ABSTRACT

Oleochemical industry in Malaysia has been diversifying significantly due to the availability of raw materials (palm oil) and the high demand for downstream products such as fatty acids, fatty alcohols and glycerine. The growth of oleochemical industries is further enhanced by fluctuations in petroleum price and regular animal diseases, which made tallow-based fats unreliable. Environmental awareness is growing rapidly in Malaysia. There is growing realization of the need to balance industrial and economic development with environmental preservation and protection, as well as, with efficient use of energy sources in order to achieve sustainable development. Extensive waste management studies were focused on palm oil mill and refinery effluents, but not on oleochemical industry. Towards meeting the increasingly stringent environmental requirements of industrial effluent controls, industries must carefully consider all available options for effluent treatment, as well as, process improvements to reduce waste generation and cleaner technologies options.

This research describes an investigation carried out on waste management in an oleochemical industry, Palm-Oleo Sdn. Bhd. The study was classified into: a) waste audit, b) waste characterization and c) cleaner technology (waste minimization) options. Palm-Oleo Sdn. Bhd. is located at a water catchment area and it has to satisfy a more stringent effluent discharge limits, as specified in Standard A, Environmental Quality Act, 1974. Among the wastes evaluated were spent bleaching earth, filter cake, spent

nickel catalyst, glycerine pitch, residue fatty acid, biological sludge and process wastewater.

Waste audit results revealed that 2.23 tonnes of spent bleaching earth, 0.78 tonnes of filter cake, 14.23 tonnes of residue fatty acid, 1.25 tonnes of spent activated carbon, 0.62 tonnes of biological sludge and 0.49 tonnes of glycerine pitch were generated daily. Spent nickel catalyst is the only hazardous waste, which was generated at an average rate of 0.17 tonnes a day. The average wastewater flow generated from the processing plants was $9.28m^3/h$. The total amount of process waste generated daily in Palm-Oleo was around 20 tonnes, while processing about 364 tonnes of oil.

Due to this high quantity of waste generation, options on waste minimization possibilities were investigated. Waste characterizations were studied prior carrying out the experiments on waste minimization. The moisture content of spent bleaching earth, filter cake and biological sludge were 0.88%, 4.80% and 4.84%, respectively. Total Organic Carbon (TOC) of spent bleaching earth was higher (63.8%) than the filter cake (48.4%) and biological sludge (14.6%). The trace metals concentration in the spent earth, filter cake, biological sludge and treated wastewater effluent were within DOE's Standard A limit, which permits these wastes to be disposed at a sanitary landfill.

The loss of glycerine as moisture in the filter cake was estimated to result a production loss of RM16,330 while the loss of glycerine as a residual matter (pitch) caused a loss of RM484,575 a year. Waste minimization investigations revealed that by recycling spent nickel catalyst generated in the fatty acid hydrogenation process, an annual saving of RM924,000 can be achieved. Furthermore, the quantity of hazardous waste (spent nickel

catalyst) that need to be handled and disposed are reduced. Reduction in liability and cost of transportation for spent nickel catalyst waste off-site can also be achieved. Another investigation on cleaner technology option was carried out by extracting retained oil from the spent bleaching earth generated in the crude oil pretreatment process. Oil was extracted by liquid-liquid extraction method using hexane as the solvent. The ratios of spent earth weight to volume of hexane were varied from 1:1 to 1:2, 1:3, 1:4 and 1:5. The 1:3 ratio was found to be the optimum combination, which extracted nearly 24% of oil, while thirty minutes was the optimum contact time of spent earth and hexane for maximum oil recovery. An estimated saving of RM60,960 per year can be achieved through this oil recovery practice. Besides hexane, further research need to be carried out to substitute it with cheaper solvents or waste solvents from other industries.