

AIR POLLUTION CONTROL IN PALM OIL MILL INDUSTRY IN  
MALAYSIA

M. YACCOB K.A. RAHMAN AND M. RASHID M. YUSUF  
DEPARTMENT OF CHEMICAL ENGINEERING  
FACULTY OF CHEMICAL AND NATURAL RESOURCES  
ENGINEERING  
UNIVERSITI TEKNOLOGI MALAYSIA  
JALAN SEMARAK  
54100 KUALA LUMPUR

PRESENTED :

SYMPOSIUM ON ENVIRONMENTAL PERSPECTIVES TOWARDS  
THE YEAR 2000 AND BEYOND  
BANGKOK, THAILAND  
NOV. 1989

## Air Pollution Control in Palm Oil Mill Industry In Malaysia

M. Yacob Khan A. Rahman & M. Rashid M. Yusuf  
Department of Chemical Engineering  
Faculty of Chemical and Natural Resources Engineering  
Universiti Teknologi Malaysia  
Jalan Semarak  
54100 Kuala Lumpur

### Abstract

In 1985 industrial solid waste from the Malaysian palm oil milling industry is estimated to be 8.1 million tonnes. Efficient waste utilization technologies are therefore highly desirable to meet increasingly stringent environmental regulations. In order to overcome the problem, the technology of utilizing the solid wastes as the fuel to the boilers and incinerators was adopted. However, such processes of course have their associated duty of atmospheric emission and it is the objective of this paper to discuss the context of milling air pollution control practice in compliance with the Malaysian's Environmental Quality (Clean Air) Regulation introduced in 1978.

### Introduction

Atmospheric emission introduced to the environment from fuel combustion, incineration and industrial emission sources are causing increasing concern to air pollution researchers. The emissions are not only posing threat human and animals but they may also affect the meteorological and geophysical set up such as the scattering of solar radiation back in to the space and reducing visibility. Therefore, atmospheric emission from a stationary source like a palm oil mill operation plant is not an exception in this regard.

The palm oil industry in Malaysia is a success story. Today it is labelled as the 'sunshine' industry having moved from a activity involving only 46 mills producing 430,000 tonnes of Crude Palm Oil and no refining capacity in 1970 [3], to the world largest producer and exporter involving 263 mills and 57 operating refineries producing 14 million tonnes in 1987 [1]. Hourly, the industry processes 8260 tonnes of Fresh Fruit Bunches (FFB) harvested from 1.7 million hectares oil palm estates [1].

However, due to high solid by-product present, the industry is continually faced with a massive solid waste disposal problem. On average, 43 tonnes or more of EFB, fibre and shell are produced per 100 tonnes Fresh Fruit Bunches (FFB) processed and the total estimated solid wastes amounted to 8.1 million tonnes in 1985 [4].

In order to overcome the problem, the technology of utilizing the EFB and fibres/shell as the fuel to incinerators and boilers was adopted [3]. Such processes of course have their associated duty of atmospheric emission and it is the objective of this paper to discuss in the context of milling air pollution control practice in compliance with the Environmental Quality (Clean Air) Regulation introduced in 1978.

### Legislation

Under the enabling legislation provided by the 1974 Environmental Quality Act, the Malaysian Government has issued the Environment Quality (Clean Air) Regulations, which came in to force on 1st. October 1978, and which limit air emissions from stationary fuel burning sources [7].

For the palm oil industry, the principle concern of the regulations is toward the control of the smoke and solid particulates emission from the burning wastes.

Under Regulation 14 and 15 of Environment Quality (Clean Air) Regulation, the existing and new facilities burning solid fuel will not be permitted to emit smoke darker than shade No. 2 on the Ringelmann Chart. Exceeding the permitted dark smoke limit shall be allowed under Regulation 16 only to the extent that the periods involved are not more than 5 minutes in any hour, with a total period for such emissions being no more than 15 minutes in any period of 24 hours.

Meanwhile, under Regulation 21 and 25 the maximum permitted level of solid particulates concentrations in gas emitted will be  $0.5 \text{ gm/Nm}^3$  before 1/10/1978 and a limit of  $0.4 \text{ gm/Nm}^3$  for plant erected after the date.

### Present Situation of Emission in Palm Oil Mill

Though, utilization of fibre and shell as the fuel in the boiler and the smouldering of EFB in the incinerators for potash production are indeed necessary and commendable. Unfortunately, the absence of proper control measures have resulted in excessive smoke and particles emissions and consequential public out-cry.

Presently, on average, every palm oil mill in the country are equipped with two boilers and one incinerator. Hence, up to 1987, the total number of boilers and incinerators installed in the country are 526 and 263 respectively. Thus, the emission from palm oil mill will certainly create a great burden to the local atmosphere if it is not properly controlled.

In order to obtain an approximate atmospheric emission level contributed by the palm oil mill, a surveillance was carried out by the Department of Environment, Malaysia (DOE) and Malaysia Oil Palm Growers Council (MOPGC).

Result of the surveillance that was carried out on several boilers and incinerators of different size, type, and age in the country are discussed below [2].

Based on the assesment by regular inspection of the smoke plumes, the intensity of the dark smoke emitted from the boilers appeared to be exceeded the smoke emission limit required by the Clean Air Regulation. However, the smoke intensity emitted from the incinerator still remained below No. 2 on the Ringelmann Chart at all times, thus complying with regulations.

Meanwhile, results of the test carried out on the particulate concentration emitted from the boiler and incinerators showed that majority are not complying with the regulation. There are large fluctuatjon in the levels of emissions ranged from 3.89 to 23.27 gm/Nm<sup>3</sup> without control device being installed.

On particle size analysis, it was reported that there is no significant difference in boiler and incinerator distribution. Large numbers of particles were sub 7-micron and majority (65%-90%) of the weight is accounted by particles of greater than 20 microns.

The emission of dark smoke and, to a certain extent, the carry over of soot and partially carbonised fibrous particulates from the palm oil mill boilers, are a result of incomplete combustion of the fuel and the readily volatilised tarry product formed.

The incomplete combustion probably results from the furnace combustion and boiler design problem which include lack of steady state condition caused by fluctuating steam load particularly manual operated fuel feed system, insufficient primary and secondary air feed, and too short residence time caused by high suction of induced draught fan [5].

The same underlying reasons are undoubtedly the cause of some of the particulates carry-over in incinerators. However, it is possible to create condition of light smoke from the incinerator because the high moisture level of the fuel being incinerated [6].

### Current Practices of Controlling Emission

Dark smoke only occurs in emission from boiler plant. In order to meet the dark smoke regulation, it will be necessary for the industry to look in to the most cost effective means of establishing the optimum staedy state combustion condition in the furnace.

Presently, in some new mills, compliance may be achieved with little or no equipment expenditure, though some increased operating cost associated with improved boiler operation, and maintenance will be necessary.

However, in some boiler, certain amount of capital expenditure on control equipment and re-engineering of the boiler design will be required if permitted smoke limits are to be met.

Improvement on the combustion condition on the boiler in order to reduce dark smoke emission will also cut back the amount of total particulates emitted without addition further control equipment.

But, currently, as regulation required, all the boiler plant in the country which are installed after July 1978 are equipped with mechanical dust arrestment equipment/plant to ensure the emission standards are consistently met [2].

Presently, in the palm oil mill, due to the relatively low ash content of the fuels, the cyclone method will be sufficient for compliance with the Clean Air Regulation Limit of  $0.4 \text{ gm/Nm}^3$  of particulate loading for chimney emission provided the boiler and incinerator has been operated according to design [5].

However, in some older boilers, the twin peripheral cyclone was found not to be effective. In this particular case, the use of bag filter plant has been proven to be most efficient to control the emission to the prescribed limits [2].

Surveillance carried out by DOE show that the installation of proven dust arrestment plant/equipment has been able to reduce the emission level down to range of  $0.05$  to  $0.39 \text{ gm/Nm}^3$  [2].

Meanwhile, currently, the most serious problem facing the palm oil industry is incinerator emission failure in meeting the prescribed limit required by the regulation.

Although, it should be possible to achieve significant reduction in particulate emissions by more careful control of combustion but it is unlikely the step will be sufficient to ensure standards are consistently met.

Beside, the addition of dust arrestment plant will be impossible because of the rudimentary open grate design of the incinerators. In other words, if particulate level still cannot be brought down to acceptable level, then new properly designed incinerator has to be considered. Clearly, the adoption of such a course of action would represent an enormous financial burden to mill operators [4].

Even though, it is difficult to meet particulate emission of  $0.4 \text{ gm/Nm}^3$  but due to its significant economic value through fertiliser savings, the General Guidelines has not stopped any construction and operation of incinerations except when the mill is very close to inhabited areas.

#### Recommendation and Future Out-Look

How the industry as a whole respond in compliance to Clean Air Regulation Standards depend very much on how the problem is being studied now.

Participation of palm oil mill through the MOPGC as well as conduct independent collaborative research in to various aspects of incinerator and boiler operations, energy management, and air pollution modelling with local Universities and various research institution are very essential.

For now, the immediate concern in the milling industry is dark smoke emission in boiler exhaust and excessive particulate emission level in incinerator's plumes. Therefore, needs to set up the Boiler And Incinerator Emission Working Committee through MOPGC to look in to the possible cost effective solution of both problems has to be considered.

Finally, MOPGC should ensure that the DOE is in full agreement with the action programme by the industry. So that, the government will be prepared to waive strict adherence to certain emission regulations.

### Conclusion

It is apparent that a considerable amount of operating and capital expenditure required in order for the palm oil industry to comply with the 1978 Environmental Quality (Clean Air) Regulations. However, surveillance result show that smoke emission levels could be very conveniently monitored by palm oil mill management. Test carried out also show that control technology currently available is capable of limiting dust discharge to statutory requirements. Nevertheless, by industry and various research institutes taking the appropriate steps, coupled with a certain degree of flexibility on the part of DOE, the cost of the compliance can be minimised.

### References

1. Palm Oil Registration and Legislation Authority (PORLA), Annual Report, 1987.
2. M.L. Tan, Surveillance of Air Emissions in Palm Oil Mills, Proceedings of 3rd. Workshop on Rubber and Palm Oil Effluent Testing '85, Kuala Lumpur, Malaysia, 1985.
3. N.M. Sulaiman, and A.F. Shafii, "Maximizing Waste Utilization in Palm Oil Mills," Institute Chemical Engineering Symposium Series No. 100, 1987.
4. A.F. Shafii, and Gopalupillay, "Atmospheric Emission Control," Paper Presented at Seminar on A Decade of Environmental Management in HMPB, 1987.
5. K.Y. Boon, and A.F. Shafii, Boiler Design for Palm Waste Firing, Proceeding of International Oil Palm/Palm Oil Conference Technology '87, Kuala Lumpur, Malaysia, 1987.

6. ERL, and Bumi Watson (M) Sdn, An Analysis of Amospheric Emission from Palm Oil Mills and An Evaluation Control Method, Final Report Prepared for MOPGC, 1980.

7. Environmental Quality Act (Malaysia), 1974.