CURRENT SITUATION AND ISSUES OF INDUSTRIAL WASTEWATER MANAGEMENT IN MALAYSIA

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OVERVIEW OF INDUSTRIAL WASTEWATER REGULATIONS IN MALAYSIA

1. TYPES OF INDUSTRIAL WASTEWATER QUALITY STANDARDS

2. CHALLENGES IN MONITORING

3. INDUSTRIAL WASTEWATER QUALITY MONITORING METHODS

4. COMPLIANCE REGARDING INDUSTRIAL WASTEWATER QUALITY STANDARDS

5. ISSUES AND CHALLENGES
**COMPOSITION OF WATER POLLUTION SOURCES BY SECTOR**

<table>
<thead>
<tr>
<th>No</th>
<th>Type of sources</th>
<th>No. of sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manufacturing industries</td>
<td>3258</td>
</tr>
<tr>
<td>2</td>
<td>Agro-based industries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Rubber mills</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>ii. Palm oil mills</td>
<td>450</td>
</tr>
<tr>
<td>3</td>
<td>Piggery</td>
<td>749</td>
</tr>
<tr>
<td>4</td>
<td>Sewage treatment plants®</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Public</td>
<td>6397</td>
</tr>
<tr>
<td></td>
<td>ii. Private</td>
<td>11,318</td>
</tr>
<tr>
<td></td>
<td>iii. Individual septic tanks (IST)</td>
<td>1,273,978</td>
</tr>
<tr>
<td></td>
<td>iv. Communal septic tanks (CST)</td>
<td>3637</td>
</tr>
<tr>
<td>5</td>
<td>Wet markets</td>
<td>888</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1,300,739</strong></td>
</tr>
</tbody>
</table>
In the interests of protecting the two traditional industries of **palm oil** and **natural rubber** production in Malaysia, and in view of the fact that strict wastewater standards are difficult to achieve in a short term due to the nature of their production processes, the government has set separate and more lenient wastewater standards for these two industries than for other manufacturing industries.

There are also special regulations and orders under the **Environmental Quality Act (EQA) 1974** that apply only to these two industries.
CHALLENGES IN MONITORING

- Limited resources
- Logistic (time-consuming, travel distance)
- "snap shot information" on industry's compliance status
- Increasing number of pollution sources
- High expectation/demand by public and industries

NUMBER OF POINTS SOURCES SUBJECTED TO EQA 1974 VS DOE ENFORCEMENT OFFICERS

<table>
<thead>
<tr>
<th>Year</th>
<th>DOE: No. Of Pollution Sources Under EQA (2004 - Ogos 2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>10623</td>
</tr>
<tr>
<td>2005</td>
<td>17866</td>
</tr>
<tr>
<td>2006</td>
<td>26105</td>
</tr>
<tr>
<td>2007</td>
<td>29136</td>
</tr>
<tr>
<td>2008</td>
<td>34686</td>
</tr>
<tr>
<td>2009</td>
<td>39780</td>
</tr>
<tr>
<td>2010</td>
<td>43819</td>
</tr>
<tr>
<td>2011</td>
<td>48477</td>
</tr>
<tr>
<td>2012</td>
<td>52344</td>
</tr>
<tr>
<td>2013</td>
<td>55516</td>
</tr>
<tr>
<td>2014</td>
<td>59874</td>
</tr>
<tr>
<td>2015</td>
<td>62599</td>
</tr>
</tbody>
</table>

INDUSTRIAL WASTEWATER QUALITY MONITORING METHODS

8 Environmental Mainstreaming Tools apply
- emphasis of enforcement is on Performance Monitoring (PM) = “Upstream of Final Discharge” or Each Unit Operation/Unit Process

- Online reporting
- Online Monitoring (in progress)
- Online database
- Mobile apps

- Enforcement
- emphasis of enforcement is on Compliance Monitoring (CM) = ‘Final Discharge’
MONITORING APPROACH 1. Guided Self-Regulation (GSR) Approach

GUIDED SELF-REGULATION (GSR)

- Guided Self Regulation is whereby the regulated sectors (primarily, the industries and project proponents) are 'taken by the hand so to speak, towards achieving the goal of self-regulation through environmental mainstreaming tools.
MONITORING APPROACH 1. Guided Self-Regulation (GSR) Approach

- Regulation 10, Industrial Effluent Regulations, 2009
- Handle by Institute Of Environmental Malaysia, (EiMAS)

The operation IETS should supervised by competent person

Certified by Director General Of DOE

Ensure the competent person on duty at anytime IETS in operation

Competent Person
KUANTAN: The Guided Self-Regulation (GSR) introduced by the Department of Environment (DoE) is expected to be an effective environment management system for industrial operators.

DoE director-general Datuk Dr Ahmad Kamarulnajib Che Ibrahim said the system which is currently in its trial process will assist industrial players to become more competent operators in managing a sustainable environment.

“GSR, a self-regulation system, will benefit industry operators as they are the ones who know their operations best and other related problems (to the environment). The system will ensure companies follow the allowed emission standards.

“The essential elements of GSR include performance monitoring and continuous emission monitoring systems (CEMs) where the industry operators can record all related data on pollutant emissions,” he told reporters after closing the GSR seminar and dialogue organised by the department today.

Ahmad said DoE will conduct inspections on factories and industrial premises to check on the data and ensure that regulations are adhered.

The GSR can also input data to DoE via an online system which includes emission from palm oil and cement factories for better and effective enforcement.
Industry's self-compliance more effective than enforcement – DOE

BINTULU: Self-compliance on environmental conservation and preservation among industrial players more effective than regulatory enforcement by the Department of Environment (DOE).

"Previously, people were scared with DOE but now we are more friendly because our style of enforcement is totally different," said DOE director-general Dato' Dr Ahmad Kamarulnojib Che Ibrahim.

He said environmental conservation requires a concerted effort from all parties.

"The laws, rules and industrial standards are in place and updated periodically by the DOE to ensure that environmental conservation and industrial development are not mutually exclusive, to ensure sustainable development," he said when officiating at the opening of a seminar on 'Environmental Legal Requirement and Compliance' at a hotel here yesterday.

The seminar attended by some 200 representatives from major industry players in Bintulu was jointly organised by DOE and Malaysia LNG Sdn Bhd in conjunction with the World Earth Day theme 'Environmental and Climate Literacy'.

Also present at the event were MLNG senior general manager Pandai Othman, MLNG Health, Safety and Environment Department head Mursyide M Ali, DOE state assistant directors Amirul Arpin and Mohamad Zahirah Lek.

Ahmad noted that compliance to rules and standards by industry players is still very much dependent on the inspection and enforcement by the DOE.

"This shows the level of awareness among industrial players on the laws, rules and standards is still lacking," he said.

Thus, self-compliance regulations, he said, are being introduced by DOE but deterrent enforcement and court action still continues for non-compliance.

"Among the self-compliance elements introduced and being enforced are competent operator, performance monitoring and continuous emission monitoring systems," he said.

According to him, every operator of air pollution control equipment, industrial effluent treatment systems (IETS) and scheduled waste management have to be competent and certified by the Malaysian Environmental Institute as a competent operator.

"Based on DOE's inspection, the compliance on the need to have competent operators was good and to-date in Sarawak, there are a total of 107 competent persons for scheduled waste management, 15 competent persons for air pollution control equipment and 38 competent persons for industrial effluent treatment systems.

"We hope the numbers of competent persons will increase in order to create a sense of ownership in the industry," he added.

Meanwhile Pandai said the seminar was the best platform for industry players to learn about the latest requirements on environmental legal requirements and compliance, for example, DOE Guided Self Regulations, CAR 2014, Waste Characterisation and others.

He also hoped the seminar can increase the awareness of industry players on their respective responsibilities in environmental conservation.
MONITORING APPROACH 2. Command and Control

End of Pipes Approaches

PREVIOUS PRACTISE
Downstream activity
Product focused
Result focused
‘Too late’ information
Process control

CURRENT PRACTISE
Upstream activity
Ingredient focused
Process focused
‘Early warning’ information
In control of process

Competent Person
Performance Monitoring
Effluent Discharge Monitoring
Green Industry Practices/Cleaner Production (material substitution, change in process, waste minimization and recycling)
Online Environmental Reporting
MONITORING APPROACH 3. Enhancement of ICT

- **E-KAS**: Electronic Environmental Pollution Control-Integrated information management system of environmental pollution sources and enforcement action.

- **OER**: Online Environmental Reporting for Industries including Palm Oil mill and rubber mill, Sewage & Landfill Leachate. Frequency, Parameter to be monitored are specified.

- **GIS**: Geographical information system for mapping and overlay with important data.

- **PROPOSED CEDMS**: Continuous Effluent Discharge Monitoring System—Real time for effluent quality discharge monitoring.
INDUSTRIES WHICH FACE CHALLENGES IN COMPLIANCE

The effectiveness of regulations is dependent on the firms' decision to comply; which in turn is based on cost and benefit considerations.

Compliance to environmental regulations is driven by enforcement activities in order to effect a change in the behaviour of firms.

The lack of appropriate treatment technology, insufficient treatment capacity, and poor maintenance of existing treatment systems resulted in a low compliance level for industries.

For example, the textile and dyeing industries generally operate without adequate treatment capabilities. These industries consist primarily of small- to medium-sized workshops & do not have enough resources to invest in treatment systems.

### Malaysia: Compliance status of industry (Department of Environment, Malaysia)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>INDUSTRIAL EFFLUENT REGULATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO. OF INSPECTIONS</td>
</tr>
<tr>
<td>2014</td>
<td>11,410</td>
</tr>
<tr>
<td>2013</td>
<td>7,201</td>
</tr>
<tr>
<td>2012</td>
<td>6,590</td>
</tr>
</tbody>
</table>
ENFORCEMENT ISSUES AND CHALLENGES

Growing Public Expectation
- Increasing nos of environmental complaints.
- Limited Resources with growing number of issues & pollution sources to be tackled.

Attitude
- Cases illegal discharges or accidental dischargers from industries.

Unwillingness to invest
- Efficient wastewater treatment technologies.
- Lacking in Green Industry Practices.

The need to protect the water supply
- Prolong Dry Season (Low River Flow) – Affect River Water Quality – Affect The Operation Of WTP
- Protection of water catchment areas.

Institutional Arrangement
- Coordinated efforts among agencies.
- Responsibilities of all relevant agencies.
CEDMS - Continuous Effluent Discharge Monitoring System
incorporate Real-Time for effluent quality discharge monitoring.

TMDL- Total Maximum Daily Load
- total max amount of daily pollutant that can enter the water body, without violating the WQ standard

NEQMP- National Environmental Quality Management Programme
- network of environmental quality monitoring stations encompassing both continuous and manual modes of monitoring
- allows for real-time river & marine water quality data to be measured and recorded, while the manual stations where river or marine water samples are collected and sent to the lab to be analysed

Regulation in cess
- Industries to contribute according to amount of generation of waste

New regulation to further control water pollution
REFERENCES


Situation and Challenges for the Problematic Industry and Countermeasures

PALM OIL INDUSTRY IN MALAYSIA
INTRODUCTION

• Malaysia is one of the largest producers and exporters of palm oil in the world, accounting for 39 % of world palm oil production and 44% of world exports (MPOC, 2012).

• This important industry, however has generated palm oil mill effluent (POME) which is the most difficult to handle due to its high volume generated (Mandaki and Lau, 2013) and the treatment process (Rupani et al., 2010).

• It is estimated that the crude palm oil (CPO) production of 19.51 million tonnes to have the potential to produce 58.53 million m³ of POME annually (Kumaran et al., 2016)
Palm Oil Mill Effluent (POME)

- POME is produced in the palm oil mill process that consists of sterilizer condensate (36%), separator sludge (60%) and hydrocyclone (4%).
- A yellow, concentrated liquid with a distinct offensive odor
- Non toxic, high amount of N, P, K, Mg, Ca
- Acidic (pH 4 – 5) (volatile acids)
- POME consists of:
  - 95 – 96% water
  - 0.6 – 0.7% of oil
  - 4 – 5 % of total solid
- POME treatment – ponding system, open tank digester and extended aeration system, or closed anaerobic digester and land application system (Wu et al., 2010)
Oil Trap

Cooling pond

Mixing pond

Anaerobic pond

Facultative pond

Algae pond

Source: DOE, 2013
<table>
<thead>
<tr>
<th>Parameters</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.2</td>
<td>3.4 – 5.2</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand (BOD)</td>
<td>25,000</td>
<td>10,250 – 43,750</td>
</tr>
<tr>
<td>Chemical Oxygen Demand (COD)</td>
<td>51,000</td>
<td>15,000 – 100,000</td>
</tr>
<tr>
<td>Total Solids (mg/l)</td>
<td>40,000</td>
<td>11,500 – 79,000</td>
</tr>
<tr>
<td>Suspended Solids (mg/l)</td>
<td>18,000</td>
<td>5,000 – 54,000</td>
</tr>
<tr>
<td>Volatile Solids (mg/l)</td>
<td>34,000</td>
<td>9,000 – 72,000</td>
</tr>
<tr>
<td>Oil and grease (mg/l)</td>
<td>6,000</td>
<td>130 – 18,000</td>
</tr>
<tr>
<td>Ammoniacal Nitrogen (mg/l)</td>
<td>35</td>
<td>4 – 80</td>
</tr>
<tr>
<td>Total Nitrogen (mg/l)</td>
<td>750</td>
<td>180 – 1,400</td>
</tr>
</tbody>
</table>


### Palm Oil Mill Secondary Effluent (POMSE)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.86 – 8.3</td>
<td>9.0</td>
<td>8.58</td>
</tr>
<tr>
<td>BOD (mg/l)</td>
<td>249 – 270</td>
<td>160</td>
<td>-</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>3,309 – 4,044</td>
<td>1,600</td>
<td>579</td>
</tr>
<tr>
<td>Color (ADMI)</td>
<td>3,860 – 6,270</td>
<td>-</td>
<td>547</td>
</tr>
<tr>
<td>Fe2+ (mg/l)</td>
<td>0 – 0.05</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total Fe (mg/l)</td>
<td>0.06 – 1.75</td>
<td>-</td>
<td>0.418</td>
</tr>
<tr>
<td>TSS (mg/l)</td>
<td>1,635 – 1,875</td>
<td>14,787</td>
<td>62.9</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>2,843 – 2,894</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOC (mg/l)</td>
<td>-</td>
<td>-</td>
<td>179</td>
</tr>
</tbody>
</table>

POMSE – result of biological treatment of POME, thick, brownish color, bad odor, higher pH, lower BOD and COD.
Palm Oil Mill Secondary Effluent (POMSE) and Palm Oil Mill Tertiary Effluent (POMTE)

POMSE (Biological Treatment)

Polishing process

Dark color of POMSE

POMTE being channeled back to the plantation area for irrigation purpose

Effluent discharged to the environment

Dark color POMTE from polishing tank before discharge
## PALM OIL MILL EFFLUENT (POME) DISCHARGE STANDARDS/ LIMITS

<table>
<thead>
<tr>
<th>Parameters</th>
<th>DOE Discharge Limit (1986 onwards)(^a)</th>
<th>Environmental Quality Act(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD(_3) (mg/l)</td>
<td>50 (20)(^d)</td>
<td>100</td>
</tr>
<tr>
<td>COD (mg/l)</td>
<td>1000</td>
<td>1000(^c)</td>
</tr>
<tr>
<td>Total Solids (mg/l)</td>
<td>1500</td>
<td>1500(^c)</td>
</tr>
<tr>
<td>Suspended Solids (mg/l)</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Oil and grease (mg/l)</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Ammoniacal Nitrogen (mg/l)</td>
<td>100</td>
<td>150(^c)</td>
</tr>
<tr>
<td>Total Nitrogen (mg/l)</td>
<td>200</td>
<td>200(^c)</td>
</tr>
<tr>
<td>pH</td>
<td>5.0</td>
<td>5.0 – 9.0</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

\(^a\) Malaysian Department of Environment (DOE)

\(^b\) Parameters Limit of Environmental Quality (Prescribed Premises) (Crude Palm Oil) (Amendment) Regulation 1997

\(^c\) No new value stipulated since 1982

\(^d\) Stringent standards in environmentally sensitive areas of Sabah and Sarawak, Malaysia starting 2006

Source: Mandaki and Lau, 2013; Shahrifun et al., 2015
IMPACT TO THE ENVIRONMENT

• Water pollution
• POME in water body could lead to oxygen depletion and suffocate aquatic life
• High nutrient content (N, P, K, Mg, Ca) lead to plant growth in aquatic region (Shahrifun et al., 2015)
• Crippled water source for residents in rural area – oil and dirt
• Greenhouse gases - methane or biogas, generated during anaerobic digestion of POME – second largest source of methane generation in Malaysia (38%) next to landfills (53%) (Mandaki and Lau, 2013)
Location: Tenegang River, Kinabatangan, Sabah, Malaysia
Date: 27 May 2014
Photos by DOE Sandakan, Sabah, Malaysia

- Eutrophication/brown algae bloom
- Suspected impact from palm oil mill effluent
- No direct evidence to show that the bloom was due to palm oil mill effluent

Blooming of aquatic plants
Reason for Non-Compliance

• Palm oil mill need to comply with the discharge standards in order to obtain or renew the palm oil production licenses

• It is very rare for the palm oil mill not to comply with the standards

• Reasons for non compliance (Shahrifun, 2015):
  • Different characteristic of POME
  • Factors affecting the quantity and quality of POME produced:
    • Different batches or days
    • Different oil extraction techniques
    • The quality of the palm fruits
    • Different climate and cropping season

• Treatment efficiency

• Overflow during heavy rain
CURRENT MITIGATION MEASURES/ТЕХНОЛОГИИ

• Zero discharge of palm oil waste
• Genting Jambongan Oil Mill, Sabah, Malaysia – Malaysia 1st zero discharge oil mill
• Inclusion of a compost plant that utilises all of its waste and by-products (shredded EFB, decanter slurry and effluent) from the mill and convert them into biofertiliser
• The system is able to evaporate all the effluent produced by the oil mill and eliminate the need for effluent treatment and land irrigation
• Biofertiliser produced is high in nutrients and it is suitable to be channelled to estate fields as a replacement for at least 80% of inorganic fertiliser that would otherwise have been applied

Source: Genting Plantations Berhad, 2016
Schematic diagram of palm oil mill effluent treatment plant

Source: Wang et al., 2015
References


