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Palm oil mill effluent treatment

R Ahmad, R Abdul Aziz and A Hussein

INTRODUCTION

Palm oil production has been known to be one of the major water pollution contributors in Malaysia. There are currently 272 palm oil mills and 36 operating refineries throughout the country (1). They produced a total of about fifteen million tonnes per annum of wastewater, most of which, finally discharged into the environment. Since rivers naturally provide convenient supply of water, many palm oil mills are located near rivers. Most of these rivers are still being used for domestic purposes, including washing and drinking.

Government concern and public awareness over the environmental effects of uncontrolled disposal of the palm oil mill effluent, has forced the industry to improve the wastewater treatment methods so as to minimise the impact of the wastewater on the environment.

RECYCLING OF PALM OIL MILL EFFLUENT (POME)

Recently, effort has been made to recycle the treated POME as process water. Such an attempt would directly reduce the amount of the POME discharged into the environment, and hopefully, would reduce the overall cost of palm oil production. In one of the mills which uses the treated effluent as process water, it was able to cut down the use of water supplied by Jabatan Bekalan Air (Water Supply Department) as much as 57% and resulting in an estimated saving of over M\$40,000.00 per annum (3).

Lately it was found, however, some difficulties arose due to precipitation of soluble materials when the water, out of necessity, is heated up to about 90°C. Accumulation of the precipitate in the piping systems has forced the milling operation to be halted periodically for cleaning operations.

The fact that the recycled wastewater is still giving rise to such problems in its usage indicates that, the existing anaerobic and aerobic digestions, although they are capable of removing most of the suspended

solids from the effluent, are not sufficient to recover the wastewater into near equivalent of the fresh water supply.

The recycled POME has the following characteristics:-

- contain about 2.77 g/L of suspended solids and dissolved materials,
- dark brown in colour,
- pH \approx 8.0
- produces green precipitate upon heating.

Typical reuse of POME is to reduce the thickness of the extracted palm oil in order to increase the mobility of the oil during process. Considering the amount of such water that is potentially being used in the future, there is a need, therefore, for an extensive study to improve the quality of the recycled wastewater.

Since further improvements on the existing treatment methods will, inevitably, incur some extra costs of production, it is obviously desirable that any alternative or additional treatment method bears only a minimum cost. Alternatively, such a study could also lead to new findings on the nature of the waste materials and subsequently suggesting some commercial values and applications.

Taking these factors into consideration, preliminary studies have been conducted on the possibility of utilizing easily available local materials, such as peat soil, as a filtering medium for a tertiary treatment of the recycled POME.

APPLICATION OF ALUM AS COAGULATING AGENT

The application of alum, was found most convenient and effective in removing the colloidal materials from the recycled wastewater. Previous studies (2) indicated that there is an optimum quantity of the added alum which correspond to the most rapid coagulation process and the settling down of the precipitate. It was also found that, temperature has a considerable effect on the minimum amount of alum required to

produce a maximum clarity (minimum turbidity) of the treated water. Table 1 indicates that a minimum dose of alum could be employed when the wastewater is heated up to 80°C.

Table 1 The minimum dose of alum needed to give a maximum clarity of the treated wastewater a different temperatures.

Temperature °C	Dose of alum mg/L
30	1804
50	1710
60	1520
70	1235
80	571

Since the process water is normally heated up to about 90°C prior to mixing with the crude palm oil, it should be possible, during the milling process, to employ a minimum amount of alum if the addition is made somewhere between the heating of the process water and the mixing with the crude oil. (Fig. 1)

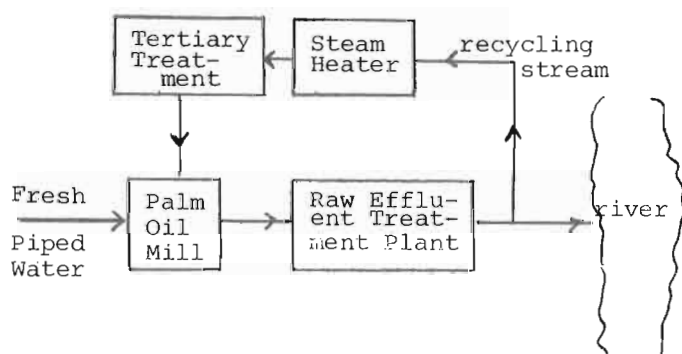


Fig. 1 : Suggested Process Flow Diagram for the Proposed Tertiary Treatment.

APPLICATION PEAT AS FILTERING MEDIUM FOR THE RECYCLED POME

A study was carried out with the aim of utilising a locally available material as a medium in the diltration system for improving further the quality of the recycled POME. In doing so, we have chosen peat soil, since it is abundantly available in various places throughout the country. The local peat was found to be a suitable filtering medium in removing heavy metals such as Cd^{2+} , Cu^{2+} , Ni^{2+} , Pb^{2+} and Zn^{2+} from aqueous solutions (4).

The use of alum was found to increase metal content (particularly aluminium) in the treated wastewater. In this preliminary investigation, a bench scale glass column was filled with a chemically modified peat and the aluminium content of the wastewater, was determined before and after passing through the column.

Table 2 Removal of Aluminium From The Wastewater After Treatment With Alum Using Peat Columns

	Fast Flow- rate	Slow Flow- rate
Flow rate (ml/min, cm ²)	50.9	1.0
Peat particle size (mm)	1.0	0.6 - 1.18
Peat quantity (gm)	10	4.0
[Al ³⁺] prior to peat treatment (mg/L)	92.6	0.101
[Al ³⁺] after peat treatment	85.2	0.015
Percentage of Al ³⁺ removed	3.8%	85.2%

[Al³⁺] = concentration of aluminium ion in wastewater

Table 2 indicates that the metal removal efficiency by a peat column is effected by flow rate. Considering the large quantities of wastewater generated in a palm oil mill, one would like to have a fast flow filtration system. Since it is known that metal uptake by peat soil is mainly through ion exchange process, it is obvious that a longer residence time would give a more complete exchange between the metal ions and the hydrogen ions of the peat active sites.

In the present study, the half time for Al³⁺ to attain equilibrium was found to be 3.0 min. as compared to 2.2, 3.1, 10.9, 11.5 and 18.8 min for Pb^{2+} , Cu^{2+} , Zn^{2+} and Ni^{2+} respectively (4).

COMPARISON BETWEEN PEAT AND ACTIVATED CARBON

As the application of peat to the palm oil effluent treatment is a rather new area, it is desirable to compare its potential as a filtration medium with that of commercial activated carbon. Table 3 represents a comparison on the total binding capacities of Al³⁺ from the wastewater by chemically treated peat and other types of activated carbon. It is apparent that peat soil, after some chemical modifications, is capable of absorbing aluminium from an aqueous solution

almost five times better than that of the commercially available activated carbon.

Table 3 Total Binding Capacity of Al^3 by Peat and Activated Carbon

Material	Binding Capacity mg/kg
Peat	144.4
Commercial activated carbon	41.6
Activated carbon derived from coconut shell	12.5

Results also show that peat has the capability to remove colouring materials from POME, but the capability is still much to be desired when compared to the capability of activated carbon.

CONCLUSION

This study has indicated that locally available peat soil is suitable as filtration medium for palm oil mill recycled wastewater treatment. It is apparent that a longer contact time between the peat and the wastewater is preferable in removing the aluminium content of the POME after alum addition. It is also apparent that chemically modified peat soil could be a better absorbance of metals from wastewaters as compared to that of the commercial activated carbons.

It is also established that the modified peat is capable of absorbing the coloured material from the wastewater. Under the present conditions, however, its absorbing capacity is apparently less than that of the commercial activated carbon.

REFERENCES:

1. Azman Firdaus Shafii, University-Industry R & D Collaboration - A Chemical Engineering Perspective, Proceeding of the Second Symposium of Malaysian Chemical Engineers. 24 - 25 June 1986, UKM Bangi, Selangor Darul Ehsan.
2. Adnan Ripin, Ramlan Abd. Aziz & Rahmalan Ahmad, Coagulation Characteristics of Treated Palm Oil Mill Effluent, Third Symposium of Malaysian Chemical Engineers, UTM, Jalan Gurney, Kuala Lumpur, 15 - 16 June, 1987.
3. Yong Yoke Choon and Chia Chok Sia, Treatment of Liquid Effluent in HMPB, Seminar: A Decade of Environmental Management in HMPB, Banting, Selangor 4 September, 1985.
4. Mohd Azraai Kassim and Rahmalan Ahmad, Removal of Heavy Metals From Wastewater by Using Locally Available Peat, Regional Symposium on Management of Industrial Wastes in Asia and the Pacific, 17 - 20 November, 1986, Kuala Lumpur.