CHAPTER 1 INTRODUCTION

1.1 GENERAL

Industrial processes of all types almost invariably are accompanied by the generation of wastes. Wastes generated may be due to operating factors, design factors, off-specification products, unusable by-products or expired raw materials. Apart from creating potential environmental problems, these wastes represent losses from the production process of raw materials and energy, incur significant disposal costs and necessitate investment in pollution control facilities.

The typical waste management strategies are more focused on pollution control - waste removal, treatment and disposal - added on to the end of the manufacturing processes. Indeed, the wastes are not eliminated but merely transferred from one medium to another medium. As an example, air pollution control equipment prevents or reduces the discharge of air pollutant into the air but at the same time produces a solid waste problem. Thus, such approach merely provides short-term solutions to an ever increasing problem.

Realizing the drawbacks and the inadequacy of these "end-of-the-pipe" or "top-of-the-stack" approach, a more direct and effective way of dealing with industrial wastes can be achieved by preventing/stop it from being created in the first place and/or minimizing the waste being generated.

Although it is almost impossible to achieve zero waste discharge, wastes can be minimized to a practicable and sensible extent through re-engineering the design of industrial processes and increasing process efficiencies. Therefore, an anticipative preventive approach is essential in industrial process design.

In light of the escalating waste management costs, increased liability costs and more stringent environmental regulations, many industrialized nations are gradually adopting waste prevention and waste minimization by practicing source reduction, reuse, recycle or recovery. In fact, it is now recognized as an essential component of total quality management (Isbell, 1991; Alm, 1992).

Malaysia's Scenario

In the 80s, the industrial progress of our nation primarily focused on accumulation of investment capital and acquisition of basic manufacturing technologies from foreign countries. In the 1990s, the nation's economic activities tend to focus on acquiring advanced technologies. As we move towards achieving an industrialized nation status, there is a need to enhance competitiveness by restructuring and upgrading the levels of industries. Thus it is imperative to incorporate industrial waste prevention programs concurrently with the progress of industrial development in our nation. Reducing wastes to remain competitive has been an important ingredient for successful business in the past and it will be absolutely essential in the future.

The use of cleaner production technology or waste minimization is gaining more attention and acceptance, however there isn't any large scale implementation effort or structured waste minimization program promulgated by Malaysia Department of Environment (DOE) (Argonne National Laboratory & the East-west Center, 1994). Generally, multinational corporations (MNCs), such as Motorola, Hitachi, Nestle and Texas Instrument are more willing to incorporate the cleaner production technology in their operation; on the other hand, small and medium scale industries (SMIs) are still reluctant to invest in this area (NST, 5 Nov 1997).

Knowing the benefits of incorporating waste minimization in their daily operation, Don Brake (M) Sdn. Bhd., an automobile brake lining manufacturing facility (a SMI) is planning to move in this direction. This project focuses exclusively on the waste minimization program and how it will form an integral part of the company's waste management program.

1.2 OVERVIEW OF DON BRAKE (M) SDN. BHD

Don Brake was first established in the 19th century in the United Kingdom. However Don Brake Malaysia was established in 1973, originated from a joint venture between Eastern Agencies and Don International (UK), a subsidiary of BBA Group PLC. (Mintex - Don). It operates with a RM10 million capital on a 3.2 acre manufacturing plant in Shah Alam, near Kuala Lumpur. In June 1991, BBA Group PLC formed a joint venture between its Asia-Pacific operation - Pacific BBA (Australia) and Allied Signal (USA).

Don Brake (M) Sdn Bhd is a small-medium industry with total workforce of about 200, among them, 85% are operational workers. The plant is involved in the upstream and downstream production - from mixing and molding to final output of friction materials for automobiles, buses and trucks. Their products include brake linings, clutch facings, metallic and asbestos disc pads and brake shoes. Don Brake has been recognized as one of the first and foremost brake pads and brake linings supplier for both original equipment (OE) and after market (AM) in Malaysia's automobile market. The production volume of various types of friction materials from the year 1993 to 1997 is presented in Table 1.1.

Table 1.1 Production volume of various friction materials in Don Brake (M) Sdn. Bhd.

Year	Brake Lining (pcs)	Brake Lining (sets)	Disc pads (pcs)	Bonded Shoes (pcs)	Shoes Lining (pcs)
1993	362,438	76,121	1,806,392	191,612	208,001
1994	362,251	81,953	2,140,902	250,236	258,834
1995	470,501	110,741	2,865,266	235,664	245,486
1996	514,669	86,639	3,533,138	209,420	209,039
1997	474,792	65,270	3,768,332	201,298	132,639

Source: Don Brake (M) Sdn. Bhd.

The Figure 1.1 illustrates the annual revenue of Don Brake Sdn. Bhd. from 1993 to 1997. In 1997, the annual production of brake lining itself was about 1/2 million pieces which generated a revenue of about RM24 million.

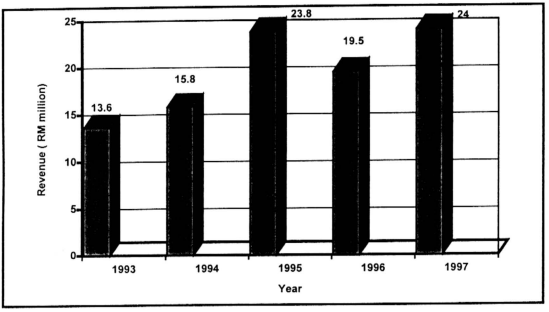

Figure 1.1 Annual revenue for Don Brake (M) Sdn. Bhd. from 1993 to 1997
Source: Don Brake (M) Sdn. Bhd.

The waste generated, namely brake lining dust, is generated during the manufacturing of brake linings (Refer to Figure 1.2). These brake lining dust constitutes 60% of the total waste generated in the facility, which is approximately 583 metric tons per year. Under the current waste management practice, the lining dust is packed in double layered high-density polyethylene (HPDE) plastic bags and placed into 200 liter metal drums. These drums are then sealed and labeled, and taken off-site to Bukit Nanas Integrated Waste Management Center for disposal. The annual disposal cost is about RM283,000, which is one of the major annual expenses of the facility.

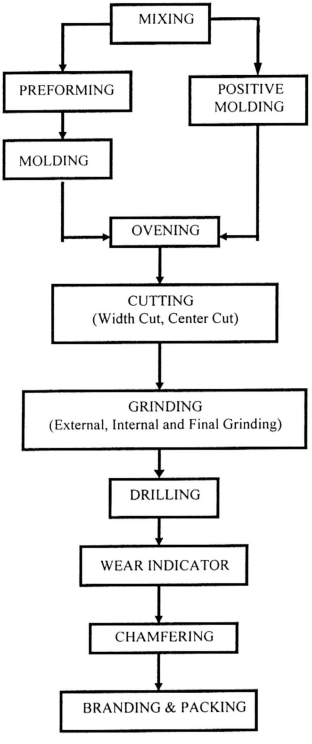

Figure 1.2 Flow chart for the manufacturing process of brake lining

Process Description of Manufacturing of Brake Lining

In the production of brake lining, the various operations involved are wholly physical. A schematic of the manufacturing process of brake lining is presented in Figure 1.2.

Process Description:

1. **Mixing**: The raw materials are mixed mechanically in the mixing vessel. Each batch of mixing needs 30 - 40 minutes. After mixing, the discharged material was placed in a cubic metal drum of capacity 100kg/drum.

2. **Preforming**: The preformed molds are operated at low pressure at room temperature, thus the compactness ratio is lower for the "cake" formed.

3. **Molding**: The molding machine has a 600 tonne press and the process was done at high temperature of 240°C, for 20 - 30 minutes. The molded material appears in billet form with different curvature for different quality of brake lining.

4. **Positive Molding**: This process involves a 400 tonne press. The molded materials are in smaller pieces with the wear indicator incorporated. (Typical condition: temperature: 150°C, cure time: 8 - 16 minutes, thickness: 10-23 mm).

5. **Ovening**: The molded material was placed in the oven for complete curing, for 10 - 12 hours at 200°C.

6. **Cutting**: The billet was then cut into smaller pieces, which are called segments and finally cut into block. Dimension precision is the main concern in this step.

7. **Grinding**: This process is to remove the glossy outer layer and to provide a rougher surface for strong bonding onto brake shoes. External, internal and final grinding are used for different types of products.

8. **Drilling**: Small holes are drilled on the outer surface of the brake lining; the number of holes depend on references required.

9. **Chamfering**: To cut-off the sharp edges for the purpose of better fitting and to reduce noise level during vibration.

10. **Branding & Packing**: The brake linings are packed after branding.

1.3 RELATED REGULATIONS

Asbestos has been classified as hazardous material in many countries and has been banned in most products. In the Malaysian context, asbestos waste is regulated under the Environmental Quality Act (EQA), Environmental Quality (Scheduled wastes) Regulations, 1989, first schedule, part II, section 16, which requires special handling and treatment to render innocuous prior to disposal at prescribed premises (EQA, 1974).

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However, the DOE does not consider the waste from the friction material plant of the Don Brake (M) Sdn. Bhd. as hazardous. On the other hand, the DOE has expressed that they are not in favor of disposal of the untreated waste materials at the municipal landfills either. Due to this reason, Don Brake is seeking ways to pre-treat their waste prior to land disposal.

1.4 PROJECT SUMMARY

Basically the project was carried out in two stages:

First stage of the project (waste audit and investigation of reuse/recycle possibilities of the brake lining dust) was carried out in the plant which took about 15 weeks. The second stage of the project (developing treatment and disposal options through solidification/stabilization of the brake lining dust) was carried out in the laboratory at the Institute of Postgraduate Studies and Research, University of Malaya.

The various aspects of this project is summarized in Figure 1.3.

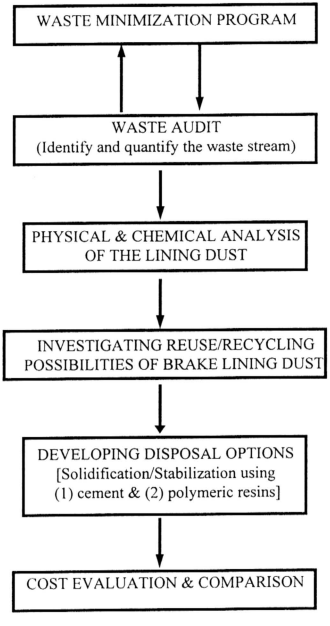

Figure 1.3 Flow diagram of Waste Minimization Program and Disposal Options

1.5. OBJECTIVES

The specific objectives of the project are as follows:

1. To identify and to quantify the potential and unavoidable waste streams from the brake lining production process.

2. To investigate the reuse/recycling possibilities of the lining dust.

3. To study solidification/stabilization of the lining dust as an ultimate treatment and disposal option, using both cement and various polymeric resins.

4. To estimate the costs associated with each of these disposal options and to compare them with the existing waste disposal options and costs.