CHAPTER 1

INTRODUCTION

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1.1 Background Information on Palm-Oleo Sdn. Bhd.

Palm-Oleo Sdn.Bhd was incorporated in 1989 as a joint venture company between two established public-listed companies, Kuala Lumpur Kepong Sdn.Bhd., Malaysia and Mitsui from Japan. The concept was to take advantage of Malaysia's primary industrial (palm-oil) output and to formulate more down stream activities, such as oleo chemicals (fatty acid and glycerine) against a backdrop of increasing world requirements for natural oleochemical.

The plant was designed with an annual capacity of 45,000 tonnes and production commenced in July 1992. The Prime Minister of Malaysia, Yang Berhormat Dato' Seri Dr. Mahathir Mohammad graced the opening ceremony in 1994. Since then, Palm-Oleo's standing has grown in the market to achieve international standing in terms of product requirement and resourcefulness. Another success was in the achievement of ISO 9002, in 1996, which has put Palm-Oleo on the world map. In 1997, Palm-Oleo expanded its plant's annual production capacity to 120,000 tonnes. With the strength of its parent company, Kuala Lumpur Kepong Berhad (total area under cultivation is about 250,000 acres) which energizes in Palm-Oleo's generation, technical resources of Japanese partners (200 years of oleochemical experience), utilizing the latest tools of the industry, such as Online Statistical Process and Quality Control Systems (SPQC), Distributed Control System and advanced laboratory equipments, it is possible to achieve and exceed

customer requirement. The technical expertise from the Japanese partners extend not only in production techniques but also in wastewater management and pollution control.

1.2 Environmental Requirements

In recent years, there has been a growing consciousness of the need to protect our environment from degradation caused by development and industrialisation. This has resulted in a number of environmental policies being drawn up and more stringent governmental regulations being imposed. However, the solution to strike a balance between development, industrialisation and environmental concerns lies in the hands of the people involved directly or indirectly with the growing industries. "Sustainable Development" refers to the development and marketing of compatible products with minimum use of non-renewable resources. Industries can achieve this by intelligently applying the pollution prevention concept with life cycle analysis and assessment approach in the product design (Thomas, 1995). Throughout the world, industries have been undergoing a learning process in accepting the need for industrial waste management, wastewater management and the necessity for optimising waste management (Joseph *et.al.*, 1975).

In the past, it has been common practice for industries to utilise the cheapest treatment and disposal facilities, which sometimes tend to compromise the effluent quality. Even in cases where licenses were obtained, often no real attempts were made to satisfy the

requirements due to lack of monitoring and inadequate enforcement policies. For proper industrial effluent management to be achieved, there is an obligation, not by the authorities to ensure that effluent standards are satisfied, but the onus should be on the industry to ensure their effluent complies with the standards set by the regulating authorities. In many cases good effluent management has other positive benefits to the industry concerned. Reduced water usage by preventing wastage and recycling and product recovery can substantially reduce operating costs.

In Malaysia, the legislative basis for the environmental control of waste discharge is the Environmental Quality Act of 1974, and Regulations issued under that Act. The enforcement authority designated by the Act is the Director General of Environmental Quality. Some of the Regulations published under this Act are Environmental Quality (Clean Air) Regulations 1978 and Environmental Quality (Sewage and Industrial Effluents) Regulations 1979. More recently, with the increased awareness of the dangers of toxic wastes, the EQA now also includes regulations to ensure that such hazardous wastes are carefully managed from their disposal point (cradle to grave approach).

In addition to this, under the Environmental Impact Assessment Order of 1987, specific categories of activities, which are likely to have significant impacts on the environment, are required to conduct an assessment of the probable effects of the proposed development on its surroundings and to identify mitigating measures (Madhev, 1991).

1.3 Development of Oleochemical Industry

Malaysia has planned to become a fully industrialized country by the year 2020, primarily on exploitation of its rich natural resources such as timber, petroleum and minerals. Palm oil industry plays an important role in developing our country and currently it contributes nearly 13% of our foreign exchange (PORLA, 1999). Oleochemical industry has been one of the catalyst in the development of palm oil sector. The term oleochemical covers a very large group of compounds. Basically, oleochemicals are the chemical substances, which are produced from oils and fats. These oils and fats are obtained either from plants (soya bean, coconut oil, rape seed, etc) or animals (tallow). The principal and traditional raw materials used for the production of oleochemical were tallow and coconut oil. Palm oil and palm kernel oil represent good substitution. The oleochemical derived from oils and fats can be divided into two categories. The chemicals, which can be obtained by carrying out unit operations on oils and fats are called 'basic oleochemicals.' Other chemicals which are produced by derivative operations on oils and fats or basic oleochemicals are known as 'oleochemical derivatives' (Narula, 1995).

These oleochemicals have a wide range of applications such as surfactants, cosmetics and toiletries, pharmaceuticals and other industrial chemicals (Yoshiteru,1985). The total world production of basic oleochemicals in 1999 is 5.76 million tonnes (Ooi, 2000), with fatty acids (3.05 million tonnes), methyl esters (0.66 million tonnes), natural fatty alcohols (1.44 million tonnes), fatty amines (0.57 million tones) and natural glycerine

(0.75 million tonnes). It is estimated that world oleochemicals production will increase to 7.5 million tonnes in 2010. Most of the growth is expected to originate from Asean region. Of the total 7.5 million tonnes, Asean countries are to contribute around 3.5 million tonnes (Ooi, 2000). The advantage of the oleochemical is that their origin is from renewable, non-depleting, natural raw materials and their biodegradability is much faster, and therefore, they are more environmental friendly. The major competition for oleochemicals are the petrochemical based products. Gradually, the petroleum resources are diminishing, and the world has come to realise the importance of natural renewable oils and fats as one of the alternative source. As the petroleum resources diminish, various chemical manufactures will have to shift to renewable feedstocks (Narula, 1995). Therefore, in the long run, oleochemicals will be the winners (Yusof *et.al.*,1996). Their eco-friendly nature is another advantage.

There are two major questions in the oleochemical business related to economic viability:

i. source of raw materials, and

ii. types of chemicals to manufacture.

Natural oils and fats due to regular price fluctuation pattern, now compete successfully with petrochemicals as potential raw materials for the chemical industry. However, there are two limitations for oleochemical oils and fats as chemical feedstocks (Langstaraat, 1997):

i. predominance of unsaturated fatty acid (C16-C22) with the absence of saturated (C8-C14) acids, and

ii. fatty acid mixtures usually require difficult separation processes.

1.4 Objectives

The new oleochemical capacity may seem more than adequate today, but it may prove to be insufficient in the near future. Due to the similarity of their fatty acid composition to those of tallow and coconut oil, palm oil and palm kernel oil can replace these two oils for the production of fatty acids (Brown, 1979). The oleochemical industry is well developed in Europe, USA, Canada and Japan whereas the Malaysian oleochemical industry only started in the early 1980's. During that period the production process was very simple, such as, converting palm and palm kernel oil into fatty acid and glycerine. Towards the 90's the industry went into further downstream processing of oleochemical. This resulted in other additional products such as soap noodles, esters, fatty alcohols, oleic acid etc. Fatty acids are used for production of candles, cosmetic products, soaps, detergents, lubricants, epoxy resins and others. Glycerine is used for manufacturing of pharmaceutical products, coating resins and ester (Ahmad and Mohammad, 1993).

The waste generated becomes much more complex as the oleochemical industry steps further downstream. Some of the waste types produced in oleochemical industry are filter cake, biological sludge, steam condensate, spent nickel, glycerine pitch fatty acids residue, wastewater and flue gas.

The Malaysian government has identified the oleochemical sector as a priority industry and has provided numerous tax incentives to promote its development. The increasing international demand on oleochemical products, will definitely result in the construction of new or expansion of existing oleochemical plants in Malaysia. Waste disposal is

always a problem in any industry. Currently there are 15 oleochemical plants in Malaysia. Most of these companies are involved in the production of basic oleochemicals such as fatty acids, fatty alcohols and glycerine. More studies need to be carried out with the cooperation of Malaysian Palm Oil Board (MPOB) in order to prevent or minimize the environmental pollution caused by the oleochemical industry. Since earlier research on oil palm related waste had been focused on palm-oil mills and refinery, there is an urgent need to carry out investigation on waste management in oleochemical industry. This investigation should focus on cleaner production including waste prevention at source, waste minimization through process or equipment modification and possibility of waste recycling. Palm-Oleo Sdn. Bhd. located at Kundang, Rawang was selected for this waste management study.

Production of oleochemical is fast becoming a green and clean industrial activity. As far as the processes are concerned, development work is underway:

i. to reduce odour,

ii. to recycle secondary raw materials,

iii. to reduce waste generation, and

iv. to minimize releases to surface waters by an organic waste recovery or waste treatment programme.

Nickel-containing distillation residues and spent nickel catalysts are still areas of concern to the oleochemical industry, though intensive catalyst research and modification in the hydrogenation process have led to a better catalyst usage and minimised the nickel

content in the distillation residues and reduced the amount of spent catalyst. However, nickel catalyst disposal is still a problem.

The objectives of this research are to:

i. Carry out waste audit in Palm-Oleo Sdn. Bhd. to identify the type of waste and source of generation,

ii. Characterize the oleochemical plant's waste by analyzing their physical, chemical and biodegradable properties, and

iii. Investigate waste minimization options and cleaner technology in the oleochemical plant by:

   (i) Investigating the recycling options for spent nickel catalyst generated in the fatty acid hydrogenation plant, and

   (ii) Studying the possibilities of oil recovery from spent bleaching earth, which is generated in the oil pretreatment plant.