

CHAPTER ONE: INTRODUCTION

1.1 General

The rubber products manufacturing industry in Malaysia has expanded rapidly in recent years. In 1995 for example, the total output of the rubber products in Malaysia was about RM 4.4 billion, i.e. about 22% higher than the previous year (Ministry of Finance, Malaysia, 1996). The rubber products manufactured in Malaysia include various latex products, tyres and tubes, industrial and general rubber goods and footwear (*Table 1*).

Export of rubber products was valued at RM 3.8 billion in 1995, an increase of about 15% compared to RM 3.3 billion in 1994. The latex products which comprise of medical gloves (surgical and examination), industrial and household gloves, latex threads, condoms, catheters and foam bedding continued to remain the major contributors to export earnings, with total export amounting to RM 3.1 billion (Ministry of International Trade and Industry, Malaysia, 1996). The increase in the export of these items was due to the ability of the Malaysian rubber products manufacturers to continue expanding their share in international

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Table 1. Natural Rubber Consumption by Product Sector in Malaysia in 1995 (Malaysian Rubber Research and Development Board, 1996)

Product	Total Consumption (Tonnes)
Latex products	219,046
Tyres and tubes	50,554
Industrial rubber goods	35,568
General rubber goods	43,201
Footwear	5,526
Total	351,895

markets. Malaysia is now the largest producer and exporter of gloves, catheters and rubber thread.

The expansion of the rubber products manufacturing industry in Malaysia has not only contributed to the high economic growth of the country but also has caused a serious environmental problem due to discharge of large quantities of wastewater from this industry. The Department of Environment (DOE) of Malaysia is very much concerned of this problem and has taken various steps to control the pollution from this industry. Among the various rubber products, rubber thread manufacturing factories are considered to contribute the most to the

environmental pollution. This is because the wastewater from this type of factories contains high levels of pollutants such as carbonaceous organics, expressed in terms of chemical oxygen demand (COD) and biochemical oxygen demand (BOD) and also zinc. Furthermore, the amount of pollutants was reported to be the highest in this wastewater compared with wastewater from factories producing other products (Zaid, 1992b).

1.2 Manufacture of Rubber Thread

The rubber thread is manufactured by an extrusion process (*Figure 1*). The outline of the process is as follows:

i) Latex compounding

The matured and deaerated compounded latex flows through a pressure regulator or a constant head device to the manifold.

ii) Coagulant bath

From the manifold the compounded latex passes through the spinnerets into a coagulant bath. The latex filaments gel rapidly upon contact with the coagulant. Acetic acid is normally used as a coagulant.

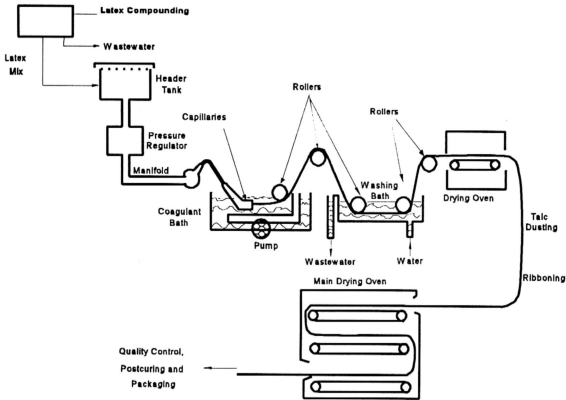


Figure 1. Schematic Diagram of Rubber Thread Manufacture

iii) *Washing bath*

The gelled filaments are pulled along and subsequently withdrawn from the coagulant bath by a set of stainless-steel rollers. They then pass through the washing bath in which water is used to wash the products.

iv) *Drying*

From the washing bath, the products are pulled along by the stainless steel rollers into the drying and vulcanization ovens.

v) *Dusting*

After emerging from the ovens, the products are treated with detackifying agents in order to prevent them from sticking to each other.

vi) *Inspection and packaging*

After the dusting stage, the products are inspected and wound into bobbins in the case of individual threads or packaged if in the form of ribbons.

As shown in *Figure 1*, basically there are two main sources of wastewater from the rubber thread manufacturing factories. These sources are:

i) *Latex compounding*

The wastewater from this stage consists of wash water, uncoagulated latex and sludge. It is normally discharged batch wise i.e. during the cleaning of latex compounding and storage tanks.

ii) *Leaching/Washing*

This is the main source of wastewater from the manufacturing of rubber thread. It contains the pollutants that leach-out during washing. The wastewater is discharged continuously during the manufacturing process.

1.3 Regulatory Standards

The regulatory standards for wastewater from the rubber products manufacturing industry are shown in *Table 2*. There are two sets of standards applicable to these wastewater, namely the Standard A for factories located at the upstream of a water supply intake and the Standard B for factories located at the downstream of a water supply intake.

Table 2. Regulatory Standards for Wastewater from Rubber Products
Manufacturing Industry

Parameter	Unit	Standard A	Standard B
Temperature	°C	40	40
PH	-	6.0 – 9.0	5.5 - 9.0
BOD ₅ (5days, 20 °C)	mg/L	20	50
COD	"	50	100
Suspended solids	"	50	100
Mercury	"	0.005	0.05
Cadmium	"	0.01	0.02
Chromium, hexavalent	"	0.05	0.05
Arsenic	"	0.05	0.10
Cyanide	"	0.05	0.10
Lead	"	0.1	0.5
Chromium, trivalent	"	0.2	1.0
Copper	"	0.2	1.0
Manganese	"	0.2	1.0
Nickel	"	0.2	1.0
Tin	"	0.2	1.0
Zinc	"	1.0	1.0
Boron	"	1.0	4.0
Iron	"	1.0	5.0
Phenol	"	0.001	1.0
Free chlorine	"	1.0	2.0
Sulphide	"	0.5	0.5
Oil and grease	"	Undetected	10.0

Note :

- Standard A : Upstream of a water supply intake
- Standard B : Downstream of a water supply intake

1.4 Scope and Objectives of the Present Study

- i) To study the characteristics of wastewater from rubber thread manufacturing industry.
- ii) To study the use of chemical precipitant/flocculant in removing zinc from rubber thread manufacturing industry wastewater.
- iii) To study the start-up performance of an up-flow anaerobic filter in treating the rubber thread manufacturing industry wastewater.
- iv) To study the influence of different parameters on the performance of an up-flow anaerobic filter in removing pollutants from rubber thread manufacturing industry wastewater.
- v) To study the importance of attached versus suspended biomass growth in an upflow anaerobic filter.