CHARACTERIZATION OF PALM OIL MILL EFFLUENT (POME) FOR PROCESS CONTROL AND BASELINE ESTABLISHMENT

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QUALITY PARAMETERS FOR THE CHARACTERIZATION OF POME

1) Biochemical oxygen demand (BOD).
2) Chemical oxygen demand (COD).
3) Total nitrogen.
4) Ammoniacal nitrogen.
5) Total solids (TS).
6) Volatile total solids (VTS).
7) Suspended solids (SS).
8) Oil and grease.
9) Volatile fatty acids (VFA).
10) Total alkalinity.

INTRODUCTION

Under the Environment Quality Act of Malaysia 1974, regulations were promulgated to provide the necessary legal instruments for the control of effluent discharged from the processing of crude palm oil. These are the Environment Quality (Prescribed Premises) (Crude Palm Oil) (Amendment) Regulations 1982.

One of the main provisions of the regulation is that palm oil mills are required to comply with the effluent discharge standards as shown in *Table 1*. These mills are required to regularly monitor the quality and quantity of their effluent.

To date, palm oil mills have generally complied with the 100 ppm BOD requirement of POME discharged into a watercourse. However, the current 20 ppm requirement imposed by the Department of Environment (DOE) in some sensitive areas, especially those involving tourism activities in Sabah and Sarawak, is difficult to comply with due to uncertainties in the performance of existing technologies.

POME generates biogas containing approximately 65% of methane. Methane has 21 times the global warming potential of carbon-dioxide; thus, the free emissions of biogas into the atmosphere can adversely affect the sustainability and marketability of palm oil, especially in the biofuels sector.

To improve the environment impact and promote a greener image of palm oil, the industry must be willingly to capture methane from POME ponds as part and parcel of the 3Ps involved in sustainability, *i.e.* planet, people and profit. At the same time, the mills can generate extra revenue from the carbon credits earned under the Clean Development Mechanism (CDM). To help the industry in the above, relevant analytical services are available at MPOB.

OBJECTIVES

- To provide technical support to streamline CDM applications and processing for biogas capture in the mills via the establishment of baseline data on raw and treated effluent quality in palm oil mills.
- To encourage and facilitate the industry's involvement in managing POME effectively through biogas utilization and methane avoidance (through composting of POME as biofertilizer).
- To support and provide consultancy to potential industrial collaborators having feasible and cost-effective technologies to manage POME effectively for BOD reduction to 20 ppm.

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TABLE 1. PARAMETERS LIMIT FOR WATERCOURSE DISCHARGE OF EFFLUENT FROM OIL PALM INDUSTRY

Parameter	Units	Parameter limits for palm oil mill effluent discharge	Remarks
Biochemical oxygen demand (BOD, 3-day, 30°C)	mg litre^{-1}	100	-
Chemical oxygen demand (COD)	mg litre^{-1}	*	-
Total solids	mg litre^{-1}	*	-
Suspended solids	mg litre^{-1}	400	-
Oil and grease	mg litre^{-1}	50	-
Ammoniacal nitrogen	mg litre^{-1}	150	Value of filtered sample (GF/B)
Total nitrogen	mg litre^{-1}	200	Value of filtered sample (GF/B)
pH	-	5-9	-
Temperature	°C	45	-

Note: *No discharge standard after 1984.

SERVICES OFFERED BY MPOB

Determination of Biochemical Oxygen Demand (BOD) of Palm Oil Mill Effluent – Winkler Titration Method (*Figure 1*)

The test measures the oxygen required for the biochemical degradation of organic material (carbonaceous demand) and the oxygen used to oxidize inorganic material such as sulfides and ferrous ion. The method consists of incubating the diluted sample at 30°C for three days. The BOD is computed from the difference between the initial dissolved oxygen (before incubation) and the final dissolved oxygen (after incubation) using the iodide equivalent.

Figure 1. Apparatus set-up for determination of BOD.

Determination of Chemical Oxygen Demand (COD) of Palm Oil Mill Effluent – 50% Reduction Method (*Figure 2*)

Most types of organic matter are oxidized by a boiling mixture of chromic and sulphuric acids. A sample is refluxed in the strongly acid solution with a known excess amount of potassium dichromate. After digestion, the remaining unreduced potassium dichromate is titrated with ferrous ammonium sulphate to determine the amount of potassium dichromate consumed, and the oxidizable organic matter is calculated in terms of oxygen equivalent.

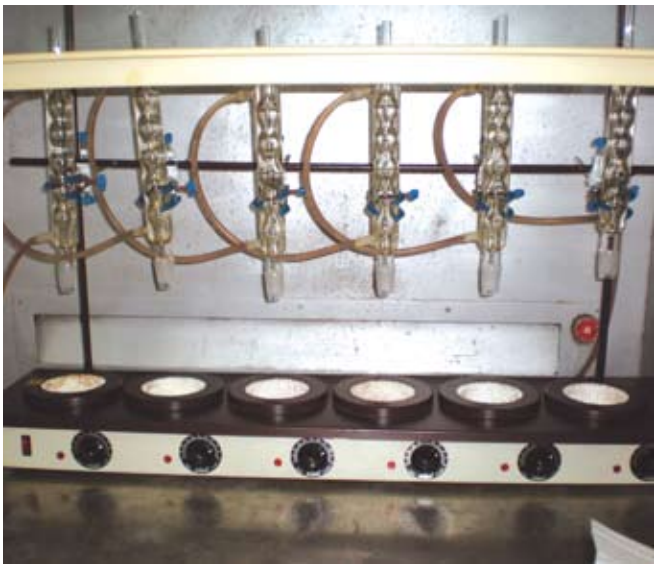

Figure 2. Apparatus set-up for determination of COD.

Determination of Total Nitrogen in Palm Oil Mill Effluent – Micro Method (*Figure 3*)

In the presence of sulphuric acid, sodium sulphate and a catalyst, amino nitrogen of many organic materials is converted to ammonium sulphate. During sample digestion, an ammonium complex is formed and then decomposed by potassium thiosulphate. The nitrogen is then determined by titrating with a standard mineral acid.

Figure 3. Micro-Kjeldhal digestion and Hoskin's distillation apparatus for determination of total nitrogen.

Determination of Ammoniacal Nitrogen in Palm Oil Mill Effluent – Reference Method* (*Figure 4*)

The ammoniacal nitrogen in the POME sample is analysed by first distilling it in a buffer solution to decrease hydrolysis of cynataes and organic nitrogen compounds. Ammonia in the distillate is then determined by the titrametric method using standard sulphuric acid.

Figure 4. Apparatus set-up for determination of ammoniacal nitrogen.

Determination of Total Solids in Palm Oil Mill Effluent – Reference Method*

Water from a well-mixed sample in a dish is evaporated and the sample is dried to constant weight in an oven at 103°C to 105°C. The increase in weight over the weight of the empty dish represents the total solids.

Determination of Volatile Total Solids in Palm Oil Mill Effluent – Reference Method*

The dried solids from the total solids analysis is ignited to constant weight at 550 ± 50°C in a furnace. The difference in the weights of ash and crucible is the weight of volatile total solids.

Determination of Suspended Solids in Palm Oil Mill Effluent – Three-piece Filter Funnel Method (*Figure 5*)

A well-mixed sample is filtered through a weighed standard glass-fibre filter, and the residue retained on the filter is dried to constant weight at 103°C -105°C. The increase in the weight of the filter represents the suspended solids.

Figure 5. Apparatus set-up for determination of suspended solids.

Determination of Suspended Solids in Raw Palm Oil Mill Effluent – Centrifugal Method

This method is applicable to effluent samples with a high amount of solids, *e.g.* raw effluent. A well-mixed sample is centrifuged. The settled residue is then dried at 103°C to 105°C. The weight of the dried residue represents the suspended solids.

Determination of Oil and Grease in Raw Palm Oil Mill Effluent – Soxhlet Extraction Method (*Figure 6*)

Oil and grease determination using the Soxhlet extraction method is recommended for samples with a considerably high content of solids. Hexane is used to extract the dried sample. The oil and grease content of the sample is determined after the removal of hexane via rotary-evaporation.

Figure 6. Soxhlet extraction unit for determination of oil and grease.

Determination of Volatile Fatty Acids – Reference Method* (*Figure 7*)

The technique recovers fatty acids containing up to six carbon atoms. The recovery of each acid via fractional distillation increases with increasing molecular weight. The volatile fatty acids content is then determined by sodium hydroxide titration.

Figure 7. Markham's still distillation apparatus for determination of volatile fatty acids.

Determination of Total Alkalinity – Electrometric Titration Method (*Figure 8*)

Hydrogen ions present in a sample as a result of dissociation or hydrolysis of solutes react with the addition of a standard acid. Total alkalinity is determined by titration of the sample to end-point when pH changes to 4.5.

Figure 8. pH meter for determination of total alkalinity.

Notes: *Adopted from Standard Methods for the Examination of Water and Wastewater, 16th Edition, (1985), American Public Health Association, Washington, USA. Others are sourced from DOE (Malaysia, 1995) Test Methods.

COSTS OF ANALYSES

Effluent analysis**	Cost/sample (RM)***
BOD	50
COD	50
Total nitrogen	50
Ammoniacal nitrogen	50
Total solids	30
Volatile total solids	40
Suspended solids	30
Oil and grease	60
Volatile fatty acids	60
Total alkalinity	20

Note: **Subject to availability of manpower and quantity of samples received at a time.
*** The costs may be revised from time to time.

For more information kindly contact:

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