute to an economically, environmentally and socially sustainable development of palm oil industry in Malaysia.

Project Summary

The proposed project (hereinafter referred to as the "Project") intends to introduce high-efficient POME treatment plants in 13 of the KLK's palm oil mills in Malaysia. Target 13 mills process about 2.5 million tons of fresh fruit bunches (FFB) of oil palm and 1.2 million tons of POME. POME discharged at these mills is currently treated anaerobically using the open lagoons, and then applied to the palm oil fields as irrigation water.

New treatment plant enables the efficient separation and recovery of the oil and solid wastes contained in POME. After going through the aeration process, 70% of the POME is reused at the mill and the remaining 30% are recycled as irrigation water. Recovered solid wastes are dewatered and applied to palm oil fields as fertilizer supplement.

Introduction of high-efficient POME treatment plants will replace the currently practiced open-lagoon process, preventing methane gases to be emitted to the atmosphere. The Project thus contributes to the reduction of greenhouse gas emissions.

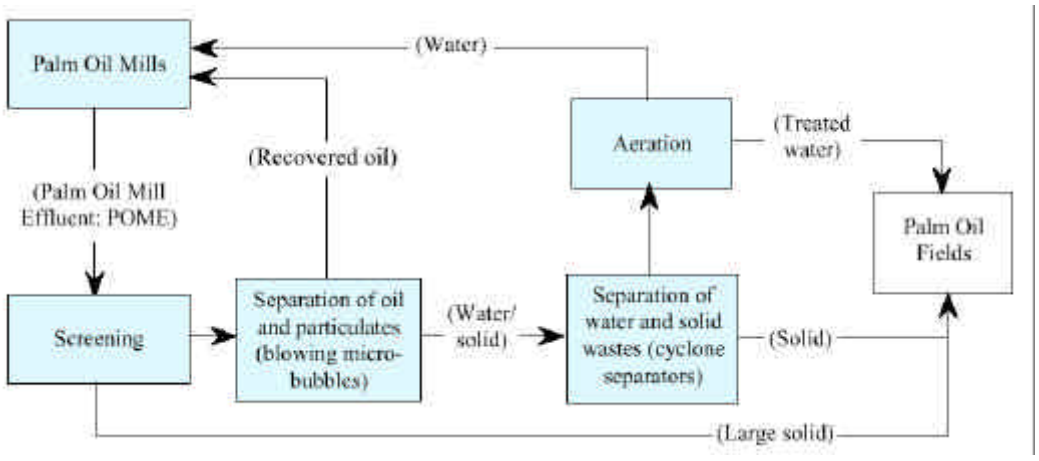

Figure 1 Flow of New POME Treatment System

■**CDM Institutional Organization in Host Country**

Malaysia ratified UNFCCC on July 13, 1994 and ratified the Kyoto Protocol on September 4, 2002. The country has designated Conservation and Environmental Management Division (CEMD) of the Ministry of Natural Resources and Environment (NRE) as Designated National Authority (DNA).

Malaysia's CDM criteria are the followings;

1. The project must support the sustainable development policies of Malaysia and bring direct benefits towards achieving sustainable development
2. Implementation of CDM projects must involve participation of Annex I Party/Parties
3. Project must provide technology transfer benefits and/or improvement in technology
4. Project must fulfill all conditions underlined by the CDM Executive Board as follows:
    i. Voluntary participation
    ii. Real, measurable and long-term benefits related to mitigation of climate change; and
    iii. Reductions in emissions that are additional to any that would occur in the absence of the certified project activity
5. Project proponent should justify the ability to implement the proposed CDM project activity

■**Contribution to Sustainable Development**

Procurement of high-efficient POME treatment plants provides employment opportunities and spurs the local economy. Capacity development in the Malaysian side can be achieved through the construction and operation/maintenance of the advanced technology. KLK owns about 50 palm oil mills in Malaysia and Indonesia, where the technology can be introduced in the near future.

In addition, high-efficient POME treatment plant does not involve any anaerobic water treatment, and at the same time allows more efficient and thorough water treatment than lagoon system. This leads to the reduction of adverse impacts on mill workers' health and local environment. In addition, the mill will use a lesser amount of water than now as the new system recycles the treated water back to the mill.

■**Participants of the Feasibility Study**

Following parties have conducted the Feasibility Study on Improvement of POME Treatment System at Palm Oil Mills, Malaysia.

Japanese Side

- Pacific Consultants International (PCI): Feasibility Study, PDD and methodology preparation
- Det Norske Veritas Certification Ltd. (DNV): Preliminary validation of PDD
- Pacific Consultants Co., Ltd.: Assistance for preparing baseline & monitoring methodologies

Malaysian Side

- Kuala Lumpur Kepong Bhd. (KLK): Project implementing agency

(2) **Project Description**

■**Technical Description of the Project**

Project Summary

The target 13 mills are located in five states in Malaysia, as shown in Figure 2. All the mills are

owned and operated by KLK, and each of the new POME treatment plant will be installed inside the target mill's estate. Each estate currently contains palm oil plantation area, a processing mill, and open lagoons for POME treatment. 13 mills currently process about 2.5 million tons of fresh fruit bunches (FFB) and 1.2 million tons of POME every year.

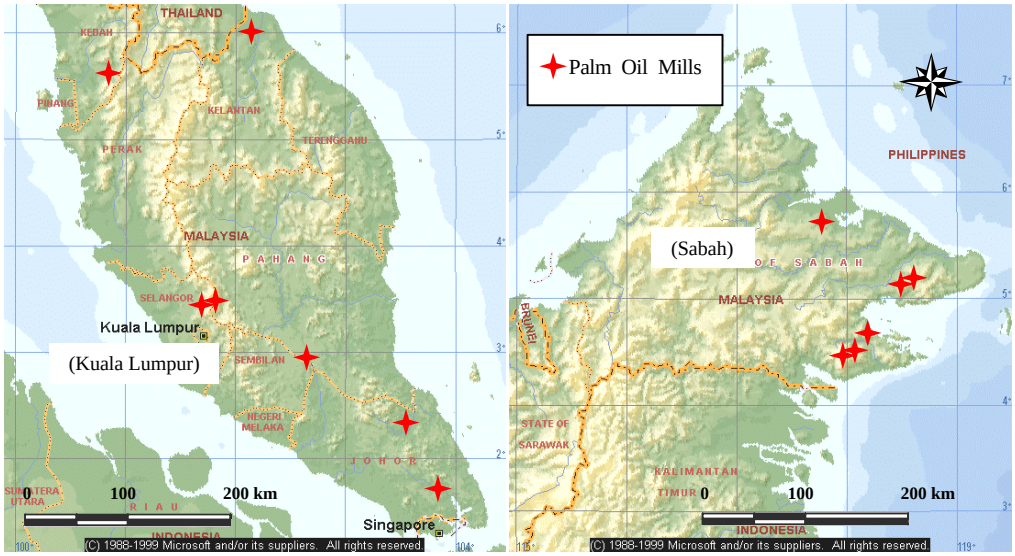

Figure 2 Project Sites

Technologies to be Introduced

The technology to be introduced under the Project allows avoidance of methane emissions from the current open lagoons by using its efficient water treatment system where oil and sludge contained in POME are sufficiently separated and removed. KLK and an Australian manufacturer have co-developed the high-efficient POME treatment plant.

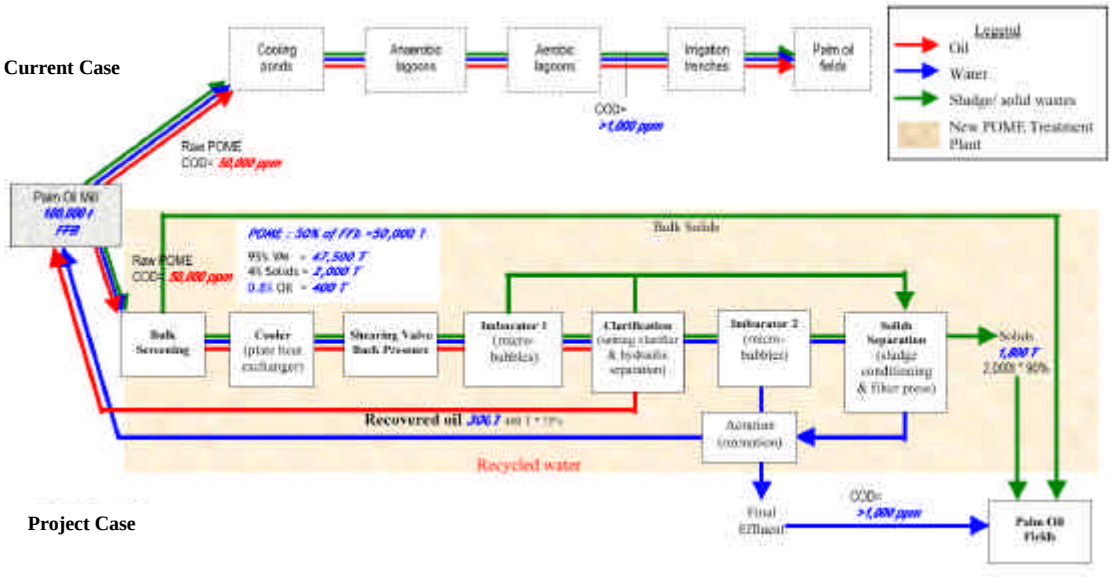

Figure 3 Schematic Diagram of High-Efficient Methane-Free POME Treatment System

Main Objectives of Introducing the Technology

a. Improvement of oil extraction rate at mills

The technology enables extraction of oil contained in POME (accounting for about 0.8% by volume in POME), which has been wasted at KLK's palm oil mills. This allows the overall oil extraction rate at palm oil mills.

b. Improvement of environmental condition

High-efficient treatment plant is a closed system and does not involve anaerobic water treatment, and thus the plant does not give off bad odor during its operation. The plant will replace the open lagoons, which are the principal cause of the odor.

c. COD reduction

Target 13 mills currently generate about 1.2 million tons of POME every year, and COD concentration in the raw POME is very high. New plant will treat all POME generated at the mills below the Malaysian effluent discharge limit in a more efficient manner than the current system. Treated water is also applied to palm oil fields as fertilizer supplement.

d. Reduction of water consumption

The plant will reuse the treated POME several times, allowing the mill to consume less water than present.

■Project Boundary, Baseline, Additionality

Baseline scenario determination

Baseline scenario is determined as "Anaerobic treatment at open lagoon (continuation of current practice) is continuously used as currently being practiced."

According to the following steps, an option that has the smallest barriers is determined as baseline.

Step i: Identification of alternatives to the proposed project activity and screening based on laws and regulations of wastewater treatment

The following baseline scenario alternatives are identified in Step i:

- Alternative 1: the anaerobic treatment at open lagoon (continuation of current practice)
- Alternative 2: the open-tank digester treatment
- Alternative 3: the closed-tank anaerobic treatment with electricity/ heat generation
- Alternative 4: the proposed project activity without CDM

All the above alternatives comply with relevant laws and regulations in Malaysia. Also, there is no incentive or any financial assistance that favors the activity and/or technology.

There is no law to regulate the methane emissions from wastewater.

Step ii: Barrier Analysis

1) Technical Barrier

Alternative 1 is commonly practiced at palm oil mills in Malaysia, and it does not require the advanced technology (thus facing no technical barrier); Alternative 2 is not commonly practiced, but the digester tank and technology is available in Malaysia, and required skills for this technology are locally available (facing little technical barrier); Alternative 3 is not a common practice, and technology for POME treatment digesters as well as required skills for this technology is locally available, except technologies for heat and power generation (facing a technical barrier); and Alternative 4 is the first case to introduce the technology in Malaysia, and it requires state-of-the-art

technology (facing a technical barrier).

2) Investment Barrier

Alternative 1 is the continuation of the current practice, and it requires no additional investment, and contains little financial risk (thus facing no investment barrier); Alternative 2 works only for wastewater treatment, and it does not have any revenue base, and the project developer cannot collect the investment for facility (facing an investment barrier); Alternative 3 requires much initial investment cost, and although it has a revenue base from energy production and by-product like compost, the revenue from energy production depends on the biogas production, which contains a technology risk, and a project developer must have a financial risk (facing an investment barrier); and Alternative 4 has a revenue base from oil recovery from POME even in the absence of CDM but requires much initial investment cost, and the project IRR is quite low for a private firm (facing an investment barrier).

3) Barrier due to prevailing practice

Alternative 1 is the most commonly practiced POME treatment method at palm oil mills in Malaysia (about 95% share), and project developers have experiences and skills for management of this activity (thus facing no barrier due to the prevailing practice); Alternative 2 is not a common practice (4%) but a project developer could employ experiences and skills in Malaysia (facing little barrier due to the prevailing practice); Alternative 3 is not a common practice (only one mill in Malaysia), some parts of the facility, such as motors and turbines need to be imported (facing a barrier due to the prevailing practice); and Alternative 4 is the first case in Malaysia, and requires state-of-the-art technology imported from Australia and also the equipment must be employed from Australia (facing a barrier due to the prevailing practice).

Therefore, Alternative 1, "the anaerobic treatment at open lagoon," contains the smallest barrier, and is determined as baseline.

Additionality Determination

The Project is determination additional according to the "Tool for the demonstration and assessment of additionality," as published in Annex 1 of the sixteenth meeting of the Executive Board (EB-16). The additionality tool has been applied to the proposed project activity as follows.

Step 0. Preliminary screening based on the starting date of the project activity

N/A

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

As described in the above clause, four alternatives are identified and Alternative 1: the anaerobic treatment at open lagoon (continuation of current practice) is selected as baseline.

Baseline and project both comply with relevant laws and regulations in Malaysia, including effluent discharge standard. Also, there is no law to regulate the methane emissions from wastewater, and there is currently no plan to establish such laws or incentives in the near future in Malaysia.

Step 2: Investment Analysis

" Benchmark analysis" is applied since the proposed project activity generates financial benefits

and project developer's required return is available as a benchmark.

According to the discussion with the project participant, the IRR is identified as a financial indicator suitable for the project type and decision context. According to KLK, higher than 20 to 30% IRR for 5 years is necessary to invest for the project.

The IRR of the proposed project is calculated as 7.9% for 5 years. The Project is obviously not commercially feasible since the IRR is much lower than the benchmark.

Sensitivity analysis shows that even if the CPO price in Malaysia remains in the same level as that of the highest CPO price in the last 10 years (1,610 RM/ton), expected project IRR is 17.9%, which is still lower than the KLK's benchmark.

Step 3: Barrier Analysis

(Investment Barrier)

The proposed project would not be commercially feasible and operable as a project to be undertaken by the private sector. Economic analysis of the project shows that the IRR will be 7.9%, which is quite low for a private project developer and makes the project activity not attractive as an investment option.

(Technical Barrier)

The Project plant has a micro bubbles technology that recovers crude palm oil from POME. This micro bubbles technology requires state-of-the-art technology imported from Australia and it is the first time to introduce this technology in Malaysia. Therefore, the Project has a technological barrier.

(Barrier due to prevailing practice)

There is no similar case to the Project and also the open anaerobic lagoon system is the prevailing practice in Malaysia. Therefore, there is a barrier due to the prevailing practice for the project implementation.

Step 4: Common Practice Analysis

Almost all palm oil mills in Malaysia currently use open lagoon systems. There is no similar case to the Project, and therefore, the project activity is not considered as a common practice.

Step 5: Impact of CDM registration

The impact of CDM registration will be financial support for the Project, because the proposed project activity is not financially viable without CDM. The CDM registration will provide additional revenue from sales of CER and improve IRR of the Project from 7.9% to 27.9 % for 5 years, which is higher than the project developer's required return. Therefore, it is considered that the CDM registration is necessary to the implementation of the proposed project activity.

■GHG Emissions Reduction and Leakage

1) Project Emissions

Since all the target mills currently consume and will consume in the future electricity that is generated by biomass generator, CO_2 is not emitted as a result of the project activity.

Project GHG Emissions = 0 (t-$CO_{2\text{-}e}$/year)

2) Baseline Emissions

Baseline emissions consist of the methane emissions from an open lagoon wastewater treatment

system. The formulae to estimate baseline emissions in a given year is described as follows:

Baseline Emissions (tCO2/yr)	=	Methane emission from open lagoon (t CH4/yr)	*	21

Methane emission from open lagoon in a given year is calculated as follows:

Methane emission from open lagoon (t CH_4/yr)	=	Total COD (t COD/yr)	*	Bo (tCH_4/tCOD)	*	MCF

Following numbers are applied to the above calculation;

Table 1 Assumptions for Baseline Emission Calculation

Item	Figure	Unit	Note for data source
COD	**62,692**	t COD/yr	To be calculated at each mill using the volume of POME and COD concentration, which are actually measured. Provisional COD of 50,000 ppm is based on the statistical data provided by MPOB.
Bo	**0.21**	tCH_4/tCOD	IPCC default value, 0.25, taking into consideration the conservativeness
MCF	**0.738**	-	IPCC value for Asia, 0.9, multiplied by the conservativeness factor, 0.82, as provided in the new baseline methodology

Baseline GHG Emissions	=	62,692 (tCOD/yr)	*	0.21 (t-CH_4/tCOD)	*	0.738	*	21
	=	**204,035 (t-CO_{2e}/year)**						

3) GHG Emissions Reduction by the Project Activity

GHG emission reduction by the project activity is determined by baseline emissions – project emissions, as shown below:

GHG Emissions Reduction	=	204,035 (t-CO_{2e}/year)	–	0 (t-CO_{2e}/year)
	=	**204,035 (t-CO_{2e}/year)**		

4) Leakage

No Leakage is identified from the Project.

High-efficient POME treatment plant separates and recovers solid wastes contained in POME, which are applied to palm oil fields after dewatering as fertilizer supplement. Since these wastes are carried to the palm oil estates using the existing fertilizer transportation system, new transportation system or vehicles are not required. And therefore, leakage is considered to be zero.

■Monitoring Plan

1) Monitoring of the emissions in the project scenario

No data is monitored since no emission is expected during the operation of the project.

2) Monitoring of the emissions in the baseline scenario

For the baseline emission calculation, following three items are monitored.

Table 2 Monitoring Items

ID	Item	Data source	Unit	Moni. Method	Frequency	Note
1	COD concentration in raw effluent (at CH_4 free organic wastewater treatment plant inlet)	KLK's laboratory	kg COD/m^3 raw effluent	Mea-sured	Monthly	Samples from each mill to be tested at KLK's central laboratories (TQCC/KDC). Measuring devices are to be calibrated according to the industrial standard.
2	Volume of raw effluent (at CH_4 free organic wastewater treatment plant inlet)	Operation centre at palm oil mill	m^3 raw effluent	Mea-sured	Monthly	To be measured by flow meters at the plant. Measuring devices are to be calibrated according to the industrial standard. Data to be aggregated monthly.
3	Regulations and incentives relevant to CH_4 emission from effluent	National/ regional legislation	-	-	Yearly	To be checked according to law, regulation and national policy.

■Environmental Impacts and other Indirect Impacts

The Project involves construction and operation of a POME treatment plant at the existing palm oil mill estate. According to the Malaysian Department of Environment, EIA is not required for the proposed activity under the Malaysian "Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987."

The new plant complies with all the Malaysian environmental regulations, and has no significant adverse impacts on the surrounding environment.

■Stakeholders' Comments

Among the target 13 mills, KLK is planning to select 4 mills that have some distinctive features such as geography, environment, or proximity to the nearest residential areas. KLK will provide explanation and collect comments from stakeholders at these mills before the Malaysian government approval.

(3) **Issues for Project Implementation**

■Project Participants and Functions

Organization chart for the Project is shown below.

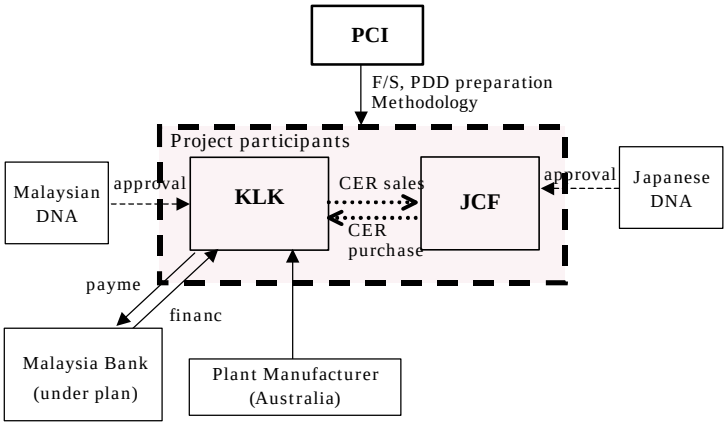

Figure 4 Organization Chart of Project Participants

KLK is planning to procure 70% of the total project cost using its own capital, and to procure the remaining 30% by the JCF (Japan Carbon Finance Ltd.) upfront payment scheme. Under this scheme, KLK is obligated to transfer some of the CERs arisen from the Project to JCF.

Japanese side is responsible for the CDM-related transaction costs including PDD and methodology preparation and registration.

■Project Financing

KLK is planning to procure70% of the total project cost using its own capital, and to procure the remaining 30% by the JCF's upfront payment scheme.

■Cost-Benefit Performance of the Project

Cost-benefit performance is calculated by dividing the initial investment cost (USD 8.5 million) and O&M costs from 2008 to 2012 (USD 2.5 million) by the estimated GHG emission reductions in the same 5-year period (1,020,177 tonCO_2).

USD 11.0 million / 1,020,177 ton-CO_2 = **USD 10.8/ ton-CO_2**

(= RM 40.68/ton-CO_2)

■ Project Schedule

KLK is currently planning to install the CH_4-free POME treatment plants at the mills located in Malay Peninsula by mid-2007, and then at the mills in Sabah state by the end of the same year. KLK is expecting one year for the construction of the plant at each mill.

For the CDM side, the Project participants will concurrently complete the submission and approval of new methodologies, approval from Malaysian and Japanese DNA, and upfront payment contract by the end of 2006, then proceed to the validation and registration to the CDM Executive Board by the end of 2007.

(4) **Validation/ Determination**

■**Validation Status**

DNV has conducted the preliminary validation on the Project's PDD in January 2006. DNV has provided the following six clarification requests (CL) for the PDD, which will be resolved accordingly.

Table 3 Preliminary Validation Results and Resolution of Clarification Requests

No.	Requests for clarifications (CL)	Actions to be taken
CL 1	DNV requests a clarification with regard to the system and components in the palm oil mills of which are inside of each site's system boundary.	The plant system and components of the palm oil mills, as well as project boundary will be clearly defined.
CL 2	DNV requests a sensitivity analyses for the investment barrier by changing plant operating length, CER prices and CPO selling price.	Sensitivity analysis on CER price (0, 6, 10 USD/ ton-CO_2) and CPO selling price (895, 1316, 1610 RM/ ton-CPO) has already been conducted, whose result will be provided to DNV.
CL 3	DNV requests the clarification with regard to standard returns in the market in Malaysia to support the benchmark selected for the investment analysis.	Investment benchmark will be clearly defined.
CL 4	DNV requests the clarification on the distance and the amount of solid waste transports and how much GHG will be emitted due to the transportation.	Transportation system for the solid waste fertilizer that is generated at the plant will be clearly identified. It shall be clearly described that no additional GHG emissions are generated due to the transportation.
CL 5	DNV requests the clarification with regard to the appropriateness of the daily monitoring of effluent.	Frequency of monitoring activities for the raw POME will be clearly defined.
CL 6	DNV requests the clarification with regard to the selected data source and the appropriateness of the COD applied in the ex-ante estimation of baseline emissions.	COD concentration in raw POME is currently monitored at all of the target mills. These actually measured data will be used for the validation, instead of the ex-ante estimation data.