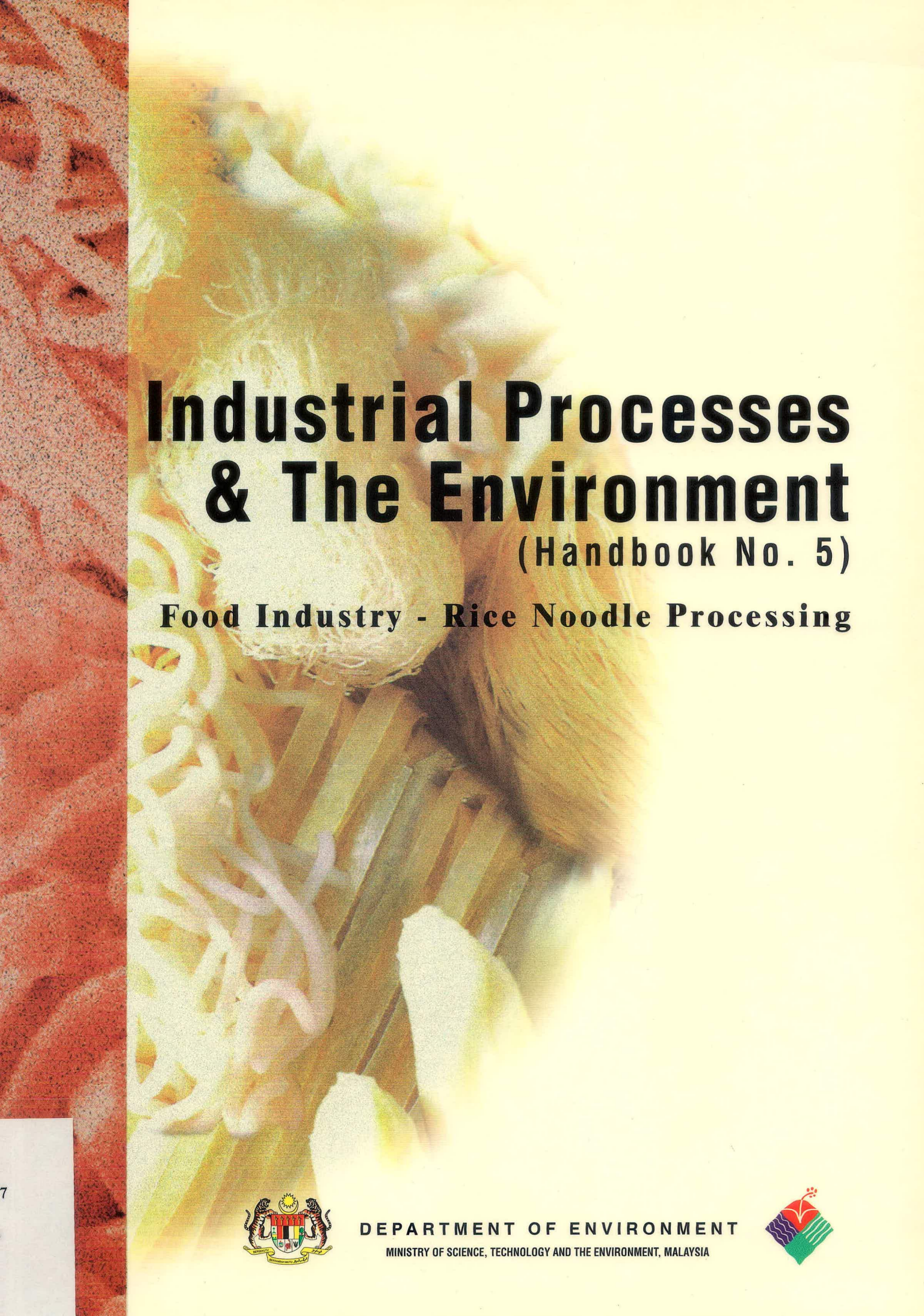

Industrial Processes & The Environment

(Handbook No. 5)

Food Industry - Rice Noodle Processing

DEPARTMENT OF ENVIRONMENT
MINISTRY OF SCIENCE, TECHNOLOGY AND THE ENVIRONMENT, MALAYSIA

Industrial Processes & The Environment (Handbook No.5)

Food Industry -

Rice Noodle Processing

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FOREWORD

There is present global recognition that environmental protection demands need not impede industrial growth and expansion, and on the contrary can assure increased business competitiveness; this certainly holds true for industries that adopt the more sensible approach of efficient resource use based on cleaner production technologies. Thus, end-of-pipe solutions should rightfully be left to the last resort. In order for environmental agencies and authorities to be in a position to catalyse industry-adoption of cleaner technologies they have had to initially expand their knowledge-base and keep abreast of the rapid current developments taking place in the field of cleaner industrial production.

The Department of Environment (DOE), in also recognising this need, embarked on the preparation of a series of industry-specific environmental management handbooks within its on-going capacity-building project with support from the Danish Cooperation for Environment and Development (Danced). These handbooks aim at providing DOE Officers with adequate technical knowledge of specific industrial processes and pollution control technologies that would enable them to steer industry towards adoption of more efficient waste management and cleaner production technologies. As an integral part of this effort, the DOE is implementing dialogue/consultation sessions with various groups of individual enterprises. This stems from the realisation that the act of policing should not be the only means to enforce the Environmental Quality Act, 1974, rather it should go hand in hand with a process of consultation with the industries to bring about the desired level of regulatory compliance.

This Handbook on Industrial Processes & The Environment: Food Industry – Rice Noodle Processing is the fifth handbook in the series of publications. In the course of preparation, extensive discussions have been held with appropriate industry representatives to ensure that the technical information and suggestions presented in the Handbook are both current and of practical value. Through this effort, it is my sincere hope that the future compliance-monitoring activities of the DOE with respect to the food (noodle) industry will be more efficiently performed. It is also our desire that the technical contents will prove beneficial to food (noodles) producers in their endeavour to comply with the environmental regulations and standards through more cost-efficient means.

Hjh. Rosnani Ibarahim

Director General of the Environment, Malaysia.

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GLOSSARY

The following are definitions of the common terms used in this Handbook.

BOD	:	Biological Oxygen Demand. It measures the quantity of dissolved oxygen consumed by micro-organisms as a result of the breakdown of biodegradable constituents in wastewater
COD	:	Chemical Oxygen Demand. It also measures the quantity of dissolved oxygen consumed in the overall oxidation of wastewater. It gives a better indication of the long term effect than BOD
EIA	:	Environmental Impact Assessment
EQA	:	Environmental Quality Act 1974
FMM	:	Federation of Malaysian Manufacturers
O&G	:	Oil & Grease
Packaging	:	Packaging refers to containment in primary containers
Packing	:	Packing refers to containment in secondary containers such as boxes, cartons
TDS	:	Total dissolved solids
TSS	:	Total suspended solids
WWTP	:	Wastewater treatment plant

1.0 ABOUT THIS HANDBOOK

Enforcement of the Environmental Quality Act and subsidiary regulations is a core issue for DOE. Consequently, there is a continuous need to strengthen and improve the enforcement effectiveness by DOE officers.

With better understanding of the production processes and waste-generating potential of the different types of factories, the enforcement officers would be able to perform their duties more effectively.

1.1 DEVELOPMENT OF ENFORCEMENT TOOLS

As part of the capacity building exercise, the first enforcement tool to be developed was the **Manual on Practical Enforcement**. Following this, other handbooks such as the above are currently being developed to assist the DOE inspection officers in their enforcement activities. At present the following specific industries have been selected to be covered by such handbooks:

- Metal finishing, focusing on electroplating
- Primary rubber industry
- Palm oil industry
- Food industry, focusing on rice noodles
- Textile industry

These industry-specific handbooks serve as a supplement to the **Manual on Practical Enforcement**. While the **Manual on Practical Enforcement** gives general advice on how to prepare, perform and follow-up on-site inspections, the **Industry-specific Handbooks** provide technical information on the production process, the common environmental problems and viable technical solutions.

Further, as complement to the manuals and handbooks, teaching materials have also been developed to conduct training courses in relevant areas such as:

- Stack sampling
- Illegal dumping
- Open burning
- Scheduled waste management
- Environmental impact assessment

1.2 OBJECTIVES OF THE HANDBOOK

This Handbook is meant for the DOE enforcement officers. The objective of the Handbook is to:

- Provide basic information on rice noodle processing and related environmental issues
- Assist the enforcement officers to :
  - Conduct on-site inspections effectively
  - Identify general cleaner production opportunities
  - Promote better environmental performance

However, the Handbook can also serve as a tool to improve the dissemination flow of information from DOE to the owners and operators of the rice noodle sector. In this way, the information sharing strives to :

- Increase the awareness of environmental issues and potential impacts
- Change the attitude towards better housekeeping practices
- Instill the realisation that water conservation and wastewater management are an integral part of the production process
- Act as a catalyst to the industry for ideas to incorporate cleaner production into its processing operations (and so be able to cope with global competition)

1.3 STRUCTURE AND CONTENTS OF THE HANDBOOK

The handbook

- is specific to rice noodle processing and
- also covers some aspects common to all sectors of the food industry

There are 9 sections in the handbook. Each section describes a certain area of rice noodle processing as follows:

Section 1 outlines and defines the scope of the guidance handbook

Section 2 presents the profile of the rice noodle processing in Malaysia

Section 3 gives the details of the rice noodle processing

Section 4 describes the various environmental issues in the rice noodle sector

Section 5 deals with the regulatory framework

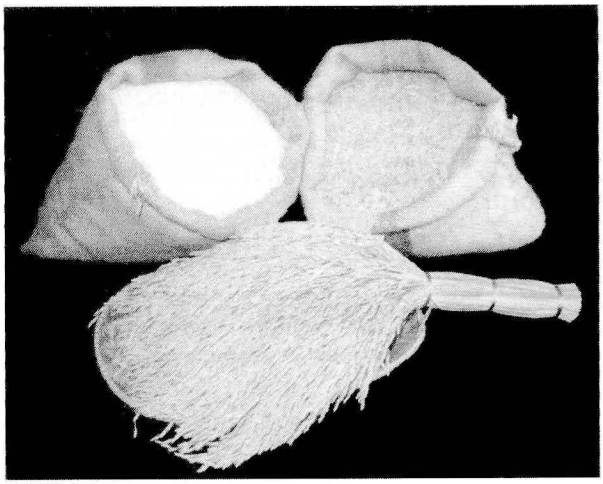
Section 6 highlights the generic pollution prevention and control measures

Section 7 shows the example of cleaner production implementation

Section 8 focuses on site inspection

Section 9 indicates the sources of references used in this handbook

As a matter of added interest, an attachment (Annex F) is included at the end of this Handbook to provide a glimpse into the Food Processing Industry in general.



Rice: primary raw material for rice noodle

2.0 RICE NOODLE MANUFACTURING - AN OVERVIEW

The profile covers the

- current situation
- characteristics of rice noodle sector
- rice noodle sector issues

2.1 CURRENT SITUATION

From literature search, data available is predominantly related to the first 12 categories of the food industry. (See Annex F - Glimpse Into Food Industry). On the other hand, data relating to the 13th category - which is ***Other Food Products Not Classified Under the first 12th Categories*** and to which Rice Noodles belong - are very scarce. Nonetheless, the ***Other Food Products category*** in Malaysia on record consists of 24 establishments (documented in the Monthly Manufacturing Statistics June 1999 issued by the Department of Statistics Malaysia). As such, the number of rice noodle factories would be less than 24.

In the overall food processing industry, including the noodle manufacturers, the dominant pollution is the discharge of effluents. According to data in DOE Annual Report 1997, the food industry does not contribute significantly to air pollution. The food processing industry

- has a high compliance rate with the Clean Air Regulations 1978 :
  - 97% in 1997 (DOE 1997 Annual Report)
  - 92% in 1998 (DOE 1998 Annual Report)
- has a low compliance rate with the Industrial Effluent Regulations 1979 :
  - 70% in 1997 (DOE 1997 Annual Report)
  - 72% in 1998 (DOE 1998 Annual Report)
- is generally poor in the methods of waste disposal (Proposed Strategic Framework for Malaysian Small and Medium-Scale Industrial Pollution Control Management, May 1999)
- encountered 17 water pollution complaints in 1997 (DOE 1997 Annual Report) and 30 water pollution complaints in 1998 respectively (DOE 1998 Annual Report)

2.2 CHARACTERISTICS OF RICE NOODLE SECTOR

In general, rice noodle processing

- is a major user of water
- is reasonably energy (electricity and heat) intensive
- requires some type of steam production for cooking
- needs a packing system to contain the processed rice noodles for dispatch
- has the potential of recovering spillages etc for use as animal feed, fertilizer etc
- generates wastes which are non-hazardous
- results in wastewater streams with high BOD and often high solids
- calls for an effluent treatment plant to treat the wastewater

Since the rice noodles are for consumption:

- the input raw materials used are non-hazardous
- any collection of semi-processed products for recycling into the process is done hygienically

2.3 RICE NOODLE SECTOR ISSUES

Like many industries, the rice noodle sector has cited various constraints standing in the way of implementing effective pollution control. These constraints include:

- space limitation
- costly affair
- lack of awareness and knowledge of available technologies
- inadequate waste management skills

However it is more likely that the principal reasons for the poor pollution control are:

- resistance to change
- poor house-keeping practices
- inadequate process control or lack of process optimization

- use of faulty or old equipment
- weak maintenance of process plants
- failure to install treatment plants

3.0 RICE NOODLE MANUFACTURING PROCESS

3.1 INTRODUCTION

To begin with, there are mainly two types of noodle processing in Malaysia:

- one using rice to produce rice noodles (vermicelli or bee hoon) and kway teow
- the other using wheat to produce instant noodles

Understandably, there are slight process variations in the manufacturing of each of these products. The following description only focuses on rice noodle processing.

3.2 MATERIAL INPUTS AND OUTPUTS

The inputs and outputs of rice noodle processing are as shown in Table 1 below:

Table 1 : Inputs and Outputs of Rice Noodle Processing

INPUTS	PARTICULARS
Raw materials	• Lower grade or broken rice • Corn starch • Sago starch
Auxiliary inputs	• Water • Energy (for conveyor belt system, air blowing, steam heating, cooling, pumping and other utility operations)
OUTPUTS	**PARTICULARS**
Finished products	• Rice noodles
Wastewater	• Spillages of rice slurry • Process equipment cleanings • Floor washings of work area
Solid wastes	• Extraneous matter (rice weevils, wood, stone fragments, etc.) • Rice fines • Rice bran • Rice hush fragments • Chalky rice • Large particles of impurities
Air emission	• Boiler flue gas

3.3 INDUSTRIAL PROCESS

3.3.1 Process Flowchart

The figure below shows the process flowchart for rice noodle processing while the process steps are described in the accompanying page.

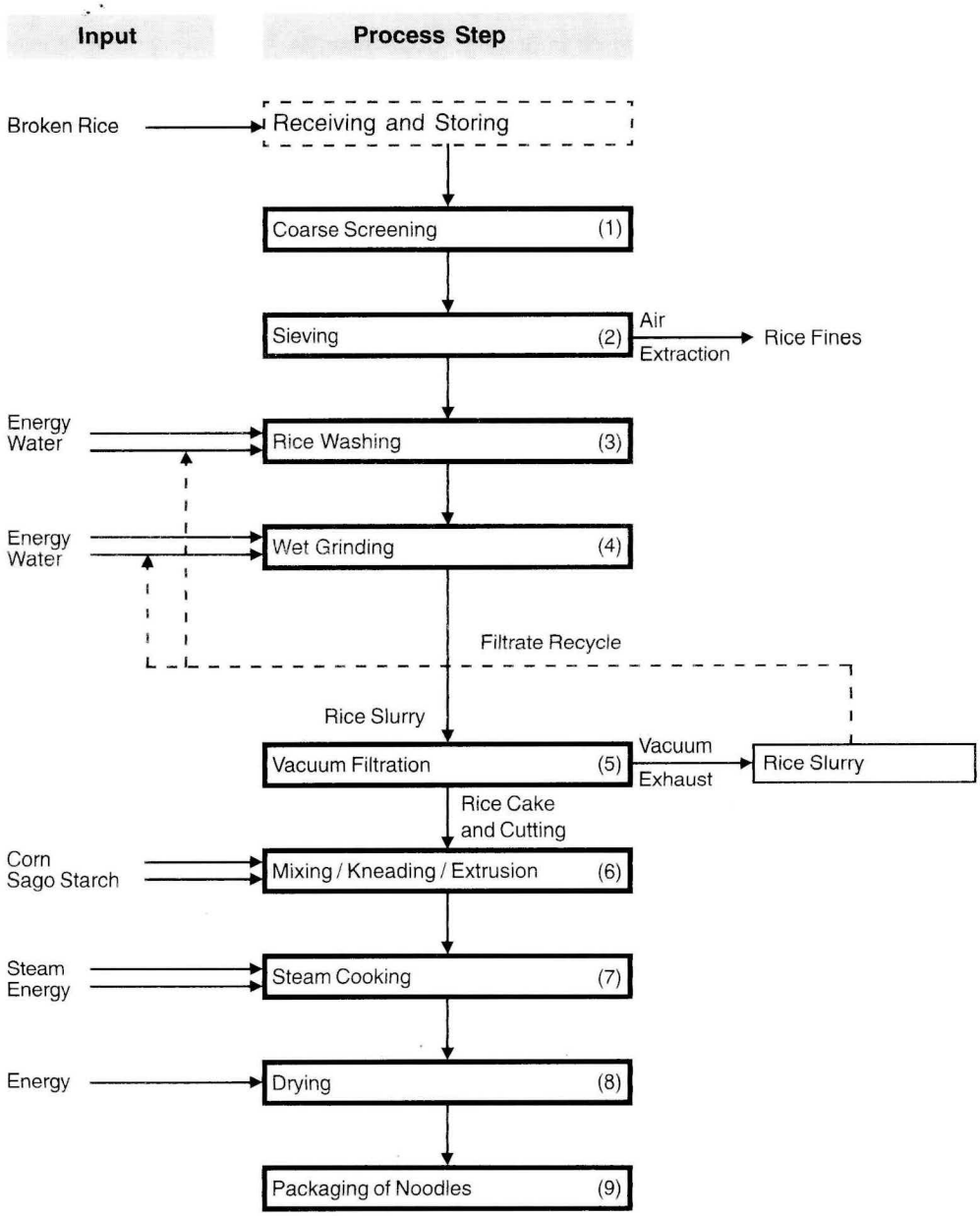
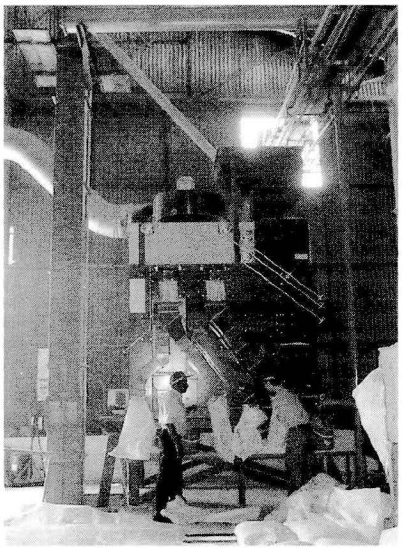
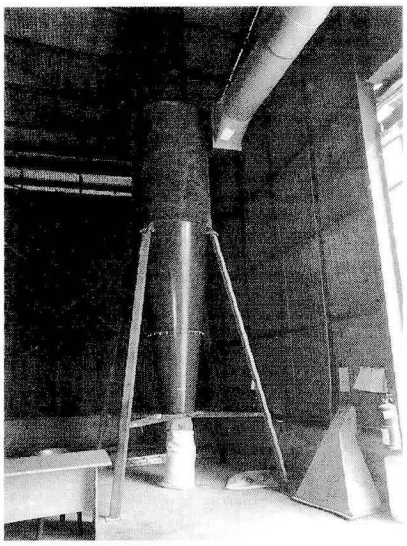


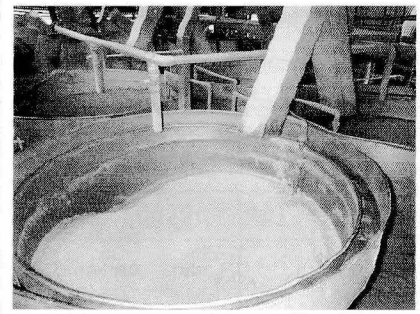
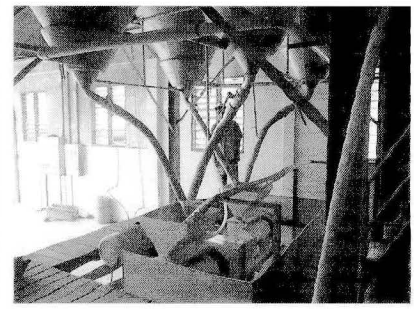
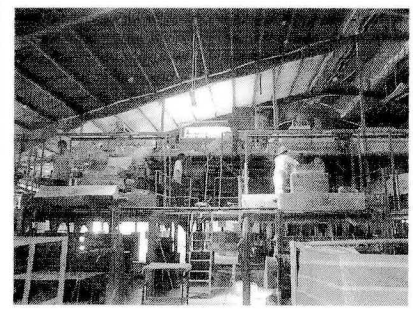
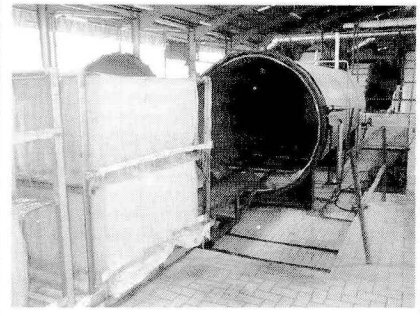
Figure 1 : Process Flowchart in Rice Noodle Processing

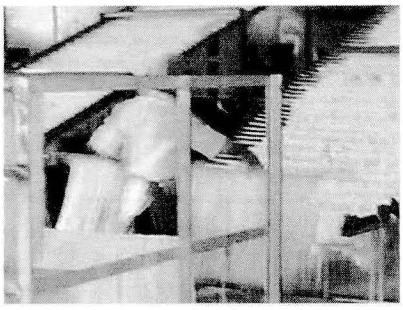
3.3.2 Process Description

The table below describes the process flow in terms of work steps and corresponding activity involvement.

Table 2 : Principal Work Steps in Rice Noodle Processing

STEP	PROCESS FLOW	ACTIVITY INVOLVEMENT	ILLUSTRATION
1.	Coarse screening	Dry rice pre-cleaning using a coarse screen to remove larger particles of impurities and extraneous matter.	
2.	Sieving	Follow-up sieving and air extraction to remove rice fines, rice bran and rice husk fragments as well as chalky rice	

STEP	PROCESS FLOW	ACTIVITY INVOLVEMENT	ILLUSTRATION
3.	Rice washing	Washing of pre-cleaned rice by agitating the wash water with compressed air, soaking in drum washers and draining out of wastewater using small mesh rice strainers	
4.	Wet grinding	Wet-grinding of cleaned rice into rice slurry of about 25% solids content which is then pumped to holding tanks that serve as feed tanks for the next step - filtration	
5.	Vacuum filtration	Vacuum filtration of rice slurry using drum filters. The rice cake formed on drum filter cloth is cut manually and allowed to drop into a hopper	
6.	Mixing with ingredients, kneading and extrusion	Corn starch and sago starch are manually added and mixed to form a rice cake of the desired consistency and moisture content. The mixture is kneaded and coarse-extruded to obtain the dough	
7.	Steam cooking	The extruded dough is subjected to initial steam cooking and then fed to extruders to yield the rice noodles. The raw noodles are cut to right length and put on bar racks and placed onto trolleys. These are rolled into a tunnel-type steam cooker for steam-cooking	

STEP	PROCESS FLOW	ACTIVITY INVOLVEMENT	ILLUSTRATION
8.	Drying	The cooked rice noodles are then sent for drying in a steam-heated air dryer	
9.	Packaging	After drying, the ready noodles are sent for packing and storage prior to external shipment	

4.0 ENVIRONMENTAL ISSUES

Rice noodle processing typically uses considerable quantities of water for cleaning of raw materials and processing and so produces large volumes of effluents and solid wastes. Scheduled waste is a non-issue as rice noodle processing generally does not generate scheduled wastes.

Air emission and noise are considered minor pollution problems. Odour can be a slight nuisance.

Therefore, the main environmental issues are :

- sources of wastes from the process cycle
- types of wastes encountered
- waste characteristics
- effluent treatment and disposal

4.1 SOURCES OF WASTES

Figure 2 shows the various sources of wastes that give rise to the wastes.

4.2 TYPES OF WASTES

The waste streams generated by rice noodle processing are :

- wastewater
- solid wastes
- air emission
- noise
- odour

4.2.1 Wastewater and Solid Wastes

The table below describes the wastewater and solid wastes in rice noodle processing. The major amount of wastes is generated directly by the process itself (Steps 1-9) while a minor amount of wastes come from:

- spillages of semi-processed materials along the process line (Step A) and
- washings of equipment and floor (Steps B and C)

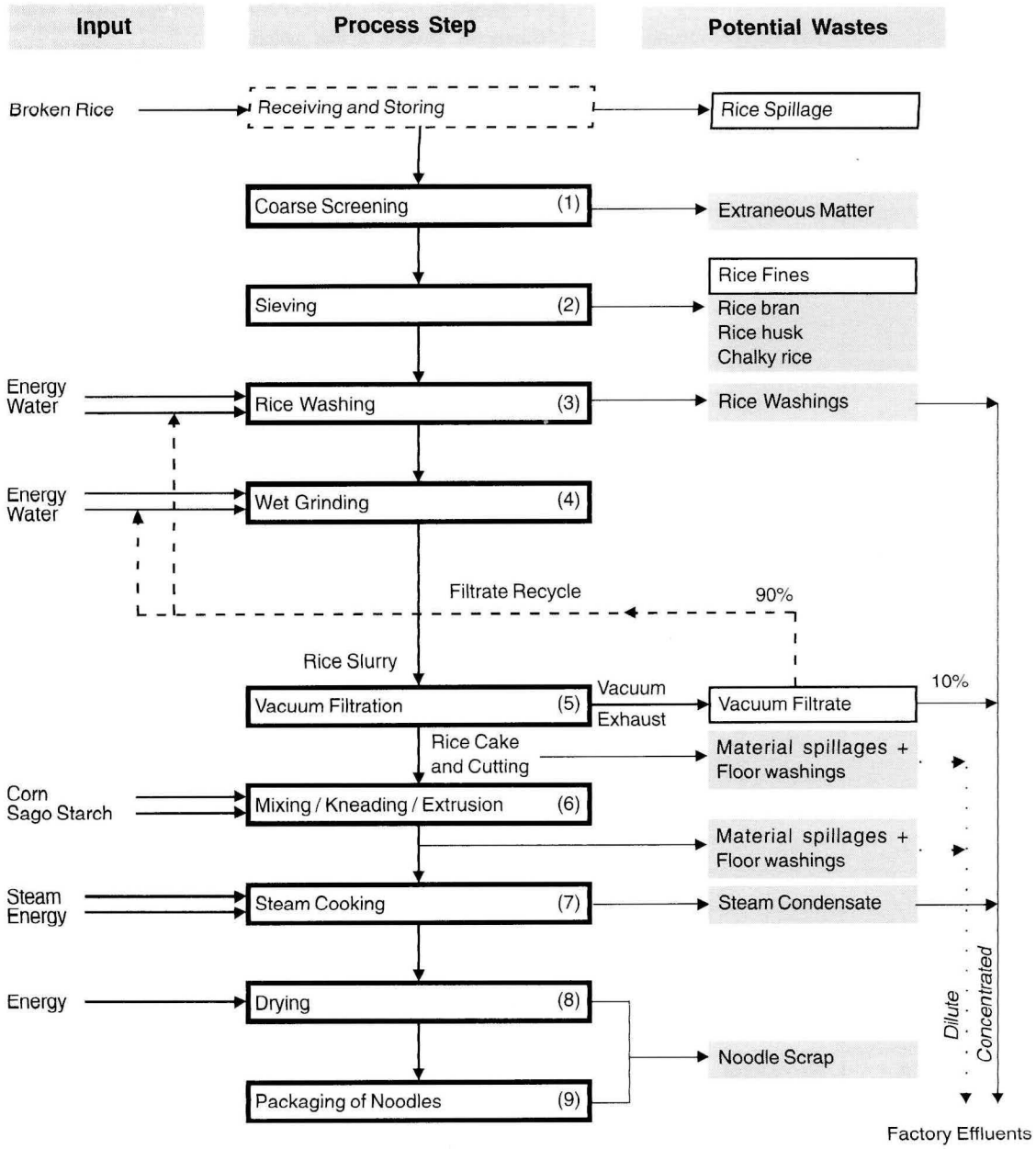


Figure 2 : Waste Generation Flowchart in Rice Noodle Processing

Table 3: Potential Waste Generation in Rice Noodle Processing

STEP	PROCESS ACTIVITIES	WASTE GENERATION POTENTIAL
1.	Coarse screening (Dry rice pre-cleaning)	Extraneous matter (rice weevils, wood, stone, metal fragments, strands of bag material)
2.	Sieving and air extraction	Rice fines, rice bran, rice husks and chalky rice
3.	Rice washing	• Rice fines • Rice washing effluent
4.	Wet grinding	None
5.	Vacuum filtration of rice slurry	• Accidental overflow of rice slurry from the filter trough onto floor due to inadequate design and/ or operator negligence during filling of vacuum trough with the rice slurry • Occasional very high organics (COD about 6,000 mg/l) in the filtrate due to filter cloth rupture resulting in escape of cake material into the vacuum filtrate
6.	Mixing with ingredients, kneading and extrusion	• Excessive spillages of rice cake, sago and corn starch during manual mixing of these materials due to worker negligence • Spillages of semi-processed materials from the conveyor belt system onto floors • Spillages of particles of dough removed from the extruder bar prior to cleaning • Floor washings of work area
7.	Steam cooking	Spillages of steam condensate
8.	Drying	Spillages of noodle scrap
9.	Packaging	Spillages of broken noodles
STEP	**SUPPORT ACTIVITIES**	**WASTE GENERATION POTENTIAL**
A.	Movement of semi-processed products through the process	Spillage Piping and / or tank leaks
B.	Process equipment washing	Wastewater
C.	Floor washing of work area	Wastewater

4.2.2 Air Emission

The rice noodle industry emits relatively less air pollutants compared to many other industries. Air emission is mainly from boilers, which use solid or liquid fuel.

Boiler

4.2.3 Noise

Noise in rice noodle food industry comes mainly from ancillary operations which include:

- mechanical processes
- conveyor belt system
- dryers
- boiler operation

Grinding operation

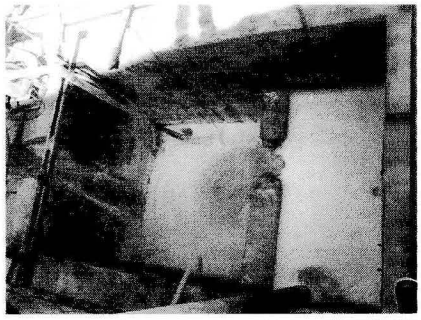
4.2.4 Odour

In the rice noodle sector, odour problems may occur from decomposing organic wastes:

- at the common entry points into open effluent drains
- at the effluent treatment plant

4.3 WASTEWATER CHARACTERISITCS

In terms of effluent quantities, for a factory with an average production of 15 tonnes per day, the total water consumption is approximately 175 m^3 per day (Industrial and domestic) whereas the total wastewater discharge is approximately 140 m^3 per day.



Wastewater collection sump

The quality of untreated effluents from individual process steps is variable. It commonly contains high concentration of organic matter (high COD and BOD_5) and high suspended solids. Effluent pH does not appear to be a problem. The characteristics of the wastewater before introduction of cleaner production is illustrated in Table 4.

In terms of pollution loading, the above 140 m^3 / day wastewater has:

- Chemical Oxygen Demand : 784 kg / day
- Biochemical Oxygen Demand : 242 kg / day
- Total Suspended Solids : 300 kg / day

Table 4 : Wastewater Streams and Characteristics in Rice Noodle Processing (Prior to Implementation of Cleaner Production)

WASTEWATER STREAM	TYPICAL WASTEWATER VOLUME, M^3/DAY	PERCENTAGE OF TOTAL WASTEWATER, %	POTENTIAL FOR REDUCTION, %	COD RANGE MG/L
1. Rice washings	37	20-30	30-35	5,000-8,000
2. Rice slurry vacuum filtrate	20	10-20	90-95	5,000-7,000
3. Noodle-cooking steam condensate	3	<5	0	8,000-10,000
4. Floor & Machinery washings	80	50-60	30-35	3,000-5,000
Combined Wastewater	**140**	**100**	**40%**	**5,000-7,000**

Adapted From :

Godwin Singam (CETEC), G. Kristensen (VKI) and Tan Lay Moy, Sept. 1999, Demonstrable Benefits of Integrating Cleaner Production and Cost-effective, End-of-Pipe Treatment in Malaysian Rice Noodle Factory

4.4 FINAL WASTEWATER TREATMENT AND DISPOSAL

Realistically, not even the best practices in cleaner production techniques will prevent the generation of wastewaters by the rice noodle industry sector or for that matter by all industries. The so-called end-of-pipe measures (by way of a wastewater treatment plant) will always be needed to treat the effluent at the tail-end before it can be discharged to the stormwater drain or river or sea.

5.0 REGULATORY FRAMEWORK

The main legislative instrument to prevent, abate and control pollution and to enhance the environment is the Environmental Quality Act 1974. The Act is administered by the Director General of the DOE.

5.1 ENVIRONMENTAL QUALITY ACT 1974

In brief, the Environmental Quality Act :

- came into force on 15 April 1975
- was amended 3 times to make it progressively more effective - in 1985, 1996 and most recently in 1998
- has 26 subsidiary legislations comprising of 13 Regulations, 11 Orders and 2Rules (as at 1st October 2000) to restrict the discharge of wastes into the environment above acceptable limits

The 1996 amendment was specially significant in that, among others, it :

- increased the penalty for offences
- empowered the DOE to inspect an offending site without a warrant
- authorized the DOE to request for an environmental audit, if found necessary

The major changes in the recent 1998 amendment were the :

- prohibition on open burning except the activities being prescribed by the Minister
- prosecution can be instituted with the consent of the Public Prosecutor
- penalty for open burning offences has been increased from RM 100,000 to RM 500,000

5.2 ENVIRONMENTAL REQUIREMENTS RELEVANT TO RICE NOODLE SECTOR

The rice noodle sector is currently not among the:

- 19 prescribed activities under the Environmental Quality (Prescribed Activities) (Environmental Impact Assessment)
- 6 prescribed premises under the Environmental Quality (Prescribed Premises) (Scheduled Wastes Treatment and Disposal Facilities) Order 1989

However, under the EQA 1974 provisions, non-prescribed activities and premises which include the rice noodle sector, have to:

- obtain the following prior approvals from the DOE Director:
  - Initial Site Assessment
  - Written permission of plans under EQ(Sewage and Industrial Effluents) Regulation 5
- comply with the following legislation upon subsequent process operation:
  - Environmental Quality (Clean Air) Regulations 1978 *(for the control of air emissions)*
  - Environmental Quality (Sewage and Industrial Effluents) Regulations 1979 *(for the control of Municipal and Industrial Waste Water Pollution)*

Besides the above environmental requirements, the rice noodle sector is encouraged to adhere to the Guidelines For Siting and Zoning of Industries which controls the noise level at the factory boundary fence.

5.3 STANDARDS / LIMITS RELEVANT TO RICE NOODLE SECTOR

Relevant standards and limits applicable to the rice noodle sector are the :

- Air Emission Standards
- Effluent Standards A and B
- Noise Requirements

5.4 NON-COMPLIANCES AND PENALTIES

The below table shows the :

- chargeable sections for non-compliances against the EQA and against the subsidiary regulations and
- the corresponding violation charges imposable

It is to be noted that offences are currently **not compoundable** within:

- Sewage & Industrial Effluent Regulations
- Noise Requirements

Table 5 : Chargeable Sections For Non-Compliance against EQA and Subsidiary Regulations and corresponding Violation Charges

CHARGEABLE SECTION	EQA REQUIREMENTS 1974	ENVIRONMENTAL ISSUE	PENALTY CLAUSE AND VIOLATION CHARGES
Section 22(1)	Restriction on pollution of the atmosphere	Dark smoke emission	Section 22(3) • Maximum of RM 100,000 or 5 years jail or both • Additional maximum fine of RM 1,000 for each day of continued offence
Section 23(1)	Restriction on noise pollution	Offensive noise emission	Section 23(2) • Maximum of RM 100,000 or 5 years jail or both • Additional maximum fine of RM 500 for each day of continued offence
Section 24(1)	Restriction on pollution of the soil	Illegal dumping of any matter (liquid, solid or gaseous) on land	Section 24(3) • Maximum of RM 100,000 or 5 years jail or both • Additional maximum fine of RM 1,000 for each day of continued offence
Section 25(1)	Restriction on pollution of inland waters	Excessive dumping of industrial wastewaters or effluent discharges	Section 25(3) • Maximum of RM 100,000 or 5 years jail or both • Additional maximum fine of RM 1,000 for each day of continued offence
Section 27(1)	Prohibition of oil discharge into Malaysian waters	Illegal dumping of oil discharge	Section 27(2) • Maximum of RM 500,000 or 5 years jail or both
Section 29(1)	Prohibition of discharge of wastes into Malaysian waters	Illegal dumping of hazardous substances, pollutants or wastes	Section 29(2) • Maximum of RM 500,000 or 5 years jail or both
Section 34(B)	Prohibition against placing, deposit, etc. of scheduled wastes	Indiscriminate disposal	Section 34(B) • Maximum of RM 500,000 or 5 years jail or both

Table 5 : Chargeable Sections For Non-Compliance against EQA and Subsidiary Regulations and corresponding Violation Charges (cont.)

CHARGEABLE REGULATION	CLEAN AIR REGULATIONS	ENVIRONMENTAL ISSUE	PENALTY CLAUSE AND VIOLATION CHARGES
Regulation No. 4	Written permission to construct new installations	Written permission approval required	Regulation 58 • Maximum of RM 2,000
Regulation No.11	Restrictions on open burning	Only certain activities are exempted from open burning prohibition	Regulation 56 • Maximum of RM 100,000 or 2 years jail or both
Regulation No.25	Restriction of solid particles emission from fuel burning equipment	Exceedance of dust emission limits	Regulation 56 • Maximum of RM 100,000 or 2 years jail or both
Regulation No.27	Restriction of gaseous substance emission in factory operation	Exceedance of gaseous emissions limits	Regulation 56 • Maximum of RM 100,000 or 2 years jail or both
Regulation No.36	Erection of fuel burning equipment	Written approval required	Regulation 56 • Maximum of RM 100,000 or 2 years jail or both
Regulation No.37	Application to erect etc. fuel burning equipment	Application required	Regulation 56 • Maximum of RM 100,000 or 2 years jail or both
CHARGEABLE REGULATION	**SCHEDULED WASTES REGULATIONS 1989**	**ENVIRONMENTAL ISSUE**	**PENALTY CLAUSE AND VIOLATION CHARGES**
Regulation No.3	Notification of generation of scheduled wastes	Notification within 1 month of waste generation	Regulation 13 • Maximum of RM 2,000
Regulation No.4	Disposal of scheduled wastes at prescribed premises	Illegal dumping	Regulation 13 • Maximum of RM 2,000
Regulation No.7	Responsibility of waste generator	Proper on-site storage, on-site treatment, handling and transport to prescribed premises	Regulation 13 • Maximum of RM 2,000

Table 5 : Chargeable Sections For Non-Compliance against EQA and Subsidiary Regulations and corresponding Violation Charges (cont.)

CHARGEABLE REGULATION	SCHEDULED WASTES REGULATIONS 1989	ENVIRONMENTAL ISSUE	PENALTY CLAUSE AND VIOLATION CHARGES
Regulation No.8	Storage of scheduled wastes	Storage in proper containers, clear labeling and segregation of incompatible scheduled wastes	Regulation 13 • Maximum of RM 2,000
Regulation No.9	Upkeep inventory of scheduled wastes	Accurate and up-to-date inventory of quantities and categories of scheduled wastes being generated, treated and disposed of.	Regulation 13 • Maximum of RM 2,000
Regulation No.10	Information by waste generator, contractor and occupier of prescribed premises	Compliance with consignment note system	Regulation 13 • Maximum of RM 2,000
Regulation No.11	Scheduled waste transfer to be accompanied by information	Accompaniment of waste information during waste transfer	Regulation 13 • Maximum of RM 2,000
Regulation No.12	Spill or accidental discharge during waste transfer	Contractor to be responsible to contain, recover and clean up	Regulation 13 • Cost of cleaning up operations

5.5 PENDING AND PROPOSED DEMANDS

To further protect the environment, DOE is currently formulating policies in the areas of:

- Waste minimization
- Cleanup of contaminated sites
- Economic tools and incentives
- Self-regulation and ISO 14000-Environmental Management System

In addition, DOE intends to :

- add on certain industries to the existing list of prescribed activities wherein factories will need to obtain a licence from the DOE to operate
- set separate stricter standards for selected industrial sectors (as done for effluent discharge from rubber and palm oil mills)

6.0 GENERIC POLLUTION PREVENTION AND CONTROL

The best approach to pollution prevention and control is the cleaner production approach which addresses efficient manufacturing processes and waste minimization at source rather than using the end-of-pipe treatment.

This Section provides an overview of various ways of introducing and implementing cleaner production, pollution control and treatment for the food processing industry, including noodles manufacturing, in general. In the following Section 7, more specific examples are given on the introduction of cleaner production at a typical rice noodle factory.

6.1 CLEANER PRODUCTION

There are essentially 5 ways in which cleaner production can be implemented. These are listed below in order of ascending capital investment requirements :

i) improved operating practices (good house-keeping)

ii) process reuse and recycle (resource conservation)

iii) changes in raw materials

iv) product changes

v) technological changes :

- process changes (improved sensors and better process control)
- equipment changes (more efficient equipment)

The following are some of the **generic** ways to implement the above.

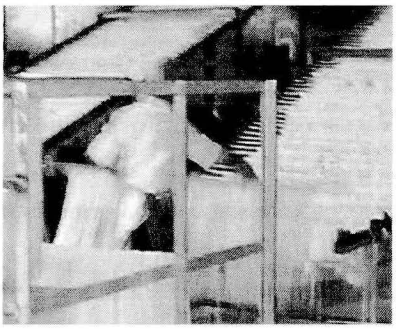
6.1.1 Improved Operating Practices

These improve efficiency and can be implemented at low cost. Improved operating practices include :

- register and quantify all raw materials (water, electricity, chemicals)
- improve material reception, storage and handling practices (material handling)
- make use of reusable baskets or trucks and trailers for goods delivery
- purchase fewer toxic and more non-toxic raw materials

- adopt a "first in-first out" policy so that older raw materials are used up before new ones are opened
- maintain strict preventive maintenance programme
- implement employee training and management feedback
- minimise losses of raw and semi-processed materials and finished products
- avoid use of the wastewater stream as a "conveyor" of unwanted solids and particulate matter
- utilise "dry cleanup" method to scrape up particulate matter before wash down
- segregate wastes (to increase recovery potential and minimize cross-contamination between non-hazardous and hazardous materials, if applicable)
- keep waste streams separate for reuse, recycling or treatment
- insulate hot tanks and hot pipes (to minimise energy consumption)
- schedule manufacturing of products using same production line or equipment (to reduce cleaning requirements)
- use automated cleaning systems which require less labour and cleaning chemicals rather than manual washing
- keep accounts of cost expenditure

Kneading/ extrusion operation



Preparing for the Drying process

6.1.2 Process Reuse and Recycle

- Install closed-loop systems for direct recycle (of leaked or spilled materials)
- Recover spilled material as animal feed. Materials not suitable for use as animal feed may be suitable for composting operations

- Recycle any other materials for offsite reuse
- Remove impurities from wastes to obtain reasonable reusable substances
- Separate toxic from non-toxic wastes
- Participate in waste exchanges (using one company's waste as another's feedstock)

6.1.3 Changes In Raw Materials

In the food industry of course, the use of alternative materials is usually very limited except for use in cleaning or sterilizing purposes. Changes in input materials can affect the generation of wastes from the production processes. Input material changes include :

- material quality (use higher purity raw materials)
- material substitution
  - substitute non-toxic for toxic raw materials
  - use longer lasting paints and coatings

6.1.4 Product Change

- Redesign or reformulate end products to have minimal environmental impact
- Design for longer life of product

6.1.5 Technological Changes

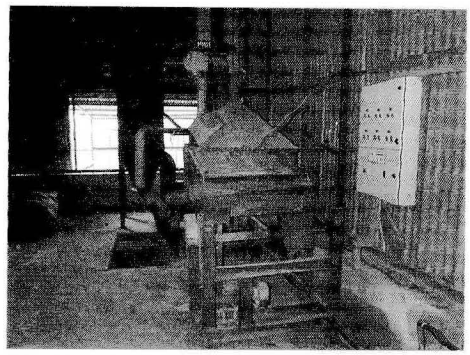
The technological changes include change of processes or equipment modifications in order to reduce waste and emissions as well as minimise energy consumption. Technological changes range from minor changes which can be implemented in a few days at low cost to equipment replacement involving higher capital costs. The changes would include:

a) **Process Changes**

- modify practices to reduce waste generation
- modify process flow, temperature, pressure and residence time
- incorporate automation to
  - optimise product yields by auto-adjusting process operating parameters
  - minimise waste generation of sludge, water usage etc

b) **Equipment Changes**

- Install equipment that produces minimal or no waste
- Redesign equipment or production layout piping to produce less waste during start-up, shut-down and maintenance
- Improve operating efficiency of equipment
- Modify equipment to enhance or permit recovery or recycling options
- Eliminate sources of leaks and spills



An obsolete pre-cleaner

6.2 ODOUR CONTROL

As a first step, odour can be minimised by reducing the generation of wastewater as much as possible. Following this, odour can also be minimised to acceptable odour quality for nearby residents by :

- condensing exhaust vapours before they are released to the atmosphere or
- sending the exhaust vapours to the boiler and burned
- using biofilters or carbon filters or scrubbers in exhaust system
- ventilating and scrubbing of air emissions

Incineration of exhaust vapours is preferable if it can be adapted into the process as it provides the most effective control of nuisance-causing odorous compounds.

6.3 NOISE CONTROL

Various options that can be considered are :

- improving the design by using insulation materials to house the noisy machine
- using a good balance of barriers and absorptive panels to reduce the noise
- reducing the use of noise-generating equipment

6.4 WASTEWATER TREATMENT

This Section provides an overview of the **variety of wastewater treatment technologies available** to the food processing industry. The two most typical wastewater treatment practices applied are - primary and secondary treatment. Primary treatment removes materials that will either float or

readily settle out by gravity. Secondary treatment removes soluble organic matter that escapes primary treatment. Occasionally, a tertiary treatment is applied which makes use of wastewater technologies beyond the conventional secondary treatment. These treatment practices are employed to address specific discharge constituents that are of concern such as pathogens, nitrogen or phosphorus compounds etc.

Frequently, wastewater treatment makes use of both the primary and secondary treatment in sequence as shown :

Table 6 : Primary and Secondary Wastewater Treatment

TREATMENT LEVEL	WASTEWATER TREATMENT AVAILABLE	POLLUTANTS REMOVAL
Primary	Screening followed by: • either gravity settling or • chemically-enhanced air floatation	• Suspended solids and floatable oil
Secondary	Biological treatment: • aerated lagoon process • activated sludge process • anaerobic digestion followed by aerated lagoon process	• Fines, dissolved organic materials and leftover oil traces

6.4.1 Suspended Solids and Oil Removal

Waste water containing materials can be separated by different treatment processes depending on the decreasing size of the materials as summarised :

Table 7 : Suspended Solids and Oil Removal Processes

MATERIAL CHARACTER	TREATMENT PROCESS
Sufficiently big	Removal by screening usually by a stainless steel fine mesh screen
Density higher than water, e.g. starch	Removal by a gravity settling tank. If particle size is small, the settling process will be slow. It is important to have sufficient holding time
Density lower than water, e.g. oils and fats	Gravity separation and removal by an oil-and-fat skimmer or by air floatation. One problem is that the oil / fat may be emulsified in the water. Therefore, separation time in the skimmer can be very long.

a) **Gravity Separation**

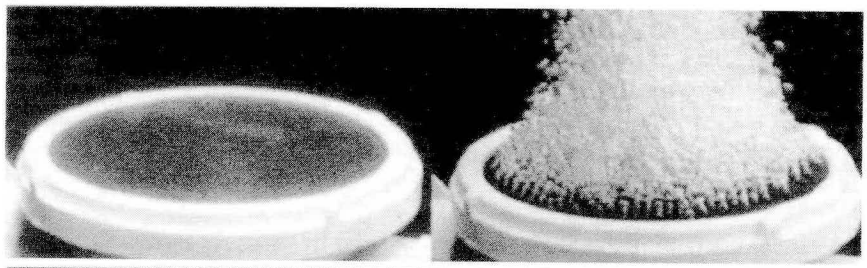
The wastewater is allowed to settle in a vessel. The oil particle rises to the surface due to lower density. Once the phase separation is completed, the floating oil is removed by skimming the top surface layer to a waste oil tank.

Readily settleable solids get settled at the bottom of the tank and are removed in the form of sludge. Gravity separation nominally has the following efficiencies :

- BOD removal efficiency : 35%
- TSS removal efficiency : 65%
- Oil removal efficiency : Lowering to 50 ppm

b) **Chemically-enhanced Air Floatation**

This is an improved version of the gravity separation principle where micro-air bubbles are injected into the wastewater through fine diffusers mounted at the bottom of the wastewater tank. These air bubbles get attached to surfaces of colloidal matter and surfaces of oil particles in the wastewater which then rapidly rise to the surface.



Fine bubble air diffuser

To improve the separation efficiency, inorganic flocculating agents such as aluminium and ferric salts (e.g. aluminium sulphate, ferric chloride) or an organic flocculant (anionic polymers) are added to bind the oil droplets or suspended solids and thus create a surface that can easily entrap air bubbles. The air bubbles with the flocs will rapidly buoy up to the water surface. The resultant sludge blanket is then continuously skimmed off from the surface.

In terms of efficiencies, chemically-enhanced air floatation has :

- BOD removal efficiency : 35%
- TSS removal efficiency : 65%
- Oil removal efficiency : Lowering to 30 ppm

6.4.2 Biological Treatment

After removing the suspended solids, there may still be dissolved organic materials and fines in the waste water. Biological treatment is usually a follow-up treatment to decrease the wastewater BOD to the level that can be discharged to public drains.

In the biological treatment, the organic material is :

- either converted by bacteria into carbon dioxide and water
- or into cellular materials which can be removed as sludge (biomass)

The common processes to treat such waste water from the food industry is to use one or combination of the following :

- aerated lagoon process
- activated sludge process
- anaerobic digestion process

The keys to operating these types of systems are detention time, temperature and air availability to the wastewater which is essential for biological activity (except for anaerobic digesters) and stabilisation of the organic pollutants. Control of pH is also important as the micro-organisms used in biological wastewater treatment are sensitive to extreme fluctuations of pH. It is noteworthy that the biological treatment plant :

- has BOD removal efficiency of approximately 85%
- will also remove about 10-25% of the nitrogen in the waste water

a) Aerated Lagoon Process

Aerated lagoons are large shallow basins where wastewater is biologically treated on a flow through basis. Oxygen is supplied by means of floating aerators to the bacteria and the process is essentially the same as the activated sludge process but without the sludge recycle. The aeration units also serve to mix the contents of the lagoon and prevent the sedimentation of suspended solids.

Aerated lagoon

Most of the solids are maintained in suspension by the mixing while the rest settles at the bottom and decomposes. The aerated lagoon system requires a periodic sludge cleanout. If not removed, the accumulated sludge will begin to adversely affect the quality of the effluent.

Aerated lagoons is a low-cost alternative to activated sludge systems especially for treating **lower strength** wastewater quantities of less than about 4,000 m^3/day with low to moderate BOD concentration (150-300 mg/L). With adequate design, these lagoons can consistently produce effluents with average BOD concentrations of less than 50 mg/L. These systems require much less operator attention as compared to activated sludge plants.

b) **Activated Sludge Process**

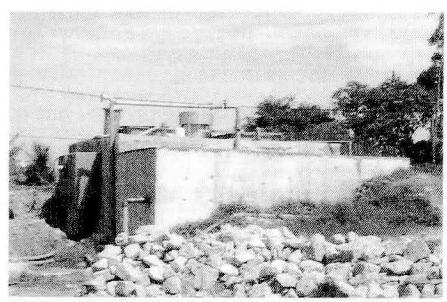
The activated sludge system can treat the wastewater faster than the aerated lagoon system in about 2-3 days time frame. The activated sludge process usually involves 3 steps as summarised:

Table 8 : Activated Sludge Process

STEP	ACTIVITY	INVOLVEMENT
1	Initial Settling	pH control in the settling tank if wash water is included in the wastewater from the plant.
2	Aeration	The wastewater is aerated by means of floating aerators or compressed air diffusers in the presence of a flocculant and mixed microbial culture known as activated sludge. Microbes consume the organic impurities (principally proteins, carbohydrates and fats) as food.
3	Final Settling	The treated effluent has to be periodically settled to remove the bacterial agglomerates. Part of this active biomass (activated sludge) containing the micro-organisms is recycled to the aeration tank to assure a balanced growth media. The supernatant from the final settling is the treated effluent.

c) **Anaerobic Digestion Process**

Higher strength wastewaters require longer residence, or hydraulic retention, time or high rates of aeration that are not economically viable in aerobic processes. The anaerobic digestion process may be thus a better choice for first stage treatment of such wastes.



Anaerobic digestor

The influent, containing high concentration or organics, is fed to an enclosed air-tight empty vessel. Anaerobic systems require a narrower pH range than aerobic systems, typically pH 6-8. The anaerobic bacteria break down the organic matter and produce methane and carbon dioxide. The digested sludge is either recycled or dewatered. The liquid fraction in turn usually goes through aerobic digestion in the next stage.

6.4.3 Final Waste Disposal

Final waste disposal refers to the disposal of the treated wastewater and sludge.

a) **Treated Wastewater Disposal**

Following the biological treatment, the quality of treated wastewater is normally within the DOE effluent discharge limits and is suitable for discharge into the municipal sewer system. In the event of exceedance, it is prudent not to discharge the effluent into the public waterway especially if its COD is higher than the COD of the receiving water body.

b) **Sludge Treatment and Disposal**

Sludge treatment consists mainly of :

- thickening
- dewatering and
- disposal

Thickening is usually the first step in sludge treatment because it is impractical to handle the slurry of solids suspended in water. Thickening is usually accomplished by allowing the sludge to flow into a tank for storage and settling. An alternative to gravity settling is dissolved air floatation. In this method, air bubbles carry the solids to the surface where a layer of thickened sludge forms.

The sludge which still contains a significant amount of water - often as much as 70% - is then dewatered using a filter press or spread over an open bed of sand and allowed to remain until dry. Where a filter press is used, the resultant squeezed-out water is recirculated to the holding tank.

In general, the addition of coagulants to wastewater treatment usually makes much of the solid waste sludge unsuitable for animal feed. As such, the dewatered sludge is either incinerated or disposed at the municipal landfill or land-farmed. In the case of land-farming, the authorities may allow the sludge to be used as plant nutrition in agriculture. However, attention must be drawn to possible presence of human parasites and pathogen organisms.

6.4.4 Effluent Treatment Relevant To Rice Noodle Processing

As can be seen, a variety of wastewater treatment options is available to the user. No single effluent treatment system suit all situations. As such, the wastewater treatment adopted at one factory is usually different from another factory. The actual choice will depend on a number of economical factors which include :

- space availability
- wastewater volume and its concentration
- sustainable level of wastewater treatment control

In one known success story, a rice noodle factory upgraded their existing wastewater treatment plant by installing the following :

Table 9 : Upgraded Wastewater Treatment Plant

TREATMENT	TREATMENT ACTIVITY	EQUIPMENT INSTALLED
Primary	Solids separation	pH control in the settling tank if wash water is included in the wastewater from the plant.
Secondary	(a) Biological Digestion	Upflow Anaerobic Digestion followed immediately by Aerated Lagoon Process
	(b) Sludge Management	Sludge Concentration Tank (for sludge thickening and water separation) and Filter Press (for dewatering)

Explanation and details of the above upgraded wastewater treatment plant is given in Section 7.3.

7.0 EXAMPLE OF CLEANER PRODUCTION IMPLEMENTED AT A RICE NOODLE FACTORY

The following are the opportunities that have been implemented to prevent and control pollution through good house-keeping, additional cleaner production practices and improved wastewater treatment.

7.1 GOOD HOUSE-KEEPING MEASURES

As can be seen in Table 10, the implementation of the good house-keeping measures focused on:

- waste minimization and
- energy conservation

Table 10 : Good Housekeeping Measures in Rice Noodle Processing

ISSUE	INITIATIVES	BENEFITS
Rice consumption	Apply first-in-first-out concept for incoming rice storage Use less contaminated rice to reduce amount of washing	Reduced growth of rice weevils which increases with prolonged storage Water savings
Good management	Install water reuse system for washing the rice Recover steam condensate as boiler feed water Recover washwater for reuse in other washing applications	Water savings
Water usage	Install on-line instruments at key points to monitor water and steam usage	Identification of large water usage and ability to take control measures to cut down water usage
Energy usage	Insulate steam equipment and exposed steam pipes Monitor energy use	Energy savings
Wastewater segregation	Segregate high strength wastewater from dilute wastewater	Reduced workload at wastewater treatment facility
Plant maintenance	Carry out regular maintenance Investigate and address steam leaks	Good plant efficiency and prevention of premature equipment breakdowns

Table 10 : Good Housekeeping Measures in Rice Noodle Processing (cont.)

PROCESS ACTIVITY	INITIATIVES	BENEFITS
Vacuum filtration of rice slurry	Take care to avoid accidental overflow of rice slurry from the filter onto the floor during manual filling of rice slurry into vacuum trough Take care to avoid excessive spillages of rice cake, sago and corn starch during manual mixing of these materials Recover spillage for reuse as secondary raw materials	Reduced product wastage and COD concentration in wastewater Revenue in sales of recovered spillages to animal feed manufacturers
Pre-cooking of extruded dough	Take care to avoid spillages of semi-processed materials from the conveyor belt system onto floors Recover spillage for reuse as secondary materials	Recovery of these materials can amount of about 10-15 kg/day Sales of recovered spillages to animal feed manufacturers
Cleaning of mixer and extruder equipment	Take care to avoid apillages of particles of dough removed from the extruder bar prior to cleaning Recover spillage for reuse as secondary materials	Reduced workload at wastewater treatment facility
Packing of noodle product	Take care to avoid spillages of broken noodles Recover spillage for reuse as secondary material	Recovery of these materials can amount of about 200-250 kg/day Sales of recovered spillages to animal feed manufacturers

7.2 ADDITIONAL CLEANER PRODUCTION OPPORTUNITIES

The additional cleaner production opportunities, which may be implemented, are as shown in the table below. These opportunities focused on:

- use of efficient equipment
- wastewater reuse

- resource recovery
- minimization of energy usage

Table 11 : Cleaner Production Opportunities in Rice Noodle Processing

PROCESS ACTIVITY	INITIATIVES	BENEFITS
Dry cleaning of the raw rice feed	Use efficient universal grain precleaner with different mesh size for: effective separation of all dirt and extraneous matter and more complete recovery of usable rice and by-product materials such as fines and rice bran	Recovery of rice fines. The rice fines are returned to the process as raw materials Recovery of rice bran, chalky rice and rice husks. These can earn revenue in selling to animal feed manufacturers
Rice washing	With usage of efficient universal grain pre-cleaner equipment	Lesser volume (35% reduction) of rice washings Reduced loss of rice materials during washing Lesser organics (25% reduction) when using cleaner rice Lesser volume and organics for wastewater treatment
Vacuum drum filtration of rice slurry	Improve mechanism for cake-cutting to prevent filter cloth rupture and loss of rice materials Use high efficient filtrate separators to recover the filtrate from the vacuum air exhaust Reuse the separated filtrate by mixing with incoming clean water to serve as water supply to the rice grinders and/or drum washers	Greater recovery (90%) of vacuum filtrate for reuse in rice washing and wet grinding Lesser discharge (10%) of surplus vacuum filtrate Lesser volume and organics for subsequent wastewater treatment
Steam cooking of raw noodle (which leads to condensate waste which has very high organic content of average COD concentration of 9,000 mg/L)	Segregate this wastewater stream and include it with the other two concentrated wastewater streams from : rice washings vacuum filtration	Combination of the 3 concentrated wastewater streams enables them to be **initially** treated in an anaerobic digester. This reduces the energy requirement and operating costs in the **subsequent** aerobic treatment in an aerated lagoon

7.3 WASTEWATER TREATMENT

7.3.1 Wastewater Treatment Flowchart

The figure below shows the upgraded wastewater treatment practised by a rice noodle factory while the treatment process is described on the next page.

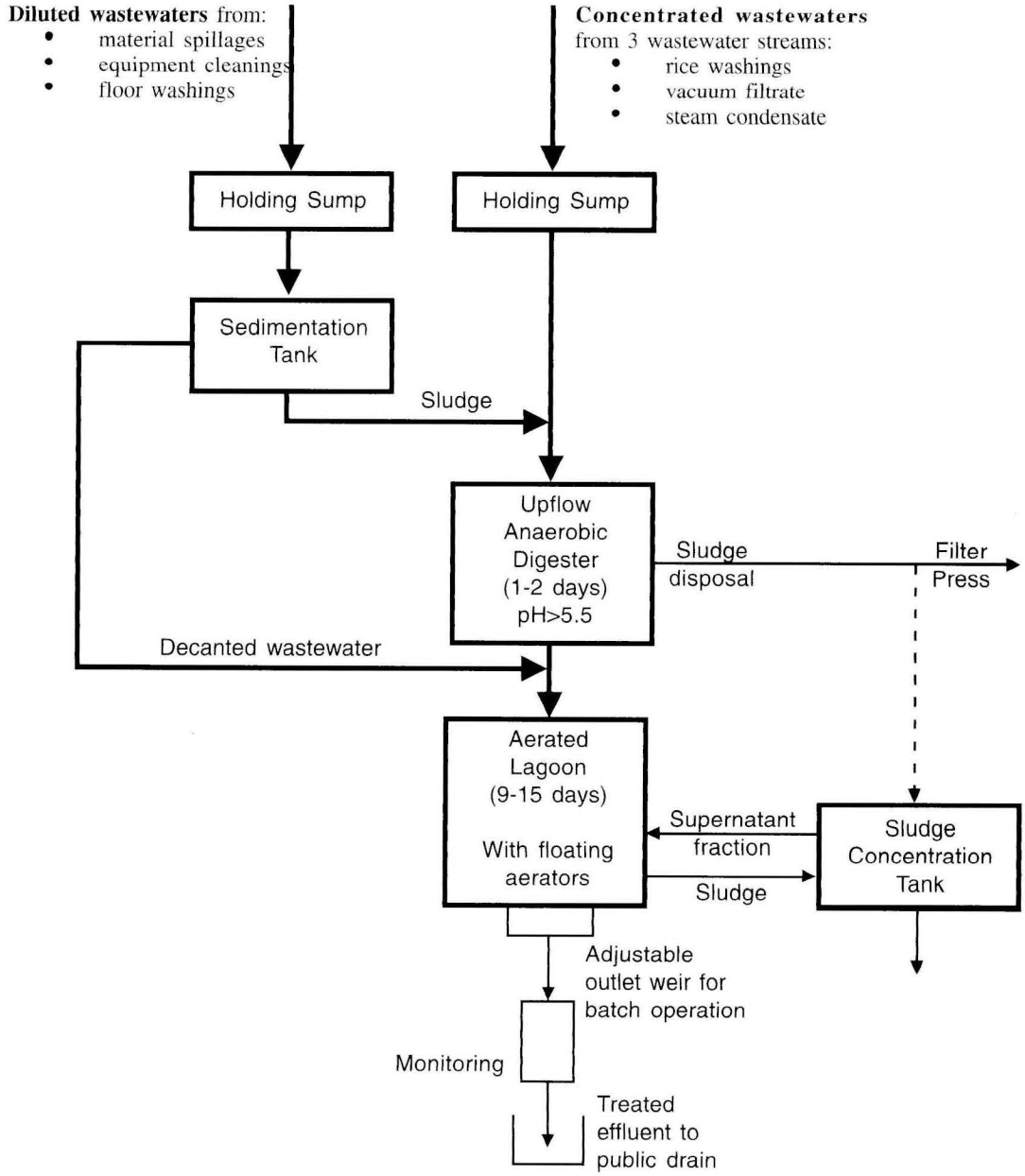


Figure 3 : Wastewater Treatment Flowchart in Rice Noodle Processing

7.3.2 Description of Wastewater Treatment Process

In brief, the wastewater is treated as follows :

- The incoming concentrated and dilute wastewaters are segregated
- The **dilute wastewaters** are diverted to a sedimentation tank to remove settleable matter
- The resultant sludge from sedimentation tank goes to the **anaerobic** digester
- The **concentrated wastewaters** are led directly to the **anaerobic** digester
- Following **anaerobic** digestion, the resultant decanted fraction (from the anaerobic digester) then joins the decanted dilute wastewater (from the sedimentation tank) to enter the **aerated** lagoon.
- In the **aeration** lagoon, air is mixed into the water using floating aerators. Twice a day, the aerators are stopped for 1-2 hours to allow settlement of the sludge
- Following settlement, the treated effluent is withdrawn from the upper water level via an adjustable outlet weir. This treated effluent is monitored before discharge to the public drain.
- Excess sludge from the aerated lagoon is transferred to a sludge concentration tank for sludge thickening and water separation. The clear supernatant fraction from the concentration tank is returned to the aerated lagoon while the sludge is dewatered by :
  - passing through the filter press or
  - discharging over a sand bed

  Typically, the desludging is carried out at 1-2 weeks interval.

In upgrading the wastewater treatment plant, the following initiatives were introduced :

Table 12 : Wastewater Treatment Initiatives

PROCESS ACTIVITY	INITIATIVES	BENEFITS
Segregation of dilute wastewaters from concentrated wastewaters	Separate sedimentation from dilute wastewaters	Smaller wastewater volume to handle Separation of settleable matter
Anaerobic digestion	Separate pre-treatment for concentrated wastewater stream in anaerobic digester	Significant reduction of organic loading (COD and BOD) of concentrated wastewaters which in turn is energy savings during later treatment in aerated lagoon

Table 12 : Wastewater Treatment Initiatives (cont.)

PROCESS ACTIVITY	INITIATIVES	BENEFITS
Aerobic Treatment	Collective treatment of combined factory effluents in a single aerated lagoon	Collective treatment reduces the energy requirement and operating costs
Oxygen control in aerated lagoon	Install oxygen control system with frequency converter for the floating surface aerators and a program logic controller	To avoid over oxygenation or oxygen depletion To conserve aeration energy input to floating surface aerators
Control of discharge of treated wastewater	Install adjustable effluent outlet weir to control discharge of treated wastewater	Better control leading to compliance with effluent regulations

7.4 OUTCOME OF CLEANER PRODUCTION IMPLEMENTATION

With good house-keeping, cleaner production and improved wastewater treatment, the factory under a DANCED demonstration project was able to achieve the following :

7.4.1 Treated Wastewater Quality

Table 13 : Treated Wastewater Quality From An Upgraded Wastewater Treatment Plant

PERFORMANCE OF UPGRADED WASTEWATER TREATMENT PLANT					
WASTEWATER QUALITY	ANAEROBIC DIGESTER INFLUENT mg/l	ANAEROBIC DIGESTER EFFLUENT mg/l	AERATED LAGOON EFFLUENT mg/l		DOE LIMITS mg/l
			Range	Mean	
COD	6,400	2,000	90-130	110	100
BOD_5	2,500	600	10-20	18	50
SS	1,100	-	7-25	16	100

Source : Godwin Singam (CETEC), G. Kristensen (VKI) and Tan Lay Moy, Sept. 1999 Demonstrable Benefits of Integrating Cleaner Production and Cost-effective End-of-pipe Treatment in Malaysian Vermicelli Manufacturing (Melaka)

7.4.2 Investments, Annual Savings and Pay-back Period

Table 14 gives an idea of the investments and pay-back period experienced by the factory under the same DANCED demonstration project.

Table 14 : Investment and Pay-back Period

INVESTMENT ITEM	COST VALUE	PAY-BACK PERIOD
• Cleaner Production - Efficient rice pre-cleaner - Efficient vacuum filtrate recovery and reuse (wet-cyclone liquid-air separator)	RM 245,000 RM 75,000	0.8 year
• Upgrading of effluent treatment plant	RM 408,000	*
Total investments	RM 728,000	1.9 year
TOTAL ANNUAL SAVINGS	**COST VALUE**	**PAY-BACK PERIOD**
• Wastewater treatment chemicals	RM 120,000	*
• Energy savings (in wastewater treatment plant)	RM 60,000	*
• Water savings	RM 30,000	*
• Recovered rice and by-products	RM 155,000	*
• Reduced sludge disposal	RM 20,000	*
Total savings	RM 385,000	*

Note: *Excludes investments and savings for new Danstoker wood-fired boiler costing RM 835,000*
** not yet available*

Source : Godwin Singam (CETEC), G. Kristensen (VKI) and Tan Lay Moy, Sept. 1999
Demonstrable Benefits of Integrating Cleaner Production and Cost-effective End-of-pipe Treatment in Malaysian Vermicelli Manufacturing (Melaka)

8.0 INSPECTION FOCUS

To assist the DOE inspection officers in each of the above activities, a **MANUAL ON PRACTICAL ENFORCEMENT** dealing with the **generic** procedures for preparation, implementation and follow-up of an inspection visit has already been separately developed. The manual addressed, among other things, the pre-inspection preparations such as :

- checking the licensing terms and conditions issued by DOE
- reviewing the quarterly submission by the factory to DOE
- examining the outcome of the previous inspection visits

This Section on Inspection Focus is **industry-specific** and serves as a supplement to the above **MANUAL ON PRACTICAL ENFORCEMENT**. The purpose is to provide :

- guidance on information that should be obtained **before** the inspection
- guidance for checking the housekeeping and cleaner production opportunities **during inspection**
- the checklists and recording worksheets to be used **during inspection**
- guidance on advising the factory management regarding environmental performance improvements **at the closing meeting**
- guidance on the follow-up action

8.1 MAIN ENVIRONMENTAL ISSUES

In rice noodle processing, some or all of the following may appear :

- occurrence of extraneous waste matter (rice, wood, strands of bag material etc) arising from coarse screening of the raw rice
- occurrence of rice bran, rice husk and chalky rice resulting from the follow-up sieving
- occurrence of wastewater from rice washing and vacuum filtration
- spillages of rice slurry from accidental overflow during filling of the vacuum trough with the rice slurry
- escape of rice cake into the vacuum filtrate due to occasional rupture of the filter cloth
- spillages of semi-finished rice noodles during multiple movement transfers along the process line

- spillages of processed rice noodles during packing
- occurrence of effluent from washings of process equipment and floor washing of work area

As such, the main environmental issues relate to :

- inadequate house-keeping;
- sizeable quantity of wastewater from the process as well as from the wastewater treatment;
- ample quantity of sludge waste from the wastewater treatment plant;

leading to:

- wastewater pollution;
- odour;
- boiler air emissions.

8.2 INSPECTION OBJECTIVES

The objectives of the inspection are to:

- ascertain the condition of house-keeping and level of cleaner production implementation
- verify data, identify missing or inaccurate data or obtain additional data
- identify the opportunities to increase the existing level of good house-keeping and cleaner production
- advise the factory management on the potential environmental improvements
- check on the status of regulatory compliance
- demonstrate DOE's commitment to enhance and protect the environment and ensure fulfilment of the EQA.

8.3 INSPECTION PROCEDURES AND STEPS

With the above objectives in mind, the procedures are as follows:

- Pre-inspection planning and information review
- Factory inspection
- Closing meeting with the factory management and
- Follow-up action

8.3.1 Pre-Inspection Planning and Information Review

Before going for the inspection, the DOE Inspectors would need to familiarize themselves with, among other things, the following background information on the factory to be visited:

- factory location and immediate surrounding landuse
- approval conditions of :
  - Initial Site Assessment
  - Written permission of plans under EQ(Sewage and Industrial Effluents) Regulation 1979 under regulation No. 5
  - Written permission of fuel burning equipment and erection of chimney under EQ (Clean Air) Regulations 1978 under regulations No. 36 and 37
- status of environmental performance of the two next-to-last inspection
- findings of the last inspection and recommendations, if any
- the production process
- the material inputs and outputs
- the wastewater treatment plant process

8.3.2 Factory Inspection

The points to bear in mind are the:

- inspection focus and
- inspection considerations

Inspection Focus

To be expected, there is a variation in approach when inspecting for housekeeping / cleaner production opportunities as opposed to inspecting for environmental regulation compliance. The table below shows the variation between these two inspections :

Table 15 : Inspection Approach for House-Keeping & Cleaner Production Opportunities against Environmental Regulation Compliance

INSPECTION FOR	INSPECTION APPROACH	INSPECTION FOCUS
Housekeeping and cleaner production	Check against wastage and shortcomings	Focus on process elements: • cleanliness (at reception and storage area) • waste handling • losses (of water and heat) • high consumption (of electricity) • faults or inefficiency (of equipment) • adequacy (of wastewater treatment plant) Focus on environmental management • environmental accounting • environmental awareness
Environmental Regulation Compliance	Check for significant pollution occurrence	Focus on plant performance status: • performance of effluent treatment plant • reading of final effluent discharge • proper waste storage, labelling and disposal • boiler performance

Inspection Considerations

The most common method is the systematic walk-through inspection of the:

- rice noodle processing plant and the
- wastewater treatment plant

The reason for the systematic approach is not to miss any functional areas, processes or activities. To inspect the processing plant, the walk-through would start from the raw material reception and storage area, then follow the production sequence and terminate at the dispatch area of the finished product. For the wastewater treatment plant inspection, the walk-through would begin at the wastewater holding tank, then follow the treatment sequence and end :

- firstly at the final effluent discharge point and
- secondly at the final sludge disposal point

It would be advantageous if the inspection is timed to coincide with pertinent factory operations such as:

- factory start up
- equipment cleanings
- effluent discharge
- in-house sampling of untreated and treated wastewater
- collection of sludge wastes by waste contractor

Where possible, it would be also beneficial to:

- inspect all areas including remote areas
- check on the existence or appropriateness of the locations for flow meters to measure water consumption and wastewater discharge
- check on the appropriateness of wastewater sampling location(s)
- examine sampling and monitoring procedures
- take photographs or take samples as evidence in event of suspect non- compliance

Besides the visual inspection, it is also necessary to check into the:

- factory wastewater analysis records
- inventory records on waste generation and waste disposal and
- factory records on public complaints

Inspectors should be careful to remain oriented during the walk-through of the factory so that they can accurately note locations of waste management areas, possible waste release points, potential sampling locations etc. At larger factories, it is good to carry a factory layout plan (obtainable from the factory) in order to pin-point the non-compliance locations.

Of course, inspectors should feel free to deviate from the above procedure to further investigate any observations that uncover potential violations or environmental hazards.

Use of Inspection Checklists and Recording Worksheets

The key tools for any inspection are the inspection checklists and recording worksheets. To facilitate the inspection, the following are provided as guidance materials :

- Recording Worksheet for factory information - Annex A
- Inspection Checklist for House-keeping and Cleaner Production Opportunities - Annex B
- Recording Worksheet for House-keeping and Cleaner Production Opportunities - Annex C
- Inspection Checklist for Environmental Regulation Compliance - Annex D
- Recording Worksheet for Environmental Regulation Compliance - Annex E

8.3.3 Closing Meeting With Factory Management

At the end of an inspection of the processing plant and the wastewater treatment plant, a closing meeting is to be held with the factory management - after the Inspector has had time to note the main points for presentation and discussion . The main purpose of the closing meeting is to :

- present the observations and findings in a manner which ensures that the results of the inspection are clearly understood
- resolve uncertainties and inconsistencies
- explain and issue compounds if necessary
- inform the management of any upcoming follow-up action by DOE in response to areas of non-compliances
- arrange the date for the follow-up visit
- obtain a formal acceptance confirming :
  - the evidence and other materials collected by the DOE Inspectors
  - the findings and conclusions of the inspection visit and
  - the corrective action(s) to be taken by the factory and the time frame

In addition to the above, the other purpose of the closing meeting is to :

- informally discuss the opportunities to improve environmental performance
- clarify and confirm any agreements made

The general procedures relating to the above can be found in the relevant section of the **MANUAL ON PRACTICAL ENFORCEMENT**.

8.3.4 Follow-up Action

The full value of an inspection is only achieved if the factory acts upon the findings identified and implements the corrective action(s) within the agreed time frame. The rationale for the follow-up action is to:

- verify that the factory has taken the action(s)
- check that the action(s) were implemented within the agreed time frame and
- examine whether the action(s) taken are effective

The general procedures relating to the above can be found in the relevant section of the **MANUAL ON PRACTICAL ENFORCEMENT**.

ANNEX A

Recording Worksheet for Factory Information

Name of Factory : .....

Address : .....

.....

Inspection Date : .....

Inspection Time : .....

INSPECTION PARTICULARS	UNIT	FINDINGS
Date of last inspection		
Highlights of last inspection • Violation observed or alleged, if any • Intended corrective action (s) • Any public complaints		
Date of present inspection		
Inspection number		
Start of inspection	am/pm	
End of inspection	am/pm	
FACTORY BACKGROUND INFORMATION		
Factory name		
Age of factory	years	
Operating Hours (shifts, working days)		
Factory representative (Name & Title)		
Factory Contact Telephone		
Factory Address		
Inspection Participants (Name & titles)		
ISO 14001 Certification		
Monthly water consumption	m^3	
Monthly electricity consumption	kWh	
Monthly production	tonnes	
Monthly chemical consumption	tonnes	
Monthly quantity of effluent generated	m^3/month	
Monthly quantity of sludge generated	m^3/month	
Frequency of sludge disposal		
Location of off-site disposal		
Name of waste contractor		
Cost of sludge disposal	RM	

DOE Inspector

Name : .....

Designation : .....

ANNEX B

Inspection Checklist for Good housekeeping and Cleaner Production Opportunities

PROCESS ELEMENTS	IDEAL SITUATION	INSPECTION FOCUS
Cleanliness	Clean and tidy in areas of: • bulk material reception & dispatch • Processing • Waste storage and disposal • Factory drains	• Littering or spillage • Careless container storage • Leak-proof containers • Provision for spillage containment • Drain blockage
High Water Consumption	Online flow metering at key points to monitor: • water consumption • wastewater discharge	• Leaky pipe system • Running water supply during idle period • Cooling water operating in open system • Overflow in hot water system • Low equipment efficiency • Poor piping design • Poor cleaning procedures • No water recycling
High Heat Consumption	Online flow metering to monitor steam usage	• Leaky valves • Malfunctioning steam traps • Poor steam condensate return system • Lack of heat recovery • Lack of insulation of hot surfaces and pipes • Low boiler efficiency
High Electricity Consumption	Online metering to monitor power consumption	• Low efficiency of equipment • Equipment operating during idling period • Leaking compressed air system • Lack of energy-saving lighting
Process Equipment	• Usage of highly efficient rice grain pre-cleaner • Usage of highly efficient boiler • Regular maintenance of equipment	• Usage of old equipment • Records of regular maintenance

Inspection Checklist for Good housekeeping and Cleaner Production Opportunities (cont.)

PROCESS ELEMENTS	IDEAL SITUATION	INSPECTION FOCUS
Wastewater Treatment Plant	• Segregation of concentrated and dilute wastewater • Good oxygen control of aeration in aerated lagoon • Adjustable outlet weir for intermittent clarification and effluent discharge	• Adequacy of treatment plant • Regular maintenance of equipment
Environmental Accounting	Keep accounts of cost expenditure of : • monthly water consumption • monthly electricity consumption • monthly cost of waste disposal	• Adequacy of treatment plant • Regular maintenance of equipment
Environmental Awareness	• Training of factory operators in good house-keeping	• Random interview of factory workers • Training records

ANNEX C

Recording Worksheet for Good Housekeeping and Cleaner Production Opportunities

Name of Factory : .....

Address : .....

.....

Inspection Date : .....

Inspection Time : .....

INSPECTION AREA	OBSERVATION	EVIDENCE	FINDINGS
1. Rice storage etc.		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
2. Coarse screening		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
3. Rice washing		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
4. Wet grinding		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
5. Vacuum filtration		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
6. Mixing with ingredients, kneading and extrusion		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
7. Steam cooking		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
8. Drying		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
9. Packaging		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
10. Wastewater Treatment - untreated wastewater - treated wastewater		☐ Photos ☐ Samples	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
11. Waste handling		☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check

DOE Inspector

Name : .....

Designation : .....

ANNEX D

Inspection Checklist for Regulatory Compliance

PLANT PERFORMANCE STATUS	REGULATORY REQUIREMENT	INSPECTION FOCUS
Final Effluent Discharge	• Compliance with DOE sewage and effluent regulations	• Unhealthy practices such as : - Effluent dilution - illegal run-off • Wastewater colouration • Floating materials • Odour • Evidence of monitoring and analysis • Sampling locations and frequency • Analytical results of effluent quality • Public complaints
Solid wastes handling (sludges from wastewater treatment plant)	Compliance with Local Authority By-Laws to ensure: • proper storage of waste • removal and disposal at disposal sites	• Suitable storage • Sheltered storage • Proper containers • Regular removal and proper disposal • Public complaints
Air Emission	Compliance with DOE Clean Air Regulations	• Approval for fuel burning equipment • Approval for chimney erection • Evidence of occasional monitoring • Factory records of test results • Dark smoke from boiler stack
Noise	Compliance with DOE Noise Level at Boundary Fence	• Evidence of occasional monitoring • Factory records of test results • Excessive noise level • Public complaints
Odour	None	• Excessive odour • Public complaints

ANNEX E

Recording Worksheet for Regulatory Compliance

Name of Factory : .....

Address : .....

.....

Inspection Date : .....

Inspection Time : .....

PLANT PERFORMANCE STATUS	SITUATION OR READING	EVIDENCE	FINDINGS
Effluent discharge unhealthy practices effluent discharge quality - pH - BOD - COD - Total Suspended Solids - Oil and Grease	☐ Unhealthy practices .... ☐ Discharge quality - pH ..... - BOD ..... - COD ..... - TSS ..... - O&G	☐ Photos ☐ Factory records ☐ Samples taken ☐ Photos	☐ Satisfactory ☐ Unsatisfactory ☐ Further check
Solid Wastes (Sludges from wastewater treatment plant)	Cleanliness ..... Containers ..... Spills etc. ..... Disposal	☐ Factory records ☐ Samples taken ☐ Photos	☐ Satisfactory ☐ Unsatisfactory
Air Emission	Dark smoke from boiler stack	☐ Visual ☐ Photos	☐ Satisfactory ☐ Unsatisfactory
Noise	Noise level	☐ Factory records ☐ Noise meter measurement	☐ Compliance ☐ Non-compliance ☐ Further check
Odour	Odour assessment	☐ Factory records	☐ Satisfactory ☐ Unsatisfactory

DOE Inspector

Name : .....

Designation : .....

ANNEX F

Glimpse into food processing industry

As a matter of added interest, this Annex is included to give a general idea of how broad the food industry is. The glimpse into the food industry covers the:

- range of the food industry
- food industry players
- sectors and sub-sectors of the food industry

Range of food industry

According to a 1995 estimate based on a sample survey (documented in Yearbook of Statistics 1998, Department of Statistics Malaysia), there are 3,276 food factories. Table 1 below gives an idea of the production statistics of the major food sectors in Malaysia.

Table 1: Category and Production Statistics of Major Food Sectors

FOOD SECTOR - CATEGORISED ACCORDING TO PRODUCT	QUANTITY UNIT	PRODUCTION PERFORMANCE	
		1996	1997
1. Animal Feed (prepared)	Tonne	1,441,305	1,674,459
Mixed poultry feed			
2. Biscuit Manufacturing	Tonne	114,878	107,017
Biscuits			
3. Coconut Oil	Tonne	16,409	14,154
Crude coconut oil			
4. Dairy Products			
Sweetened condensed milk	Tonne	190,607	174,673
Milk powder as infant food	Tonne	19,240	16,545
Full cream powdered milk	Tonne	37,967	41,347
Milk drinks	Litres ('000)	67,344	77,228
5. Fish/ Shrimp/ Prawn Canning Preserving and Processing			
Canned fish	Tonne	19,444	19,479
Frozen shrimps/ Prawns	Tonne	14,451	15,119
6. Flour Mills	Tonne	692,257	720,240
Wheat flour			

FOOD SECTOR - CATEGORISED ACCORDING TO PRODUCT	QUANTITY UNIT	PRODUCTION PERFORMANCE	
		1996	1997
7. Malt Liquors and Salt	Litres ('000)	not available	not available
Beer and stout			
8. Pineapple Canning	Tonne	30,274	31,114
Canned pineapple			
9. Rice Mills (Large)			
Whole rice	Tonne	357,293	345,500
Broken rice	Tonne	42,161	48,558
10. Vegetable & Animal Oils and Fats			
Margarine	Tonne	28,141	26,572
Blended cooking oil	Tonne	64,238	86,637
11. Soft Drinks and Carbonated Water			
Carbonated beverages	Litres ('000)	341,177	339,547
Non-carbonated beverages	Litres ('000)	163,586	173,800
12. Sugar Factories and Refineries			
Refined sugar	Tonne	1,116,515	1,155,320
13. Other Food Products			
Rice noodles	Tonne	Not available	Not available
Meat Processing	Tonne		
Cocoa, chocolate & sugar confectionery	Tonne		

Source: Yearbook of Statistics Malaysia, Department of Statistics, 1998

Food industry players

According to the Malaysia International Trade and Industry Report 1995, the largest proportion of SMIs were involved in the food, beverage and tobacco industry as shown :

- Food, beverage and tobacco (20%)
- Fabricated metal products and machinery and equipment (18%)
- Wood and wood products including furniture (17%)
- Textile, wearing apparel and leather (12%)

- Chemical, petroleum, rubber and plastic products (11%)
- Paper and paper products, printing and publishing (8%)
- Non-metalic, mineral products exluding petroleum products (6%)
- Basic metal industry (4%)

Although the good number of SMIs was in the Food, Beverage and Tobacco category, the Food sector alone accounted for 90%, while Tobacco and Beverage sectors accounted for 8% and 1% respectively.

In terms of distribution, the Industry Briefs Report 1999 by the Malaysian Industrial Development Authority indicated that there are about 38% small scale firms, 48% medium scale firms and 14% large firms involved in the food industry.

Sectors and sub-sectors of the food industry

As shown in Table 1, the food industry is broadly categorised under 13 food sectors.

Under each of the above food sector, there are in turn a good number of sub-sectors where many factories specialise on a one food product althought some factories are engaged in more than one food product but use a common single production line on a batch process basis. This entails the intermittent shutdowns of the plant to thoroughly water wash clean the equipment (mixing tanks, centrifuges, cookers etc.) in preparation for the next batch process.

The Table 2 below gives an idea of the spread of the sub-sectors of three randomly picked sectors:

Table 2: Some Food Sectors and Corresponding Sub-sectors

SECTOR	SUB-SECTOR
Seafood processing	Fish - cooked sardine processing - cooked anchovies processing - frozen fish meat manufacturing - fish paste products manufacturing Others - seaweed/ gelatin processing - cooked and frozen prawn manufacturing - minced prawn processing - cooked and frozen crab meat manufacturing - cooked cockles processing - cooked clams processing

Table 2: Some Food Sectors and Corresponding Sub-sectors (cont.)

SECTOR	SUB-SECTOR
Edible Oil Processing	Refined Products - refined, bleached and deodorised palm olein (cooking oil) - refined, bleached and deodorised palm stearin - palm fatting acid distillate - palm acid oil Oleochemical Products - fatty acids - methy esters - fatty alcohols - fatty esters - glycerol Other Downstream Products via Fractionation, Hydrogenation, Interesterification, Blending and Emulsification - high quality soap - shortening - vanaspatic (a substitute for ghee) - margarine - lubricants
Beverage Processing	Non-alcoholic Beverage - non-carbonated soft drinks - carbonated soft drinks - cordials and concentrates - mineral water Alcoholic beverages - beer - wine - spirits (whisky, brandy, etc.)

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