Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency (EEAA)

Inspection Manual
Dairy Industry

2002

List of Acronyms

BOD	Biological Oxygen Demand
CAPMAS	Central Agency for Public Mobilization and Statistics
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
EMS	Environmental Management System
O&G	Oil and Grease
SIC	Standard Industrial Classification
SM	Self-Monitoring
SMS	Self-Monitoring system
SO_x	Sulfur Oxides
TDS	Total Dissolved Solids
UHT	Ultra High Temperature
WWTP	Wastewater Treatment Plant
µm	Micro meter 10^{-6} m
VOCs	Volatile Organic Compounds
NO_x	Nitogen Oxides
CFCs	Chloro-fluoro carbon
MHUUC	Ministry of Housing, utilities and urban Communities
CP	Cleaner Production
Eop	End-of-pipe

P2	Pollution Prevention
HACCP	Hazardous Analysis& Critical Control Point
CIP	Clean in Place

Dairy Industry
Inspection Handbook

Table of Contents

1. Introduction

The Egyptian Pollution Abatement Project (EPAP) sponsored by FINIDA has assigned Finish and Egyptian consultants for the task of developing Sector specific inspection and monitoring guidelines. This task is based on a previous collaboration between FINIDA and EPAP that resulted in the development of four Inspection Guidelines:

- Fundamentals and Background Manual that provides basic information about air pollution, wastewater characteristics, solid waste, hazardous materials and wastes and work environment.
- Guidelines for Inspectorate Management that discusses the strategy, objectives and tasks of the inspectorate management.
- Guidelines for Team Leaders that identifies the team leader resposibilities and tasks.
- Guidelines for Inspectors that presents a methodology for performing all types of inspection. Tasks during the various phases of planning, performing field inspection, report preparation and follow-up are discussed. Several checklists are included.

The three guidelines were later summarized into one that will be referred to as the Inspection Guidelines. A General Inspection Manual, GIM, is being developed covering aspects common to all sectors.

On the other hand, a Self-Monitoring manual was also developed to present the industrial community and government officials with the general principles, both managerial and technical, to be followed for self-monitoring. The textile industry was chosen as a case study for implementing and testing the manual and a self-monitoring manual for this industry was developed.

1.1. Preface

The developed manuals were tested through a number of training programs that targeted RBOs and EMUs. The inspectors involved in the training used these manuals to inspect a number of industrial facilities. Feedback from the concerned parties led to the improvement of these manuals and their continuous update. There was clearly a need for sector-specific guidelines and EPAP took the initiative to develop such manuals. Five sectors were chosen:

- Food Industry with specific reference to the five sub-sectors of Dairy products, Vegetables and Fruit processing, Grain Milling, Carbonated Beverages and Confectionery.
- Pulp and Paper Industry
- Metallurgical Industry with specific reference to the two sub-sectors of Iron and Steel and Aluminum.
- Engineering Industry
- Textile Industry.

1.1.1. Project objectives

The project aims at the development of sector-specific guidelines for inspection and monitoring to be used by inspectors and plant personnel respectively. These manuals are meant to be simplified but without abstention of any information necessary to the targeted users. Flowcharts, tables and highlighted notes are used for easy representation of information.

With respect to the food industry, each sub-sector will have two distinct manuals one for inspection and the other for self-monitoring. Description of the industry, pollution aspects and relevant environmental laws will be similar for both manuals. Each manual will be, as much as possible a stand-alone with occasional cross-reference to the General Guidelines previously developed to avoid undue repetitions.

1.1.2. Organization of the inspection manual

The inspection manual for the dairy industry includes ten chapters. The first chapter represents an introduction to the whole project and to the specific sub-sector of the industry. Chapters two to five deal with the dairy industry and its environmental impacts.

The description of the industry in chapter 2 includes the inputs and outputs, a description of the different production lines with their specific inputs and outputs, a brief description of the service and auxiliary units that could be present at the industrial establishment with their potential sources of pollution and the various emissions, effluents and solid wastes generated from the different processes.

Chapter three describes the environmental and health impacts of the various pollutants whereas chapter four gives a summary of the articles in the Egyptian environmental laws relevant to the dairy industry. Chapter five gives examples of pollution abatement techniques and measures applicable to the dairy industry.

The inspection procedures are described in chapters 6 to 10 starting with a brief description of the inspection process in chapter 6 then the planning aspects that should be considered at the inspectorate level are explained in chapter 7. The different tasks at the inspectors level specific to the Dairy industry, will be described in chapters 8 to 10. The tasks before field inspection are presented in chapter 8 whereas the inspection tasks for actually performing the field visit are defined in chapter 9. Chapter 10 is concerned with the conclusion of the field visit including inspection report writing, supporting the enforcement case and following-up the compliance status of the facility.

1.2. Introduction to the dairy industry

The dairy industry is a major enterprise in Egypt, occupying a significant place in food supply. This industry has been identified as an important contributor to the pollution of waterways especially when large industrial establishments are involved.

1.2.1. Egyptian SIC code for the dairy industry

The Standard Industrial Classification (SIC) code for the food industry is 15 and the Dairy Products Industries have a sub-sector code of 152.

The CAPMAS (Central Agency for Public Mobilization and Statistics) 1997 data, which is based on the 1996 census, shows that the total number of dairy product processing facilities is 3334.

1.2.2. Industry size and geographic distribution

Table 1 presents a classification of the facilities by manpower for Egypt. Manpower is an indicator for the facility size, although modern facilities employ fewer workers for the same production rate. It is clear from that 75% of the facilities are operating with less than 4 workers and 7.8% have more than 40 employees. Table 2 shows the distribution of facilities by manpower for each governorate.

Table 1: Size distribution of dairy industries

Manpower	1	2	3	4	5	6-10	11-15	16-20	21-25	26-30	31-40	41-50	51-100	101-500	501-1000
No of facilities	1419	603	494	312	362	57	21	20	10	6	4	11	12	3	-

Table 2. Size distribution of dairy industries per Governorate

Manpower	Cairo	Alexandria	PortSaid	Suez	Damieta	Daqahlya	Sharkia	Qalyoubia	Kafr-el-sheik	Gharbiya	Menoufia	Behera	Ismalia	Giza	Benisuef	Fayoum	Minia	Asyout	Sohag	Qena	Aswan	Luxor	RedSea	NewValley	Matrouh	Total
001	26	26	3	17	29	93	135	60	11	24	127	219	4	74	371	31	104	2	4	49	9		1			1419
002	35	30	5	104	38	64	51	44	8	32	35	29	3	41	23	12	18	5	5	18	1		1			603
003	17	24	7	61	35	102	35	30	23	40	21	22	7	26	3	16	14	1	2	8						494
004	9	7	4	31	36	77	15	16	21	15	11	22	1	15	1	7	16	1	4	1			1		1	312
005	28	17		6	51	80	33	22	18	20	12	17	7	24	3	6	10	1	6	1						362
010	6	4		2	5	8	12	1	3	3	3	1		4		1	2	1		1						57
015	2	2	1		2	1	3			1	1	2		2	1	2										21
020	2	2				10						1		2			1	1	1							20
025		1				2	1	1	1			2		1				1								10
030						2				2						1		1								6
040							1					1		2												4
050	2	1				2	2			1		1		1												11
100	2							1	1	1	1		1	5												12
500					1			1						1												3
1000																										
Total	129	114	20	221	197	441	288	176	86	139	211	317	2	198	402	76	165	14	22	78	11	1	3	1	1	**3334**

2. Description of the industry

The dairy industry is characterized by the multitude of products and therefore production lines. Plants can have as few as one or two production lines or all of them. Service and ancillary units provide water and energy requirements as well as maintenance, storage, packaging, testing and analysis needs. Because of the nature of milk and milk products, which are susceptible to microbial spoilage, equipment is characterized by designs which facilitate hygienic operation, easy cleaning and sterilization. While many older plants use open equipment and batch processing, modern dairy food plants used closed systems operated continuously for periods up to 24 hours. Shut down for cleaning is generally required at least once per day.

2.1. Raw materials and utilities.

The main raw materials used are: fresh cow and buffalo milk, powder milk, rennet, roqueforti fungi (for Roquefort cheese), yeast, butter oil, starter for yogurt, preservatives, green pepper.

Chemicals are used in the lab for quality control and analysis. Detergents and antiseptics are used for cleaning and sterilization purposes (sodium hydroxide, nitric acid, sodium hypochlorite). Lube oil is used for the garage and workshops.

Different types of packaging materials are also used (aluminum foil, plastic containers, tin sheets).

Boiler grade water is pretreated in softeners to prevent scale formation. Steam is generated in boilers that use either mazot (fuel oil), solar (gas oil) or natural gas as fuel. Steam is used for providing heat requirements and in some plants for electric power generations.

Water is used for cleaning equipment and floor washing, as boiler feed water, as cooling water and for domestic purposesWater sources may be supplied from public water lines, wells or canal water. The type of water will dictate the type of pretreatment.

Some plants manufacture their own containers. Tin can manufacturing plants could be present in some facilities. Big facilities could also include a housing complex generating domestic wastewater.

Note: Defining the inputs and outputs helps predict the expected pollutants.

2.2. Production lines

Table 3 presents the various production lines and service units that could be present in a facility.

Note: Knowledge of the processes involved in each production line and units allows the prediction of pollution hazards and expected violations and helps determine possibilities for implementing cleaner technology.

Table 3. Production lines and service units in dairy industry

Production Lines (Dairy)	Service Units
Production of pasteurized, UHT milk	Boilers
Production of white cheese	Cooling towers
Production of Roquefort cheese.	Refrigerators
Mish production	Tin can manufactoring plant
Yogurt production	Laboratory
Processed cheese production	Mechanical & electrical workshops
Whey concentration and drying	Garage
Hard cheese production	Storage facilities.
Ice cream production	Wastewater Treatment Plant
	Restaurant and Housing complex

2.2.1. Production of pasteurized and UHT milk

Figure1 presents the main operations in the milk production line, the inputs to the units and the pollution sources. These operations are:

Receiving and testing raw milk Raw milk is received from the collection centers which are either privately owned or government owned (public sector). Milk is tested for quality by the facility lab, which measures the following parameters: fat content, solid content, presence of preservatives (formaldehyde)

The price of received milk is determined according to the measured quality and consequently reduced for lower fat or protein content. Milk is rejected if formaldehyde is present.

Straining The accepted milk is then passed through strainers then to a volume-measuring device for quantification. Milk is then cooled to 6-8 ^{o}C and stored in storage tanks, some for cow milk and others for buffalo milk.

Pasteurization Milk is heated in two stages, first from 7 to 65 ^{o}C, and then from 65 to 80 ^{o}C. It is kept at 80 ^{o}C for 15 seconds and then cooled to 4-6 ^{o}C. The pasteurization temperature used in Egypt is higher than the standard (72 ^{o}C at 15 sec.), to ensure that most commonly present bacteria are killed and accordingly guarantee public safety.

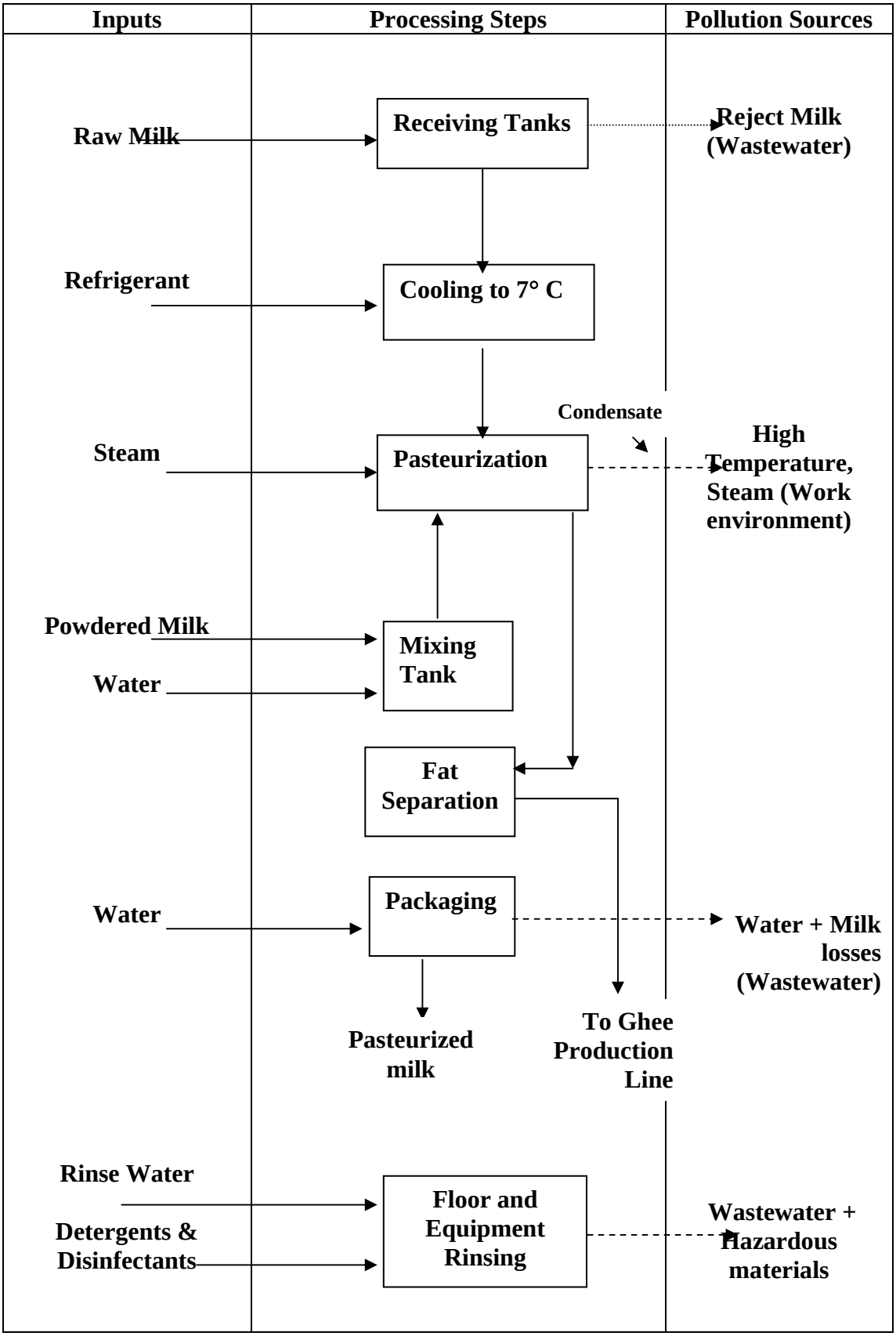
UHT milk Pasteurized milk is sterilized by raising the temperature to 135 – 150 ^{o}C for 4 seconds (Ultra High Temperature, UHT). Milk is then homogenized by reducing the size of fat globules to prevent separation of cream on the surface.

Packaging Milk is introduced in an automatic filling machine that usually used polyethylene bags or tetra pack containers.

Milk losses from the filling operation are estimated to be about 2% of the feed and are discharged to the factory sewer.

Water is used to facilitate the movement of the plastic bags and to cool the machines.

Figure (1) – Production Line for pasteurized Milk and Related Pollution Sources



Note: Find out:

- What happens to reject milk?
- How and when does cleaning of tanks and floors occur?
- What type of detergent and/or antiseptic is used?
- Is there any steam leak that can cause work environment violations?

2.2.2. White cheese production

Figure 2 presents the processing steps for white cheese production and the potential pollution sources. These steps are:

Heating	Pasteurized milk is heated to 50 ^{o}C using steam, which is introduced in coils or in the jacket of the heated vessel.
	Indirect heating ensures that steam does not contact milk.
	Steam condensate can be collected and recycled back to the boiler grade feed water.
Ultra-filtration	Milk is then passed under pressure though a membrane that allows small molecules like water and lactose to pass through. The filtrate is usually discharged to the factory sewer. The membrane retains concentrated milk that is further processed.
Curding and packaging	Different additives (rennet, salt) are mixed with the concentrated milk and the mixture is left to complete the curding process.
	The curded milk solids are separated from the whey by means of a cotton cloth. The produced cheese is then cut in cubes, packed in salt solution and stored in refrigerators.

Note : There are two sources of pollution :

- Water and lactose mixture
- Cheese whey

Both streams contain valuable by-products that could be recovered.

2.2.3. Production of Hard cheese

Figure 3 presents the processing steps for Hard cheese production, related raw materials and potential pollution sources. These steps are:

Curding	The pasteurized, concentrated milk is left to start the curding process. After that steam is fed and additives such as salt and rennet are mixed with milk. A cheese whey is produced.
Molding	After the mixture is left to complete the curding process. The formed cheese is put in molds and pressed to separate the cheese whey
Aging & Storage	The cheese is left to dry, then left for storage in a cold area

Note : If the industrial facility precipitate protein from whey produced from curding operation by blowing steam. This action will in turn reduce BOD of whey stream.

2.2.4. Production of Roquefort cheese

Figure 4presents the processing steps for Roquefort cheese production, related raw materials and potential pollution sources. These steps are:

Preparation and curding	Penicilium roqueforti fungi and other additives are mixed with pasteurized milk. Curded milk solids are separated from cheese whey by filtration.
Salting and aging	Salt addition is performed in two stages. First, dry salt is added, then a 23% salt solution in which it is left for 3 days at 15 ^{o}C. The cheese is then punched and left in refrigerators at 8 – 10 ^{o}C for one month.
Packaging	An automatic packaging machine fed with aluminum foil cuts the cheese and performs the packaging.

Note:

- Check if incubation at 22^{o} C is performed by cooling water or refrigerant
- Cooling water can be used in closed or open cycle.
- Some refrigerants are hazardous.

Figure (2) – White Cheese Production Line and Sources of Pollution

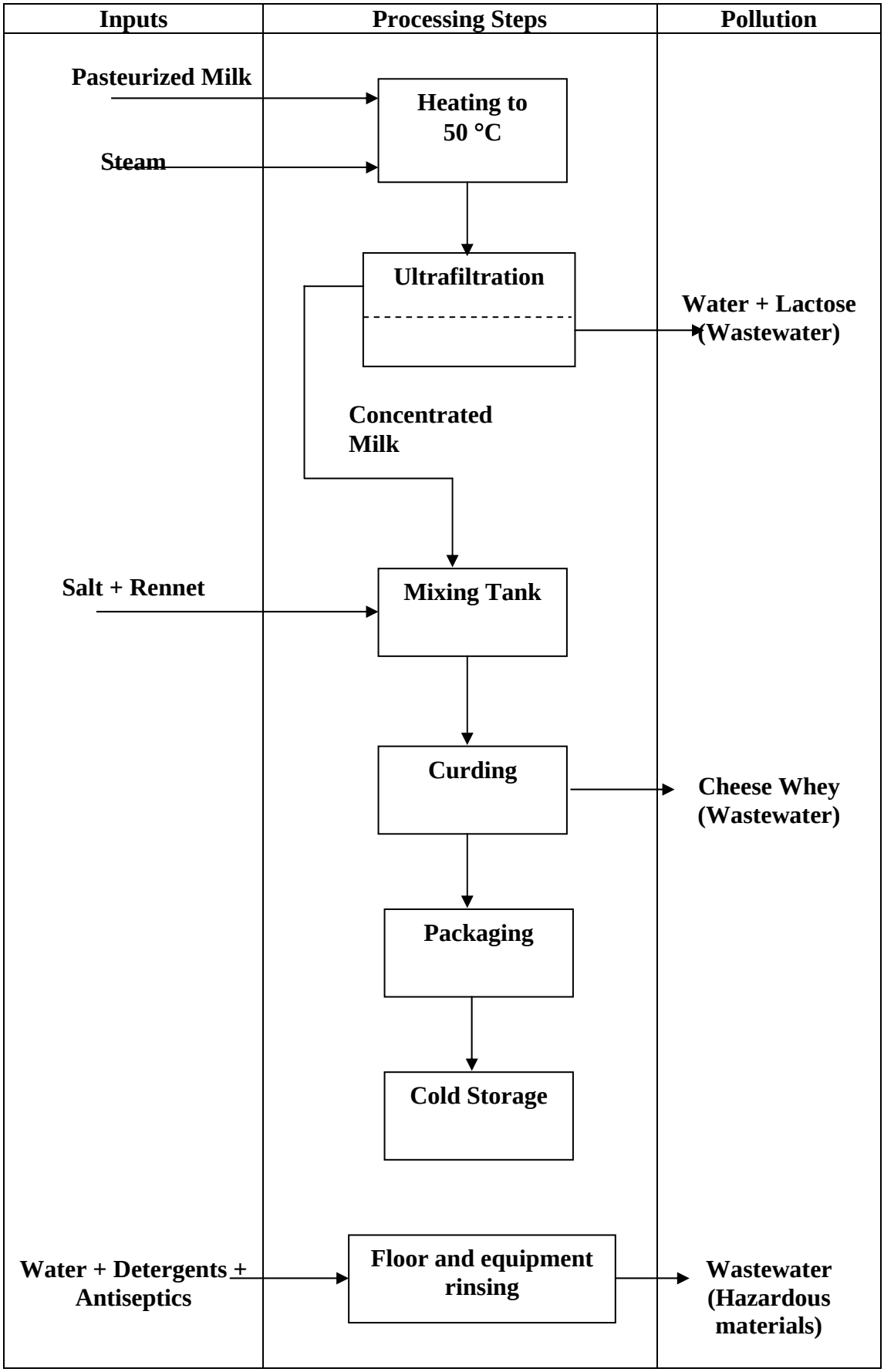


Table (3): Hard Cheese Production line and Sources of Pollution

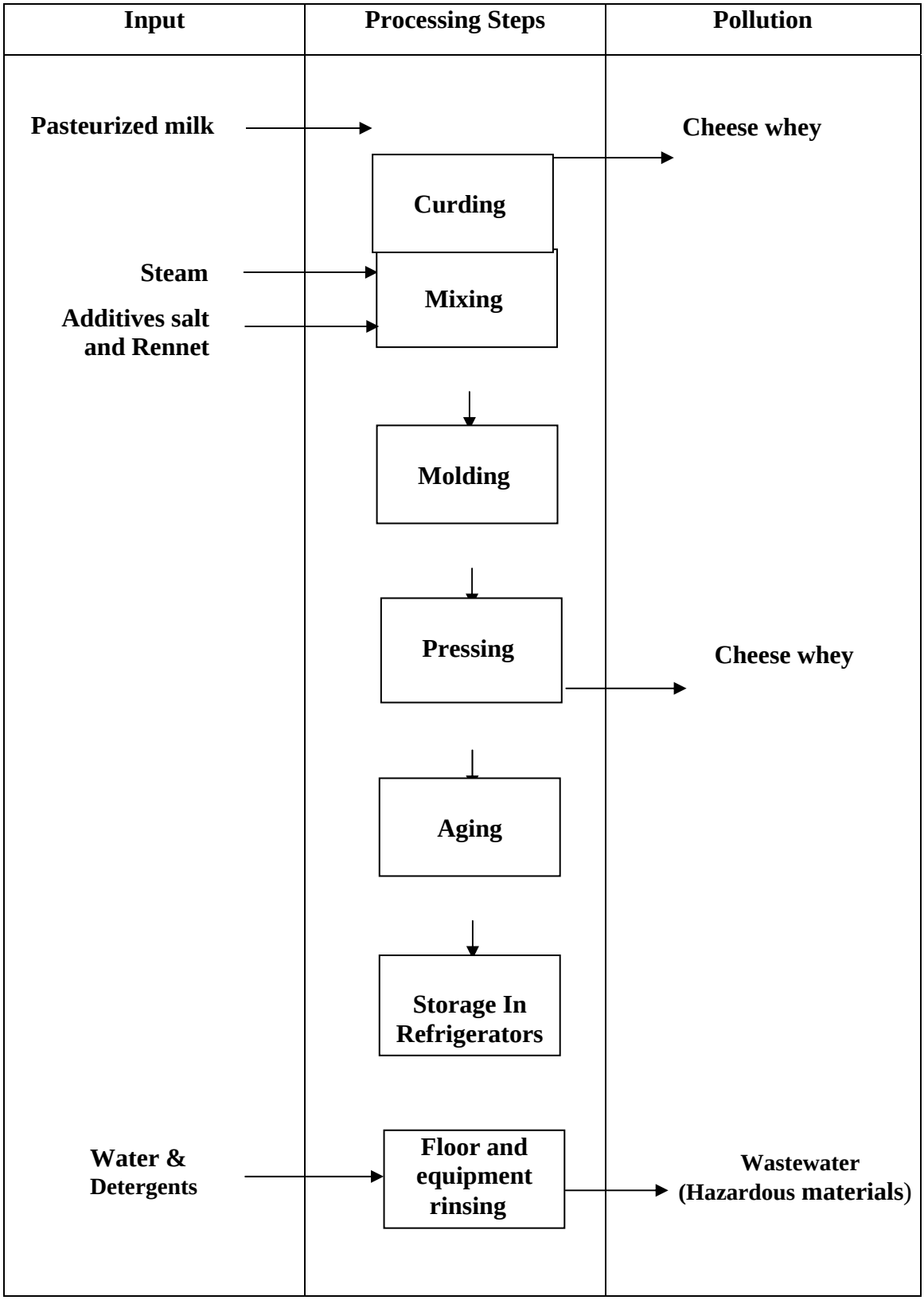
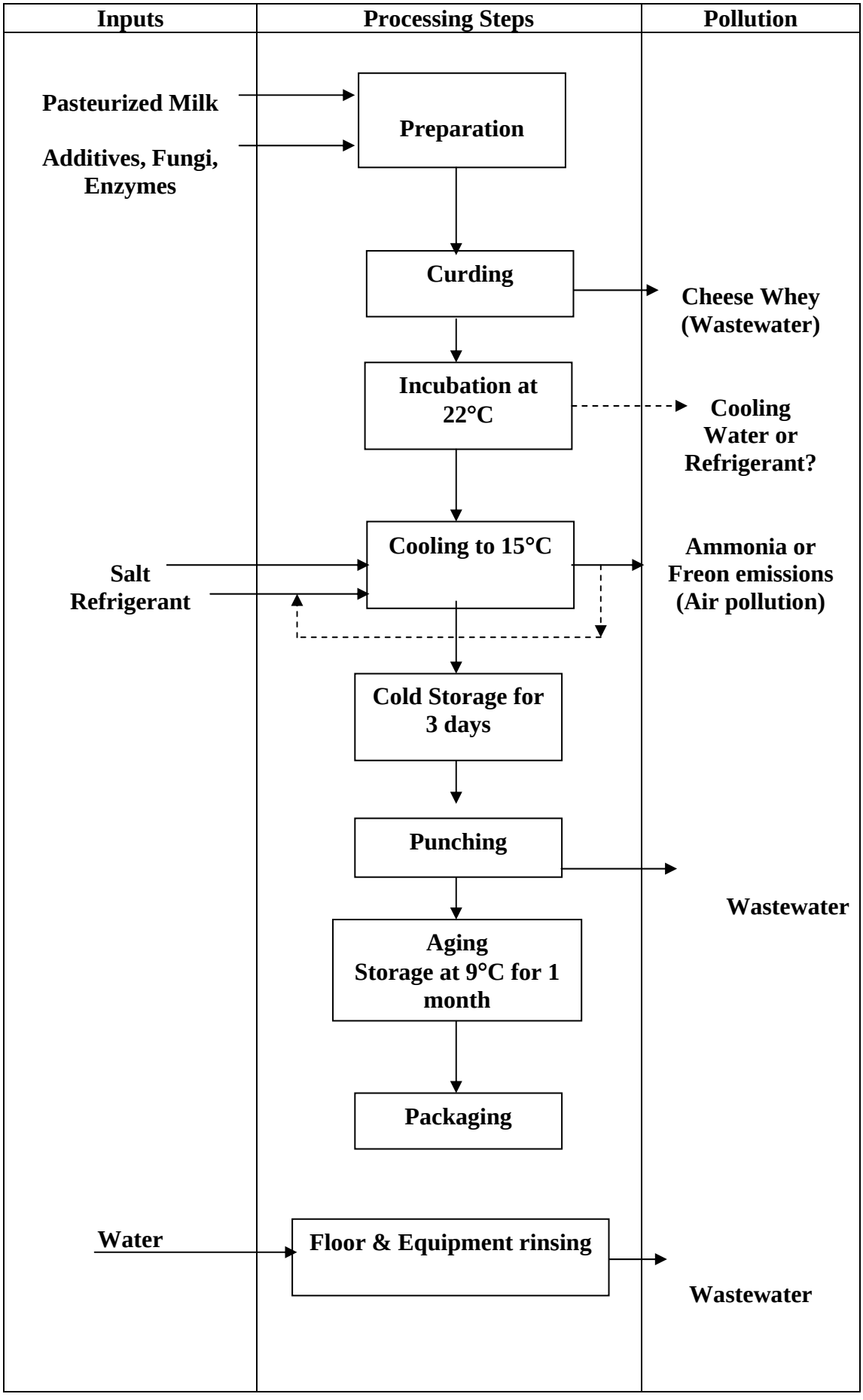


Figure (4) – Roquefort Cheese Production Line and Related Pollution Sources



2.2.5. Mish (salty cheese mix) production line.

Figure 5 presents the process flow diagram, relevant raw materials and potential pollution sources.

Mish production is considered as a useful effective method for reuse of any dairy product which is unacceptable for marketing, but acceptable from the health and quality points of view, e.g. damaged packages, fermented milk, unsold stocks close to expiration date.

All the above stated raw materials are mixed and salted then ground and pasteurized. Filtration is performed to separate cheese whey from milk solids (mish). The produced mish is packaged after the addition of preservatives.

Note:

- Mish production can be considered as a pollution abatement measure.

2.2.6. Ghee (clarified butter) production

Ghee is produced by melting milk cream with the addition of 2 – 3% salt. Some manufacturers add margarine. The product is filtered and the solid residues are sold as a by-product under the name "Morta".

Automatic filling machines are usually used to fill tin cans with ghee and seal them. Some producers use plastic containers.

2.2.7. Yogurt production

Yogurt is made from pasteurized milk after adding milk powder (2.6 %) to increase milk solids and yogurt-fixer. The product is automatically packaged in plastic cups, which are then incubated at 37 ^{o}C for a few hours. The product is stored in refrigerators.

2.2.8. Processed cheese production.

Processed cheese is made from many ingredients, mainly palm oil, cheese curd, Roquefort cheese, skimmed milk, protein whey, emulsifying salts and preservatives.

2.2.9. Ice cream Production

Figure 6 presents the processing steps for ice cream production and the potential pollution sources, these steps are:

Dissolution & Mixing	Powdered milk is dissolved in water and other ingredients are mixed such as sugar, milk, flavours and colours. The mixing is at temperature of about 60º C
Pasteurization and homogenization	The mixture is pasteurized by heating the mixture to a temperature 85 ºC. After that the mixture is homogenized at temperature 72º C

Cooling & Maturation	The mixture is cooled to 5º C and left for maturation
Freezing	The cooled, maturated mixture is freezed at –2º C to obtain a semi solid shape.
Hardening & Packaging	The semi solid ice cream is harden at –35º C then undergoes packaging

Figure (5) – Mish Production Line and Related Pollution Sources

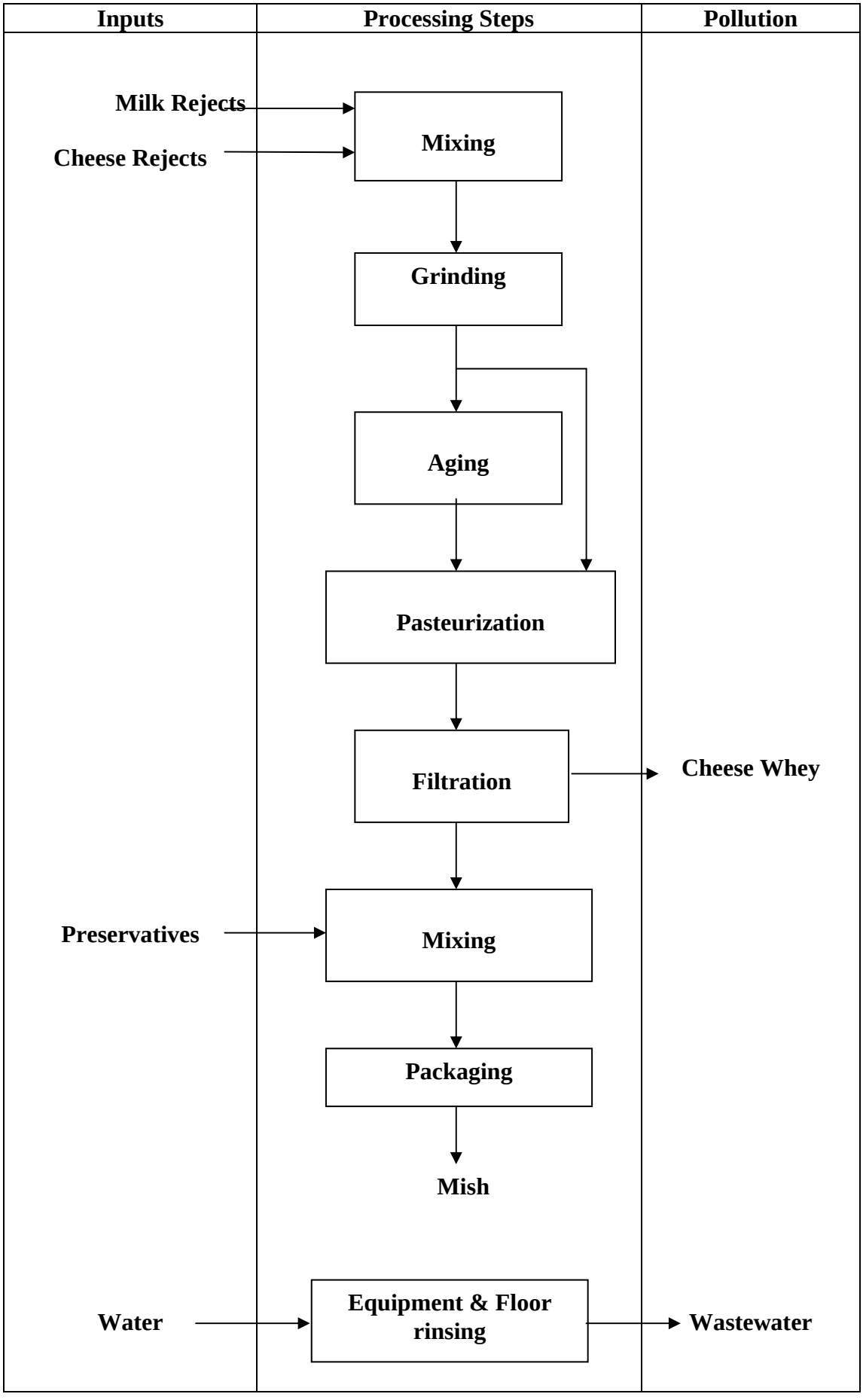
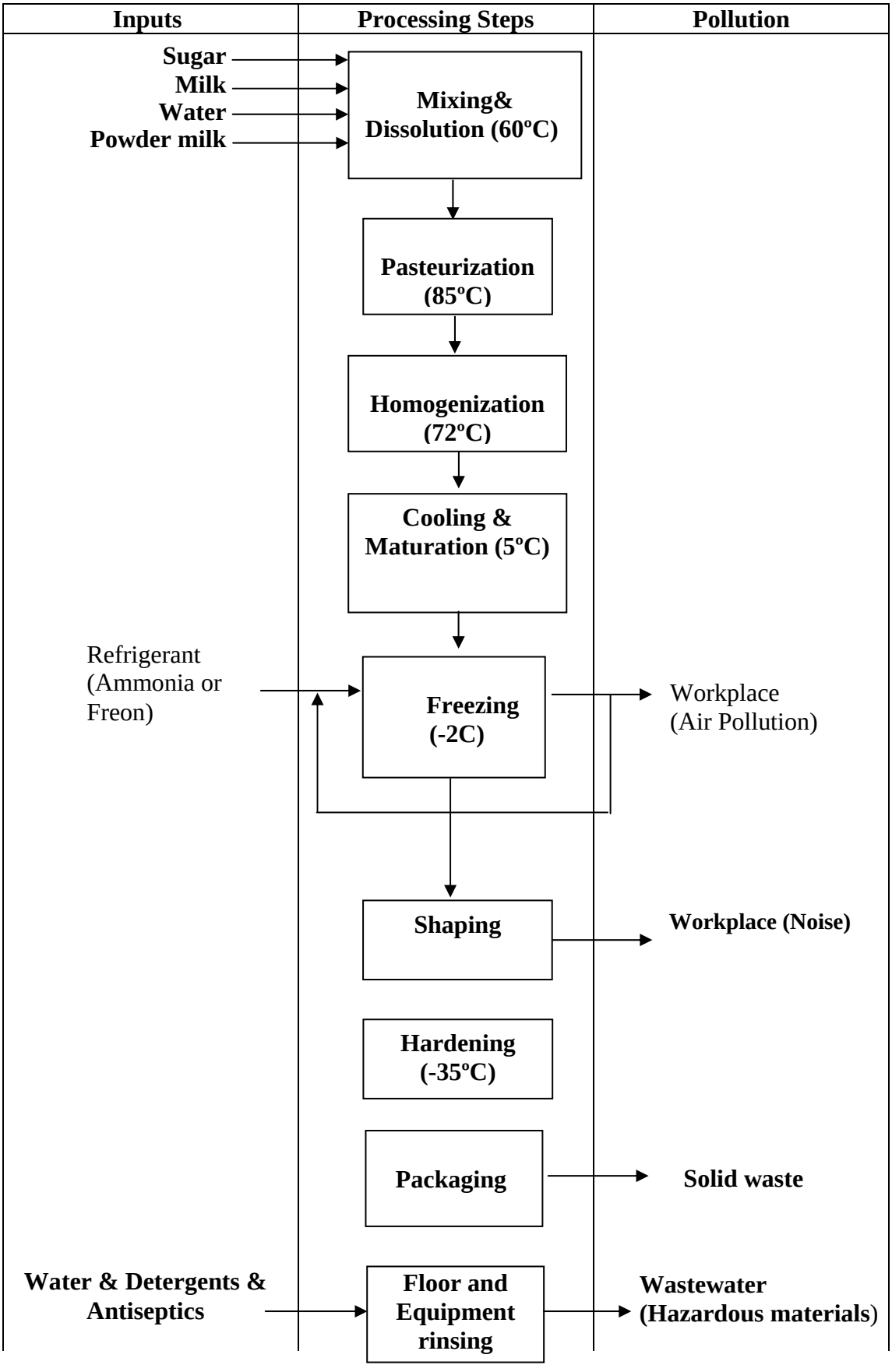


Table (6): Ice Cream Production Line and Sources of Pollution



2.3. Service units: description and potential pollution sources

Medium and large size plants will have some/all of the following service and auxiliary units. These units can be pollution sources and therefore should be inspected and monitored. Figure (7) shows the various units with their corresponding raw materials and potential pollution sources.

2.3.1. Boilers

Boilers are used to produce steam for:

- heat supply to the processes
- electric power generation

Conventional steam-producing thermal power plants generate electricity through a series of energy conversion stages. Fuel is burned in boilers to convert water to high-pressure steam, which is then used to drive the turbine to generate electricity.

The gaseous emissions generated by boilers are typical of those from combustion processes. The exhaust gases from burning fuel oil (Mazot) or diesel oil (solar) contain primarily particulates (including heavy metals if they are present in significant concentrations in the fuel), sulfur and nitrogen oxides (SOx and NOx) and volatile organic compounds (VOCs).

The concentration of these pollutants in the exhaust gases is a function of firing configuration (nozzle design, chimney height), operating practices and fuel composition.

Gas-fired boilers generally produce negligible quantities of particulates and pollutants.

Wastewater is generated as blowdown purged from boilers to keep the concentration of dissolved salts at a level that prevents salt precipitation and consequently scale formation. The blowdown will be high in TDS.

In the case of power plants, water is used for cooling the turbines and is also generated as steam condensate. The amount of wastewater generated depends on whether cooling is performed in open or closed cycle and on the recycling of steam condensate. Contamination may arise from lubricating and fuel oil.

2.3.2. Water Treatment Units

There are different types of water used in industry. Depending on the application and the water source, different treatment processes are applied.

a) ***Water Softening for medium hardness water:*** Calcium and magnesium ions are removed from hard water by cation exchange for sodium ions. When the exchange resin has removed the ions to the limits of its capacity, it is regenerated to the sodium form with a salt solution (sodium chloride) in the pH range of 6-8. This is performed by taking the softener out of service, backwashing with the salt solution, rinsing to eliminate excess salt, then returning it to service. The treated water has a hardness level of less than 1 ppm expressed as calcium carbonate.

b) ***Water softening for very high bicarbonate hardness:*** Water from wells and canals is pre-treated before softening. Water is treated first by the lime process, then by cation exchange. The lime process reduces dissolved solids by precipitating calcium carbonate and magnesium hydroxide from the water. It can reduce calcium hardness to 35 ppm if proper opportunity is given for precipitation. A coagulant such as aluminum sulfate (alum) or ferric sulfate is added to aid magnesium hydroxide precipitation. Calcium hypochlorite is added in some cases. Currently the use of organic polyelectrolytes is replacing many of the traditional inorganic coagulant aid. Sludge precipitates and is discharged to disposal sites whereas the overflowing water is fed to a sand filer followed by an activated carbon filter that removes any substances causing odor and taste. A micro filter can then be used to remove remaining traces. A successful method to accelerate precipitation is contacting previously precipitated sludge with the raw water and chemicals. The sludge particles act as seeds for further precipitation. The result is a more rapid and more complete reaction with larger and more easily settled particles.

c) ***Reverse Osmosis:*** Demineralization can also be performed by reverse osmosis. In this process water is forced through a semi-permeable membrane by applying pressure.

2.3.3. Cooling Towers

Cooling water is used extensively in industry. During the cooling process, water heats up and can only be reused if cooled. Cooling towers provide the means for recycling water and thus minimizing its consumption. The cooling effect is performed through partial evaporation. This causes an increase in the concentration of dissolved salts which is controlled by purging some water (blowdown). The blowdown will be high in TDS.

2.3.4. Refrigeration systems

The term refrigeration usually applies to cooling below ambient temperature. Refrigeration operations involve a change in phase of a substance (refrigerant) so that it will be capable of abstracting heat. The refrigerant absorbs heat at low temperature by vaporization and gives it up at the condenser. Compressors are used for increasing the pressure of the vaporized refrigerant. The increase in pressure is accompanied by an increase in temperature that enables cooling water to condense the vapor, and the cycle is repeated.

The major pollutants can be:

- Noise from the compressors operation, which can be a violating parameter in the work and ambient environment.
- Waste cooling water, which could be contaminated with lube oil
- Hazardous materials, such as Chloro-Fluoro-Carbons (CFCs), if used as refrigerants.

2.3.5. Tin Cans Manufacturing

Some food plants have their own tin can production where tin sheets are fed to a cutting and forming machine operating in a continuous mode. The sheets are first lacquered and left to dry. The sheets are then moved to the printing line that uses inks and solvents to print labels. The produced cans are sterilized before filling.

Environmental violations could be due to:

- Air emissions (VOC's) in workplace
- Heat generated from paint dryer
- Noise generated by machine operation
- Solid waste resulting from damaged cans and scrap tin.
- Floor washing wastewater contaminated with Oil and Grease from lube oil, paints and solvents.

2.3.6. Laboratories

Laboratories have an important role in the food industry, as they are responsible for:

- Testing raw materials, chemicals, water, wastewater, packaging material, etc.
- Quality control of the different products and comparing the findings with the standard specifications for raw materials and final products
- The measured parameters are physical properties, chemical composition, and bacteriological counts.

Chemicals used for testing could be hazardous. Proper handling and storage are required for compliance with environmental law.

2.3.7. Workshops and Garage

Large facilities have electrical and mechanical workshops for maintenance and repair purposes. Environmental violations could be due to:

- Noise
- Rinse water contaminated with lube oil

Pollution in the garage area will depend upon the services offered. The presence of a gasoline or diesel station implies fuel storage in underground or over the ground tanks that require leak and spill control plans.

Replacing lube oil implies that there is a possibility for spent oil discharge to sewage (check the presence of a collection and sales system (contract)).

2.3.8. Storage Facilities

The specifications for the storage facilities depend on the stored material.

- Raw milk is stored in insulated and refrigerated (6-8 °C) tanks.

- Pasteurized milk used as raw material for manufacturing milk products is usually stored next to the corresponding production tank for shorter periods of time.
- Pasteurized and UHT milk sold as product is packaged and stored in refrigerators.
- Products are packaged either in plastic containers (hard or soft), tin containers or Tetrapack. Cheese products are stored in refrigerators.
- Chemicals are used as additives for the process (salt, …), for washing and disinfecting purposes, for the lab. Some of the chemicals could be hazardous and require special handling, storage and management procedures as required by law.
- Fuel is used for the boilers and for the cars and delivery trucks. It is stored in underground or over ground tanks. The types of fuel usually used are fuel oil (Mazot), gas oil (solar), natural gas and gasoline.
-

2.3.9. Wastewater Treatment Plants

Although a WWTP is a pollution abatement measure, it has to be inspected and monitored for potential pollution. Pollution may be due to malfunctioning or improper management. A dairy facility discharges wastewater, high in organic load. From time to time peak load will be discharged. They may be due to internal processes, to seasonal fluctuations, to lack of control or a "force majeur" situation such as power collapse.

The potential pollution sources are:

- Sludge which represents a solid waste problem
- Treated water could represent a water pollution problem if not complying with relevant environmental laws

2.3.10. Restaurants, Washrooms and Housing Complex

These facilities will generate domestic wastewater as well as domestic solid waste.

Figure (7) – Service Units and Their Related Pollution Sources (Continued)

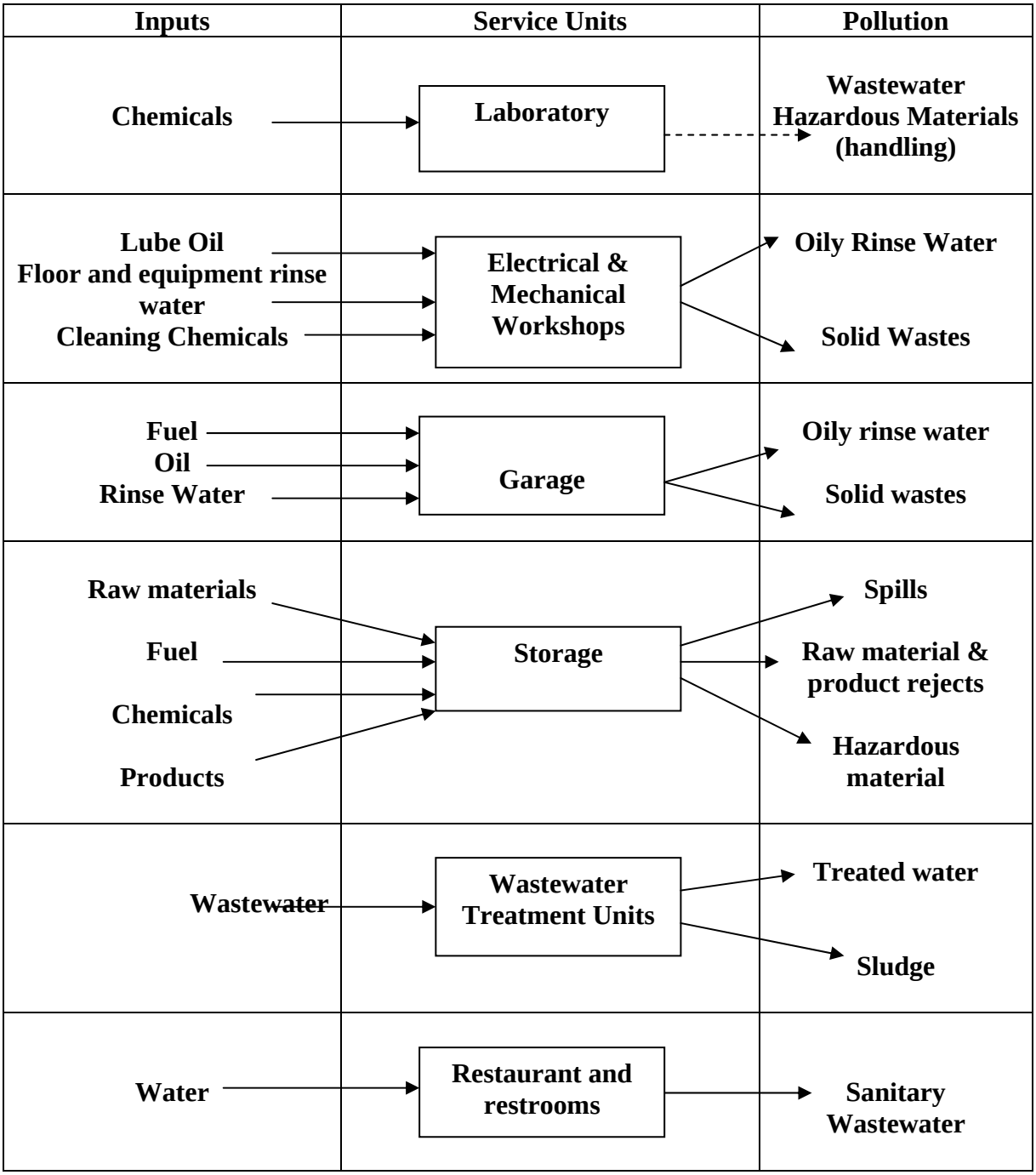
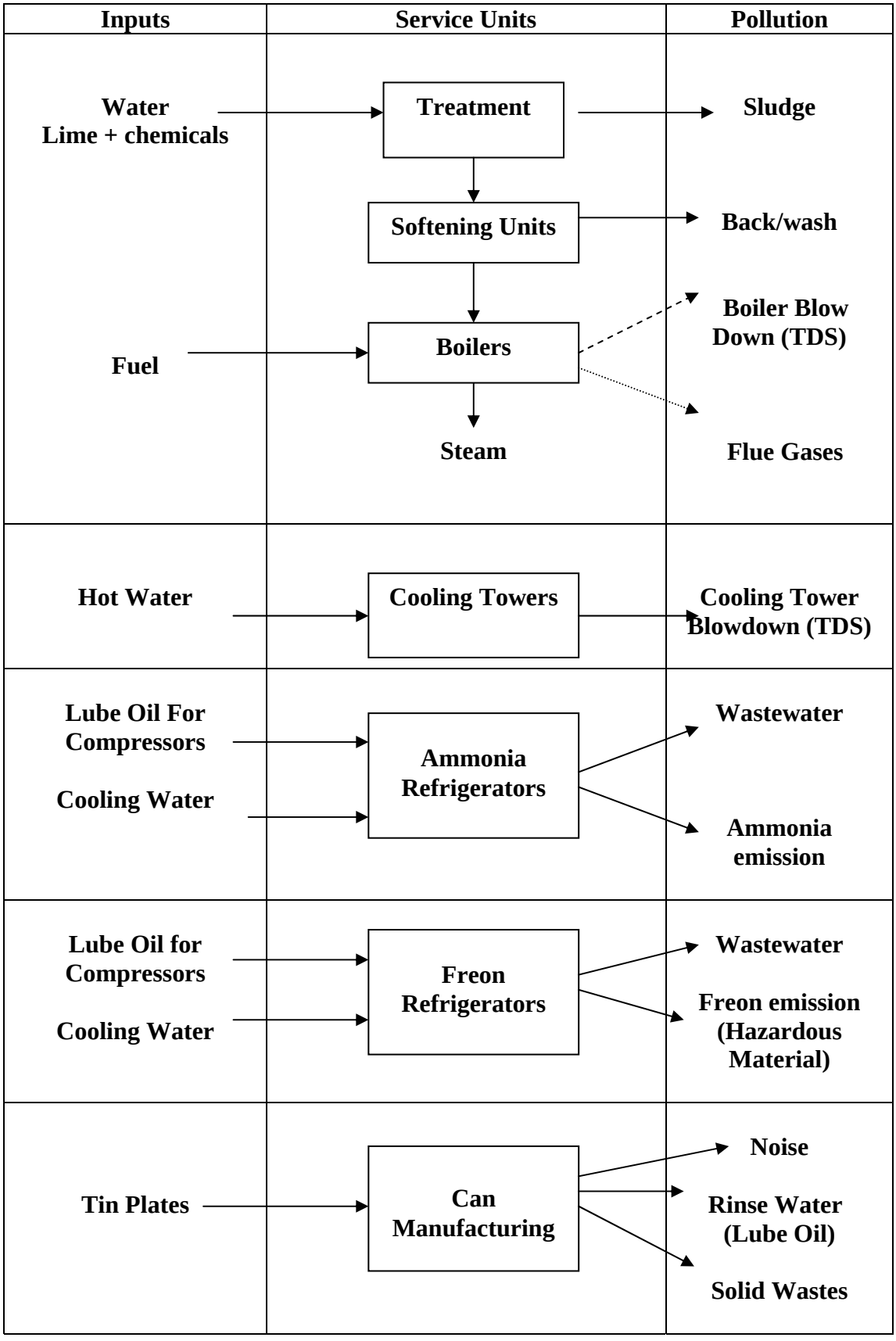


Figure (7) – Service Units and Their Related Pollution Sources



2.4. Emissions, effluents and solid wastes

Table (4) summarizes the major polluting processes, their outputs and the violating parameters.

2.4.1. Air emissions

There are four sources of air emission in the dairy industry.

- Exhaust gases resulting from fuel consumption used to generate steam from boilers. The violating parameters would be: particulate matters, (PM10), sulfur oxides, nitrogen oxides, carbon monoxide.
- Freon and ammonia resulting from leaks in refrigeration tubes
- Steam leaking from heating tubes or used as live steam has a negative impact on air quality

2.4.2. Effluents

The major pollution load of the dairy industry is the wastewater from the various sources:

- Rejected milk discharged to the plant sewer sewer system (BOD)
- Cheese whey is a by-product of the curding process (BOD)
- Milk filling machines are responsible for milk spills (BOD)
- Blowdowns from the cooling tower and boilers as well as backwash of softeners are high in TDS and TSS.
- Spent lube oil from garage and workshops if discharged to sewer will give oily wastewater (O&G).
- Floor and equipment washing and sanitation produces a wastewater containing organic matter, oil and grease, and traces of the chemicals used for neutralization and sanitation.

Typical effluent characteristics of the Egyptian dairy industry are shown in table 5. Typical pollution loads per ton of production are given in table 6.

Table (4). Pollutants Per Process

MAJOR POLLUTING PROCESS	PROCESS INPUTS	PROCESS OUTPUTS	POLLUTION PARAMETERS	IMPACT
Raw Milk Inspection	Raw Milk	Accepted Milk		
		Reject to Sewer	BOD, TS, pH	Water
Pasteurization	Steam	Steam Condensate	Temp., Humidity	Work Environment
	Raw Milk	Pasteurized Milk		
Ultrafiltration	Milk	Concentrated milk		
		Water and lactose	BOD	Water
Curding	Pasteurized milk + Rennet + Salt	Cheese		
		Whey	BOD, TSS, pH	Water
Refrigeration with Freon	Dairy Products	Refrigerated Milk Products		
	Freon	Freon leaks	Freon (hazardous)	Air
Refrigeration with Ammonia	Dairy Products	Refrigerated Milk Products		
	Ammonia	Ammonia leaks	Ammonia	Work Environment
Packaging	Dairy products	Losses in wastewater	BOD, COD, pH	Water
Softeners	Raw Water	Treated Water		
		Backwash	TDS, TSS	Water
Boilers	Treated Water + Condensate recycle	Blowdown	TDS, TSS	Water
	Fuel	Flue Gasses	CO, SO_x	Air
Cooling Towers	Water	Blowdown	TDS, TSS	Water
WWTP	Process WW	Treated effluent	BOD, COD, TSS, Color	Water
		Sludge	TSS	Soil

Table (5): Typical chemical Analysis of dairy factory waste effluents.

Parameter	pH	BOD mg/1	COD mg/1	T.S.S mg/1	S.S mg/1	TDS mg/1	$C1_2$ mg/1	Oil& Grease mg/1
1. Final effluent	5.8	13160	18800	10640	120	2512	Nil	Nil
2. Milk receiving & Pasteurization.	4.1	15624	20823	680	Nil	5780	-	Nil
3. Milk Packaging.	5.9	480	659	420	Nil	1432	-	Nil
4. Yogurt.	6.1	528	800	192	Nil	1140	-	Nil
5. White cheese.	7.2	5896	8800	160	2	1516	Nil	38
6. Lactose solution from ultrafiltration.	6.4	38909	42330	Nil	Nil	18980	-	Nil
7. Car garage.	5.2	532	800	9148	20	9004	-	1245

Table 6. Typical organic pollution loads in Egyptian dairy industry per ton of production

Plants	Effluent flow rate, m^3/d	BOD, kg/d	COD, kg/d
Milk receiving and pasteurization	18	281	375
Milk packaging	2.5	1.2	1.7
Yogurt	11	5.8	8.8
White cheese	24.5	144.5	216
Lactose solution	6	233	340
Final effluent	98	1290	1842

Typical wastewater loads from milk production plants in the US are 1-2 cubic meters per metric ton (m^3/t) of milk processed, typical product losses from American dairy industry are given in table 7. The plant operators should aim to achieve rates of $1m^3/t$ or less at the intake of the effluent treatment system. The BOD level should be less than 2.5 kg/t of milk, with a target of 1-1.1.5 kg/t. The BOD level from butter and cheese production should be less than 2kg/t of product.

2.4.3. Solid wastes

The main sources of solid wastes are the workshops and garage, packaging wastes, iron scrap, outdated solid products. The biological wastewater treatment plant also generates sludge. There are no hazardous wastes discharged from the plants.

Table 7.Typical product losses from American dairy industry

Operation	Product losses		
	Milk	Fat	Whey
Butter /transport of skimmed milk	0.17	0.14	n.a.
Butter and skimmed milk powder	0.60	0.20	n.a.
Cheese	0.20	0.10	1.6
Cheese and whey evaporation	0.20	0.10	2.2
Cheese and whey powder	0.20	0.10	2.3
Consumer milk	1.9	0.7	n.a.
Full-cream milk powder	0.64	0.22	n.a.

n.a. Not applicable

Note: Data are expressed as the percentage of the volume of milk, fat ,or whey processed.

2.5. Characteristics specific to the dairy industry

Proper inspection and monitoring of the dairy industry should take into consideration the following aspects:

- Production lines operated on continuous bases are usually higher technology than batch processes. However, due to the special nature of food processes, washing and sanitation are performed at least once a day for both operating modes.
- Shock loads are expected and are caused by discharging reject milk to sewer and in the case of batch processes cheese whey and lactose solution are probably discharged suddenly.
- Milk products production rate is seasonal since it relies on fresh milk that decreases in winter.
- Pollution loads are expected to be higher during start-up and shutdown.

3. Environmental and health impacts of pollutants.

3.1. Impact of air emissions

a) Particulate matters Recent epidemiological evidence suggests that much of the health damage caused by exposure to particulates is associated with particulate matters smaller than 10μm (PM_{10}). These particles penetrate most deeply into the lungs, causing a large spectrum of illnesses (e.g. asthma attack, cough, bronchitis). Emissions of particulates include ash, soot and carbon compounds, which are often the result of incomplete combustion. Acid condensate, sulphates and nitrates as well as lead, cadmium, and other metals can also be detected.

b) Sulfur Oxides Air pollution by sulfur oxides is a major environmental problem. This compound is harmful to plant and animal life, as well as many building materials. Another problem of great concern is acid rain which is caused by the dissolution of sulfur oxides in atmospheric water droplets to form acidic solutions that can be very damaging when distributed in the form of rain. Acid rain is corrosive to metals, limestone, and other materials.

c) Nitrogen Oxides Nitrogen oxides also dissolve in atmospheric water droplets to form acid rain.

d) Carbon dioxide Combustion of fossil fuels to produce electricity and heat contribute to the green house effect caused by the formation of carbon dioxide. The greenhouse phenomenon occurs when heat radiation from earth is absorbed by the gases causing a surface temperature increase.

e) Freon Freon is a trade name for Chloro-Fluoro-Carbons (CFCs) which are considered to be Ozone Destroying Substances (ODSs). The Ozone Depleting Potential (ODP) for these substances reflects the ability to destroy the ozone layer (Table 8).

Water Vapor (Humidity) Humidity in workplace is regulated by law 4/1994 due to its effect on the respiratory system especially for people suffering from asthma.

Table 8. Ozone Depletion Potential (ODP) of the principal Ozone Depleting Substances (ODSs)

ODS	ODP
CFC-11,-12,-13	1.0
CFC-113	0.8
CFC-115	0.6
CFC-111,-112,-114	1.0
CFC-211,-212,-213,-214,-215,-216,-217	1.0

3.2. Impact of effluents

It is clear that the main impact will be due to high organic loads. Table 15 clearly shows that the effluent is violating Egyptian environmental laws.

Spent lube oil from garage and workshops could be a cause for concern if discharged into the sewer system.

The organic material in wastewater stimulates the growth of bacteria and fungi naturally present in water which then consume dissolved oxygen.

The environmental impact of the wastewater depends on the receiving water body. The Ministry of Irrigation has set limits for the pollutants in the wastewater discharged into agriculture canals and drains as well as the Nile river for their detrimental effect on agriculture (Decree 8/1983). The parameters of relevance to the dairy industry are BOD, COD.

Discharge of polluted wastewater high in BOD into lakes and sea can cause eutrification and impact bio-diversity.

Sudden discharge of high BOD loads to the public sewer system will have an indirect environmental impact. Shock loads can cause malfunction of the domestic wastewater treatment plant.

3.3. Environmental Impact of Solid Wastes

Solid waste is mainly scrap that is collected and sold. No impacts are expected.

4. Egyptian laws and regulations

There are a number of laws and regulations that address the different environmental violations. The following are the laws applicable to the dairy industry.

4.1. Concerning air emissions

Article 40 of Law 4/1994, article 42 of the executive regulations and annex 6 deal with gaseous emissions from combustion of fuel. The statutes relevant to the fuel combustion are:

- The use of solar oil and other heavy oil products, as well crude oil shall be prohibited in dwelling zones.
- The sulfur percentage in fuel used in urban zones and near the dwelling zones shall not exceed 1.5%.
- The design of the burner and fire-house shall allow for complete mixing of fuel with the required amount of air, and for the uniform temperature distribution that ensure complete combustion and minimize gas emissions caused by incomplete combustion..
- Gases containing sulfur dioxide shall be emitted through chimneys rising sufficiently high in order that these gases become lighter before reaching the ground surface, or using fuel that contains high proportions of sulfur in power generating stations, as well as in industry and other regions lying away from inhabited urban areas, providing that atmospheric factors and adequate distances to prevent these gases from reaching the dwelling and agricultural zones and regions, as well as the water courses shall be observed.
- Chimneys from which a total emission of wastes reaches 7000 – 15000 kg/hr, shall have heights ranging between 18 – 36 meters.
- Chimneys from which a total emission of gaseous wastes reaches more than 15000 kg/hour, shall have heights exceeding at least two and a half times the height of surrounding buildings, including the building served by the chimney.
- The permissible limits of emissions from sources of fuel combustion are given in table 9 (Ministerial decree no. 495, 2001).

Table 9. Maximum limits of emissions from sources of fuel combustion

Pollution	Maximum limit mg/m^3 of exhaust
Sulfur Dioxide.	3400
Carbon Monoxide.	250
Volatized ashes in urban regions.	250
Volatized ashes in remote regions.	500
Smoke.	50

4.2. Concerning effluents

Limits for pollutants in wastewater vary depending on the type of receiving water body. The parameters that should be monitored and/or inspected are BOD, COD, pH, temperature, residual chlorine, TSS, TDS, Oil and Grease.
Table (10) presents the permissible limits for discharges to the different recipients (sea, Nile, canals, agricultural drains, public sewer) according to the different relevant laws.
Spent lube oil has a negative impact on water and soil and therefore its disposal should be monitored/inspected. A record should be kept for this purpose.

4.3. Concerning solid waste

A number of laws address solid waste management. The following laws apply to scrap and sludge from the WWTP:

- Law 38/1967 which addresses public cleanliness, regulates the collection and disposal of solid wastes from houses, public places, commercial and industrial establishments.
- Ministry of Housing, Utilities and Urban Communities (MHUUC) decree No. 134 of 1968, which provides guidelines from domestic and industrial sources, including specifications for collection, transportation, composting, incineration and land disposal.
- Law 31/1976, which amended law 38/1967
- Law 43/1979, the Law of Local administration, which provided that city councils are responsible for "physical and social infrastructure", effectively delegating responsibility for infrastructure functions.
- Law 4/1994 regulates incineration of solid waste

4.4. Concerning work environment

Violations of work environment could be encountered:

- In the boiler house: gas emissions, regulated by article 43 of Law 4/1994, article 45 of the executive regulations and annex 8. The limits for the relevant pollutants are presented in Table 11:
- Wherever heating is performed: temperature and humidity are regulated by article 44 of Law 4/1994, article 46 of the executive regulations and annex 9.
- In refrigeration rooms: ammonia leaks are regulated by article 43 of Law 4/1994, article 45 of the executive regulations and annex 8.
- Near heavy machinery: noise is regulated by article 42 of Law 4/1994, article 44 of the executive regulations and table 1, annex 7.
- Ventilation is regulated by article 45 of Law 4/1994 and article 47 of the executive regulations.
- Smoking is regulated by article 46 of Law 4/1994 and article 48 of the executive regulations, and Law 52/1981.
- Work environment conditions are addressed in Law 137/1981 for Labor, Minister of Housing Decree 380/1983, Minister of Industry Decree 380/1982

Table 10. Egyptian Environmental Legal Requirements for Industrial Wastewater

Parameter (mg/1 unless otherwise noted)	Law 4/94: Discharge Coastal Environment	Law 93/62 Discharge to Sewer System (as Decree 44/2000)	Law 48/82: Discharge into :			
			Underground Reservoir & Nile Branches/Canals	Nile (Main Stream)	Drains	
					Municipal	Industrial
BOD (5day,20 deg.)	60	<600	20	30	60	60
COD	100	<1100	30	40	80	100
pH (Grease)	6-9	6-9.5	6-9	6-9	6-9	6-9
Oil & Grease	15	<100	5	5	10	10
Temperature (deg.)	10C>avg. temp of receiving body	<43	35	35	35	35
Total Suspended Solids	60	<800	30	30	50	50
Settable Solids	—	<10	—	20	—	—
Total Dissolved Solids	2000	—	800	1200	2000	2000
Chlorine	—	<10	1	1	—	—

Table 11. Permissible limits as time average and for short periods

Material	Threshold			
	Time average		Exposure limits for short periods	
	ppm	mg/m^3	ppm	mg/m^3
Ammonia	25	18	35	27
Carbon dioxide	5000	9000	15000	27000
Carbon monoxide	50	55	400	440
Sulfur dioxide	2	5	5	10

4.5. Concerning hazardous material and waste

Law 4/1994 introduced the control of hazardous materials and wastes. The dairy industry does not generate any hazardous wastes. Hazardous chemicals such as hydrochloric and nitric acids are used for washing vessels. The hazardous chemicals used in the lab and the fuel for the boilers, fall under the provisions of Law 4/1994. Articles 29 and 33 of the law makes it mandatory for those who produce or handle dangerous materials in gaseous, liquid or solid form, to take precautions to ensure that no environmental damage shall occur. Articles 25, 31 and 32 of the executive regulations (decree 338/1995) specify the necessary precautions for handling hazardous materials. Storing of fuel for the boilers is covered by the Law 4 as hazardous material There is no explicit articles in Law 4/1994 or in decree 338/1995 (executive regulations), regarding holding a register for the hazardous materials; article 33 is concerned with hazardous wastes. However, keeping the register for the hazardous materials is implicit in article 25 of the executive regulations regarding the application for a license.

4.6. The Environmental Register.

Article 22 of Law 4/1994 states that the owner of the establishment shall keep a register showing the impact of the establishment activity on the environment. Article 17 and Annex 3 of the executive regulations specify the type of data recorded in the register.

The emergency response plan and the hazardous materials register will also be part of the environmental register as stated in part 4.5.

5. Pollution abatement measures

This section deals with pollution abatement (preventions) in the three media air, water and soil. Three types of interventions will be considered:

- In-plant modifications, which are changes that are performed in the plant to reduce pollutant concentrations in streams through recovery of materials, segregation and/or integration of streams, reducing the flow rate of the wastewater streams that need further treatment to reduce the hold-up of the required WWTP.
- In-Process modifications, which are changes performed on the process such as the introduction of newer technology, substitution of a hazardous raw material, performing process optimization and control.
- End-of-pipe (EoP) measures, which involve treatment of the pollutant or its separation for further disposal. Whereas in-plant and in-process modifications usually have an economic return on investment, end-of-pipe measures will be performed for the sole purpose of compliance with the laws without economic

Egyptian Environmental Laws do not require water and energy conservation measures. These measures have been considered in this manual since resource depletion and hence conservation is a worldwide-recognized environmental issue that could be implemented in Egypt in the near future. Water conservation measures can lead to higher concentrations of pollutants in the effluent streams. Both energy and water conservation measures will provide both financial and economic benefits. Table 12 gives an overview of pollution prevention (p2) techniques and their relative ease of implementation

The term Cleaner Production (CP) refers to the same concepts of pollution reduction through in-process, in-plant and resource conservation, in contradistinction to end-of-pipe treatment. In many cases, the adoption of CP can eliminate the need for (EoP) treatment.
The dairy industry sector has a great potential for implementation of cleaner technology measures. Newly installed factories employing manpower above 200 has acquired relatively newer technologies, which need little in-process or in-plant modifications and are carrying out end-of-pipe treatment to meet the requirement of environmental laws. However, medium size enterprises as well as public sector companies badly need the 3 types of modifications. Small private enterprises are using primitive technologies.
The following CP and EoP measures have been identified for the dairy industry.

5.1. Air pollution

Flue gases *Particulate matter* in flue (exhaust) gases are due the ash and heavy metal content of the fuel, low combustion temperature, low excess oxygen level, high flow rate of flue gases. *Sulfur dioxide* is due to the sulfur content of the fuel. *Nitrogen oxides* are formed when maximum combustion temperature and high excess oxygen. *Carbon monoxide* is formed when incomplete combustion occurs at low air to

fuel ratio.

The following measures can be adopted to minimize air pollution from flue (exhaust) gases:

- Replace Mazot by solar or natural gas. Mazot is high in sulfur content.
- Regulate the fuel to air ratio for an optimum excess air that ensures complete combustion of carbon monoxide to dioxide.
- Keep the combustion temperature at a moderate value to minimize particulate matter and nitrogen oxides.

Gas leaks Ammonia, Freon and steam leaks are minimized through maintenance and repair. Freon should be replaced by another non-hazardous refrigerant.

Odor Control Odor controls (such as absorbents/ biofilters on exhaust systems) should be implemented where necessary to achieve acceptable odor quality for nearby residents. Fabric filters should be used to control dust from milk powder production to below 50 milligrams per normal cubic meter (mg/Nm^3)

5.2. Water pollution abatement measures

In-plant modifications

- Whey is a major cause of pollution of wastewater. It can be concentrated or dried and sold as a fodder supplement. However, this process can be economically viable only for large production plants.
- BOD reduction of the whey effluent can be achieved by separating milk fat in a centrifuge and recycling to the ghee production line or the hard cheese production line.
- BOD reduction of the whey effluent (in case of hard cheese production) can be achieved by separation of protein by blowing of steam in whey collecting tank.
- Lactose can be recovered from the lactose solution produced at the ultra-filtration process.
- The installation of product-capture systems for filling machines can reduce product losses.
- Implementation of a quality control system such as HACCP (Hazard Analysis & Critical Control Point) is recommended to minimize waste.
- Integration and segregation of sewer lines to minimize treatment needs and ensure compliance with the environmental laws, can be an option for many factories. In some cases where there are several discharge points from the factory, mixing of the streams could lead to compliance. In other cases where treatment is imperative some streams could be segregated and discharged without violation. The remaining streams will require a smaller

treatment unit.

In-process modifications

- Implementation of a control system involving pressure regulators on the steam lines, temperature controllers, flow controllers…
- Partial recycling of cheese whey to be added to white cheese packages replacing salt solution.
- Replace batch processes with continuous ones, such as the introduction of ultra- filtration technology as a method for continuous cheese production.
- Modernize the equipment and upgrade the sterilization system.
- Introduce new products to increase sales and minimize product return.
- Optimizing use of cleaning chemicals and disinfectants avoiding use of chlorinated chemicals for example, risk of disturbance in biological wastewater treatment.
- Design of tanks and piping to avoid microbial growth and corrosion. This will reduce the use of toxic chemicals
- Planning of packaging systems to avoid solid waste and/or facilitate recycling of packages or packaging wastes

End-of-pipe treatment

Because of the typically high content of suspended solids, COD and BOD in the dairy industry waste-streams, end-of-pipe treatment frequently involves settling tanks and biological treatment. Pretreatment of effluents consists of screening, flow equalization, neutralization and air flotation (to remove fats and solids); it is normally followed by biological treatment. If space is available pond systems are potential treatment methods. Possible biological is the activated sludge treatment.

Pretreated dairy effluents can be discharged to a municipal sewerage system, if capacity exists with the approval of the relevant authority.

5.3. Abatement measures for solid waste pollution

Scrap

Scrap is collected and sold.

Sludge

- Effluent treatment processes generate solids. On average 70-80% of the original carbon is converted to solids. This sludge is subject to putrefaction, is malodorous and offensive. It can also be hazardous to health by absorbing pathogens that multiply in this favorable medium and toxins. Raw sludge is saturated with bound water, should be de-watered and disposed of in sanitary landfills.
- Sludge can also be generated from water treatment when lime and chemicals are used.

5.4. Water and energy conservation

Water and sewer service costs have been rising, and these increases can cut into profits. Using water more efficiently can help counter these increases.

Water Conservation

- Install water meters and monitor water use
- Use automatic shut-off nozzles and mark hand-operated valves so that open, close and directed-flow positions are easily identified.
- Use high-pressure, low-volume cleaning systems, such as CIP (clean in place) for washing equipment.
- Install liquid level controls with automatic pump stops where overflow is likely to occur.
- Recycle cooling water through cooling towers.
- Minimize spills on the floor minimizes floor washing.
- Repair leaks.
- Handle solid waste dry.
- Recycle steam condensate whenever economically viable.

Energy conservation measures

- Insulation of steam lines.
- Installation of steam traps.
- Repair or replace steam valves.
- Maximize boilers efficiency.
- Install pressure regulators on steam lines.

Table 12. Overview of pollution prevention techniques

Type of P2 Technique	Technique	Process or Ancillary Activity	Ease of implementation
Process/equipment modification	Replacing traditional faucets	Receiving and preparation	Easy-Moderate
	Water shutoff during breaks	Processing and filling	Easy
	Water control units	Processing and filling	Moderate
	Installing flow meters	Processing and filling	Easy
	Exterior area water use reduction	Storage and distribution	Easy
Operational and housekeeping changes	Placing catch pans under potential overflows/leaks	Storage	Easy
	Covering outside storage area	storage	Easy
	Inspection and preventive maintenance of potential discharge area	Storage	Easy
	Secondary containment	Storage	Easy -Moderate
	Monitor liquid fill machines	Processing and filling	Easy -Moderate
	Cleaning prevention	Cleaning	Easy-Difficult
	Pre-cleaning and dry cleanup	Cleaning	Moderate
	Skim grease traps regularly	Cleaning	Easy
Recycling /reuse	Counter current washes	Processing and filling	Moderate
	Process water reuse	Processing and filling	Easy-Moderate
	Water recirculation units	Processing and filling	Moderate
	Water used to chill product	Processing and filling	Moderate
	Residuals management	Processing and filling , storage and distribution	Easy-Moderate
	Recycling refrigerants	Refrigeration	Moderate
	Reducing/recycling/reusing packaging	Processing and filling	Easy-Moderate
Material substitution and elimination	Laboratory inventory reduction	Laboratory	Easy
	General inventory control	Purchasing	Easy
	Using alternative refrigerants	Refrigeration	Moderate

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Material substitution and elimination	Laboratory inventory reduction	Laboratory	Easy
	General inventory control	Purchasing	Easy
	Using alternative refrigerants	Refrigeration	Moderate

6. Industrial inspection

The inspection of the dairy industry will follow the procedures described in the Inspection Guidelines. This chapter presents a summary of the inspection process regarding the purpose and scope of various types of inspection, and the proposed inspection procedure for the Dairy Industry.

The overall purpose of inspections is to enforce environmental laws. Table 18 lists the various types of inspections and the objectives that have to be fulfilled for each type.

Table 13: The different types of inspections and their objectives

Inspection type	Objectives
Site Inspection	
1. Comprehensive	Evaluate compliance status regarding all aspects of Law 4
2. Specific	Evaluate compliance status regarding some aspects of Law 4 (usually complaint driven) Review special conditions set by EEAA in EIA studies. Investigate complaints
3. Follow-up	Check environmental register and implementation of compliance measures
Inspection campaign	
1. Geographic	Check pollution sources to specific receiving media Check pollution sources from facilities in a specific area
2. Sector specific	Check aspects relevant to specific sector

As evident from the above table, comprehensive inspection deals with all aspects of environmental laws and therefore is considered in this manual. Other inspection types can be tailored accordingly.

Developing an inspection strategy and quarterly and/or monthly plans are the responsibility of the inspectorate management. Developing site-specific inspection plans for carrying out the scope of work that fulfills inspection objectives is the responsibility of the inspection team. Planning for inspections is presented in more detail in the General Inspection Manual, GIM (EPAP-2001).

7. Inspection planning at the inspectorate level

The responsibilities of the inspectorate management regarding the specific inspection are to state clearly, in writing, the type of inspection and related objectives as well as the time schedule necessary to carry out inspection. The inspectorate management is also responsible for providing preliminary information about the facility, inspection tools, and logistics.

7.1. Activities characteristic to the Dairy Industry

Taking the comprehensive inspection as an example, the objectives stated in Table 13 dictate the activities required for covering all aspects of compliance with environmental laws and regulations. The required personnel, equipment and logistics are determined accordingly.

As evident from the information presented in section 1.2 concerning the size of the dairy facilities, about 75% of facilities operate with less than 4 workers. Accordingly, it is to be expected that these facilities will have one or two production lines with no treatment or quality control. The inspectorate management should have a clear idea about how to proceed with inspection of this type of facilities since the only reliable way for productive disposal of cheese whey (which is the major pollution source) is to

concentrate or dry it. This calls for a considerable expenditure on the facility. The irregular seasonal supply makes it impractical to found central plants of small capacity. Discharge to sea or to surface water of large self-purifying capacity is possible. Discharge to canals and agriculture drains is not allowed unless treated to reach the limits set by the law. However, discharge to the public sewer system could be allowed for a surcharge. Large facilities are expected to have most production lines and most service units. These facilities could most probably, sustain pollution abatement measures.

Note to inspectorate management:
Usually small and medium size facilities cannot afford the cost of treating cheese whey and other WW effluent streams since it requires either evaporation and/or biological treatment. Repeated inspections and fines would not solve the problem. Inspectorate management should have a clear plan on how to proceed with these facilities even if the plan is to ignore temporarily these facilities.

7.2. Providing information about the facility

Chapters (2-7) present the technical aspects regarding the dairy industry, its pollution sources and relevant environmental laws. Information regarding compliance history related to other inspecting parties (irrigation inspectors, occupational health inspectors, etc.) can be helpful in anticipating potential violations and preparing necessary equipment. Compliance action plans, Environmental Impact Assessment (EIA) studies and IPIS data bases are also important sources of information.

Other sources of information can be found on the Internet at the following sites:

- http://www.tei.or.th/bep/ctic/danced.cfm
- http://www.lu.se/IIIEE/research/eastern_europe/lithuania/cp_kaunas_1993-95.html
- http://www.emcentre.com/unepweb/publication/food.html
- http://www.emcentre.com/unepweb/tec_case/food_15/house/casename.shtml

7.3. Providing resources

The required personnel, tools and equipment depend on the size of the facility to be inspected. The inspection team leaders, in coordination with the inspectorate management, are responsible for assessing the inspection needs. The number of inspectors required depends on the size of the facility and the planned activities. Usually the team members are split and assigned different tasks during the field visit to allow the required activities to be performed in parallel. Each task is rotated among the inspectors to diversify their experience.

Small facilities Small dairy facilities will probably produce hard and soft white cheese. Most of the service units described in section (2.3.) will not be present. The major pollution problem would be the discharge of cheese whey to surface water bodies or the public sewer system. The amount of whey generated is three times the amount of cheese curd (4 kg of milk produce 1 kg of cheese and 3 kg of whey). Unless an inspection campaign is planned, only one inspector is required for calculating the amount of cheese whey discharged, determining type of receiving body, reviewing the licenses, establishing the violation if any, and preparing the legal report.

Medium size facilities These facilities could have a number of production lines or specialize in one or two products with medium production capacity. Inspection of these facilities will be similar to inspection of large facilities using a

smaller inspection team depending on the number of production lines and service units.

Large facilities Large facilities will typically have many production lines with large production capacity. Planning for the comprehensive multi-media inspection will require several inspectors, sampling equipment to provide proper samples for analysis as well as measuring devices. A lab technician will also be needed. The inspectorate management will provide the inspection checklist presented in Annex 1.

8. Preparation for field inspection (inspection team)

As presented in the General Inspection manual, GIM (EPAP-2001), tasks necessary for preparation for field inspection, are:

- Gathering information about the specific facility to be inspected
- Preparing of the inspection plan
- Preparing the checklists and other inspection tools.

This manual presents the case of a comprehensive multi-media site-inspection of a large dairy facility since it represents the highest level of inspection complexity. Tasks for carrying out less complicated inspections can be easily deduced.

8.1. Gathering and reviewing information

The inspection team should review the general information prepared for the dairy industry (chapters 2-5) and then check - if possible - what production lines and service units are present at the targeted facility. In addition to the required information listed in Annex (a) of the General Inspection Manual, GIM (EPAP-2001), it is important at this stage to determine the following:

- The type of receiving body for the industrial wastewater and review relevant Egyptian laws (Chapter 4).
- The scope of inspection and related activities based on the type and objectives of inspection required by the inspectorate management.
- The potential pollution hazards as addressed in section 2.4, and accordingly, define measurement and analyses needs.
- The characteristics of the dairy industry as presented in section 2.5, and their implications on the inspection process of the targeted facility.

Note to inspector:

- *Some facilities dilute cheese whey with water before discharging to sewer. Decree 44/2000 explicitly prohibits this behavior.*

8.2. Preparation of the inspection plan

An example of an inspection plan is included in Annex (C) of the General Inspection Manual, GIM (EPAP-2001). The plan should take into account the following:

- For large dairy facilities, the inspection team could be divided into smaller groups. Each group will be responsible for inspecting a number of production lines and service units.
- At the beginning of the field visit, the inspection team should check the environmental register for completeness using the checklist provided in Annex (E) of the General Inspection Manual, GIM (EPAP-2001).
- At the end of the field visit, the information included in the environmental register should be checked based on the field visit observations. If not confident with measurements and analyses results, the inspector should make his own.

Notes to inspector:

- *When the final effluent is expected to be in violation of environmental laws, sampling should be planned.*
- *Because of possible shock loads a grab sample at the time of discharge should be performed. If grab samples are taken when no shock load is discharged the results will not reflect the actual pollutants loads.*
- *To prove that a shock load has been discharged, a composite sample over the shift duration should be analyzed. If the results show higher pollutant concentrations than those of the grab sample, then a shock load was discharged.*
- *Make sure that the polluting production lines are in operation since some factory management resort to halting the polluting lines during the inspection.*

8.3. Preparation of the required checklists

The checklist for the dairy industry is presented in Annex 1 of this manual. The checklist has been prepared in such a way that it starts with general information about the facility and its operation. Separate checklists are then filled for each production line/service unit independently for relevant environmental aspects and media. The inspection team will compile the checklists relevant to existing production lines and service units in the targeted facility.

The development of the checklists goes through the following steps:

- Draw the block flow diagrams for the production lines with their pollution sources as presented in tables 4-8. Similar tables can be developed for other dairy production lines that were not covered by this manual.
- Identify the areas of possible non-compliance and the parameters that need checking. For example, noise should be checked near the compressors and temperature and humidity where steam leaks occur.
- Identify what to observe, ask and/or estimate that can convey information about pollutants. For example:
  - the type of detergent or antiseptic determines the contaminant in the wash streams,
  - oily effluents from production lines or oily cooling water indicates the contamination of the plant effluent with oil,
  - the amount the cheese whey can be calculated from knowledge about cheese production capacity.

Note to inspector:

*Law 4 does not specify standards for effluent from production lines but only for final disposal points. However, effluent quality from production lines is an important indicator of the final discharge***.**

8.4. Legal aspects

As evident from chapter 2, a large dairy facility is expected to be in violation of several environmental laws, specifically with respect to wastewater if no treatment is performed. The inspection team should be prepared for legally establishing such a violation.

Note to inspector:

It is the responsibility of the inspector to assess the seriousness of the violation upon which the enforcement action will be based. His information about the nature and cause of the violation must be well documented and the evidence sound. The case could be contested in court and the inspector will be asked to defend his technical judgement.

9. Performing the field inspection

9.1. Starting the field visit

The General Inspection Manual, GIM (EPAP-2001) describes the procedures involved for entering an industrial facility. The inspector's attitude and behavior are very important from the start and will dictate the factory's personnel response to the inspection tasks.

Note to inspector:

- *It is better at this stage not to ask direct questions about the cheese whey and reject milk. Interviewing the workers on-site in an indirect manner can give better results.*
- *Check the results of effluent analyses, time and place of sampling. If suspicious make your own analyses.*
- *The types of detergent and antiseptics used for cleaning and sanitation are important information for determining the type of pollutant in the effluent. In this case a direct question is preferred.*
- *Get a sketch of the factory layout with sewer lines and final disposal points.*

9.2. Proceeding with the field visit

Information gathered during the facility tour is dependent on interviews of facility personnel and visual observation. Annex (F) of the General Inspection Manual, GIM (EPAP-2001) presents some useful interviewing techniques.

Using the facility layout, start by checking the final disposal points and the various plants and/or service units connected to each point. This will determine where and how to take the effluent samples. Visual observations about the condition of the sewer manholes should be recorded. In some facilities the discharge to the receiving body is performed through a bayyara (cesspit), septic tanks or holding tanks. If the lining of the holding tank is defective, contamination of the underground water could occur.

Note to inspectors:

Cesspits, septic tanks and holding tanks are a form of pre-treatment that generates settled sludge. Check:

- *The presence of accumulated sludge and related hygienic conditions*
- *The disposal of the sludge*

Inspection of the production lines should start with the feeding of raw materials and end with the product packaging and storage. Referring to Figures 1 to 7, check the following:

Production Lines

Milk production line	What happens to reject milk? Is there any steam leaks from the pasteurization and sterilization units?

Cheese production line	Calculate the amount of cheese whey produced daily from the weight of processed milk. - Is cheese whey stored? Is it diluted with clean water? - Is there an ultra-filtration process, and where and how is lactose solution discharged? - When during the shift are whey and lactose discharged? Is there a centrifuge that separates fat from cheese whey and recycles it to other production lines?
Hard cheese production	- Calculate the amount of cheese whey produced daily from curding and pressing? - Is cheese whey used? Is it diluted with clean water?
Roquefort cheese production	Check the generation of cheese whey (amount and discharge method) - How is water-cooling performed (open or closed system)? - What type of refrigerant is used, and the possibility for replacing hazardous refrigerant? - Do you smell ammonia?
Mish production	The presence of a mish production line means that rejects are processed. If not available ask about reject cheese.
Ice cream	- What type of refrigerant is used, and the possibility for replacing hazardous refrigerant? Do you smell ammonia?
For all lines	Check for steam leaks, which affect humidity and temperature in the work environment. - Check for losses during packaging and spill prevention measures. - Check for noise near packaging machines and compressors in refrigeration units. - How is solid waste managed? Is it washed down to the sewer? This housekeeping practice increases the pollution load in the effluents. - Is the sewer system in the plants made of open gutters covered with a grill or closed pipes with drains? Open gutters contribute to the foul smell in the plant.

Service Units

Water treatment units	If chemicals and coagulants are used, such as lime, alum and ferric sulfate, inorganic sludge will be generated. Check the amount and method of disposal. - In case of ion-exchange units and reverse osmosis the effluent wastewater will be high in dissolved solids.
Boilers	Check the height of the chimney in relation to surrounding buildings. - Perform flue gas analysis if mazot is used as fuel or if suspicious about results of analysis presented by facility management in the opening meeting. - Check for fuel storage regulations and spill prevention. - Check noise.
Cooling towers	- The amount of blowdown from the cooling towers is about 10-15% of the make-up water and is low in BOD and high in TDS.
Refrigeration systems	- Check the type of refrigerant. - Check amount of cooling water (open or closed cycle)
Tin Can Manufacturing, Garage, and Workshops	Check for noise and take measurements if necessary. - Check solid waste handling and disposal practices. Check for spent lube oil disposal method. Ask for receipt if resold.
Storage facilities	- Check storage of hazardous materials and fuel as per Law. - Check spill prevention and containment measures for storage of liquids.
WWTP	- Check for sludge accumulation and disposal. Analyze the treated wastewater.

Effluent analysis

Receiving body	The nature of the receiving body determines the applicable laws. Check if effluent discharge is to public sewer, canals and Nile branches, agricultural drains, sea or main River Nile. - Accordingly, define applicable laws, relevant parameters and their limits.
Sampling	A composite sample must be taken from each final disposal point over the duration of the shift or a grab sample at peak discharge. Each sample will be analyzed independently. - According to legal procedures in Egypt, the effluent sample is spilt and one of them is sealed and kept untouched.

9.3. Ending the field visit

When violations are detected a legal report is prepared stating information pertaining to sampling location and time. Violations of work environment regulations should also state location and time of measurements. Other visual violations such as solid waste accumulation, hazardous material and waste handling and storage, and material spills should be photographed and documented. It is preferable that facility management signs the field-inspection report but this is not a necessary procedure. A

closing meeting with the facility management can be held to discuss findings and observations.

Note to inspector:

- *The less certain the team leader is about a specific violation the more reason not to discuss it at the closing meeting.*

10. Conclusion of the field inspection

The activities performed during the site inspection are essential for preparation of the inspection report, for assessing the seriousness of the violations, for pursuing a criminal or civil suit against the facility, for presenting the legal case and making it stand in court without being contested, and for further follow-up of the compliance status of the facility.

10.1. Preparing the inspection report

An example of an inspection report is included in Annex (I) of the General Inspection Manual (EPAP, 2001). The inspection report presents the findings, conclusions, recommendations and supporting information in an organized manner. It provides the inspectorate management with the basis for proposing enforcement measures and follow-up activities.

10.2. Supporting the enforcement case

Many issues may be raised and disputed in typical enforcement actions. Enforcement officials should always be prepared to:

- Prove that a violation has occurred. The inspector must provide information that can be used as evidence in a court of law.
- Establish that the procedures were fairly followed.
- Demonstrate the environmental and health effect of the violating parameter.

Note to inspectorate management:

- *Although the inspector is not required to suggest pollution abatement measures, the inspectorate management should be able to demonstrate that a remedy for the violation is available.*
- *Enforcement should not cause financial collapse of the facility and inspectorate management should demonstrate the ability of the violator to pay.*

10.3. Following-up compliance status of violating facility

After performing the comprehensive inspection and detecting the violations the inspectorate management should:

- Decide on the sanctions and send the legal report to the judicial authority.
- Plan routine follow-up inspections. This type of inspection focuses on the violating source and its related pollution abatement measure. Self-monitoring results are reviewed during the visit.
- Follow-up the enforcement case (legal department)

Annex (1)

Inspection Checklist for Dairy products Facility

Checklist for Boilers and Water Treatment Units

1. General	
1.1 Boiler number and capacity	....
1.2 Type of fuel used for boilers In case of using mazot for boilers Is it a dwelling zone	Mazou t ❑ Solar ❑ Yes ❑ No ❑
Note : The use of mazot as fuel in the dwelling zone is prohibited by law.	
1.3 What is the method used for water treatment	Lime method ❑ Reverse osmosis ❑ Ion exchange ❑
2. Status of Air Pollution	
2.1 What is the height of the stack	.....
Note : the height of the stack must be 2.5 times the height of surrounding buildings.	
2.2 If mazot is used in non dwelling regions, or smoke is detected	Are there analyses of the flue gases for sulfur dioxide, carbon monoxide, and particulate matter Yes ❑ No ❑ <u>If Yes</u> Are they enclosed in the environmental register Yes ❑ No ❑ <u>If No</u> Ask for preparation of these records and their inclusion in the environmental register
Note : Perform analysis, if necessary	
. Status of Effluent	
3.1 What is the blow down rate from the boilers	---------- -m^3/day
3.2 What are the blow down and back wash rates for the treatment units	Blow down----------m^3/day Backwash ----------m^3/day
3.3 Steam condensate is	Recycled to boilers ❑ Discharege to sewer ❑
4. Status of Solid Waste	
4.1 If the lime method is used, sludge is generated. What is the amount of sludge generated per day?	.....
4.2 What is the sludge disposal method?	.....
5. Storage and Handling of Hazardous Material	
5.1 Check the storage of chemicals used in the treatment process. Is it in compliance with law 4/94 ?	☐ Yes ☐ No
5.2 Is there any fuel leaks from fuel tanks	☐ Yes ☐ No
5.3 Is there any fire extinguishing devices and equipment	☐ Yes ☐ No

5.4 Is there a spill prevention plan	☐ Yes ☐ No
5.5 Do you notice anything that can provoke a fire? Such as the presence of a pump underneath the fuel tank (the start-up of the engine can produce a spark)	☐ Yes ☐ No Comment ....
6. Status of Work Environment	
6.1 Check the noise next to the boilers	----------
6.2 Check the heat stress next to the boilers	----------
6.3 Are there any existed measurements? Are they included in the environmental register?	Yes ❑ No ❑ Yes ❑ No ❑

Checklist for Wastewater Treatment

1. General	
1.1 What is the capacity of WWTP	.....
1.2 Specify the units included in WWTP :	
Pumping station	☐ Found ☐ Not found
Equalization tank	☐ Found ☐ Not found
Aeration tank (ditch or channel)	☐ Found ☐ Not found
Final sedimentation tank	☐ Found ☐ Not found
Sludge thickening tank	☐ Found ☐ Not found
Sludge drying	☐ Found ☐ Not found
Others	.....
1.3 List any chemical and their quantity used for wastewater treatment	....
2. Status of Effluent	
2.1 Are there analyses for the effluent If not Make your own	☐ Yes ☐ No
2.2 Are the results of the analysis included in the environmental register	☐ Yes ☐ No
3. Status of Solid Waste	
3.1 Determine the sludge disposal method *Note : It can be use in liquid or dry form, in agriculture*	.....
If a third party is involved in disposal, get documents for proof	☐ Found ☐ Not found Comment .....

Checklist for Garage

1. General	
1.2 Is there any detergent or solvent used for washing equipment parts, trucks, floor,….etc	☐ Yes ☐ No
1.3 What is the amount of oil and grease used per day?	.....
1.4 What is the amount of spent lube oil produced per day ?	.....
1.5 How does the facility dispose of the spent oil ?	.....
2. Status of the Effluent	
2.1 What is the amount of wastewater produced ?	
2.2 Do you observe any oil / foams / solid matter in the inspection manhole ?	☐ Yes ☐ No

Checklist for Workshops

1. Status for the Effluent	
What is the amount of wastewater produced ?	.....
1.2 What is your visual observation for the inspection manhole of the workshop ?	.....
2. Status of solid waste	
2.1 What is the amount of solid waste produced	.....
2.2 How does the facility get rid of the solid waste produced ?	.....
3. Status Of the Work Environment	
3.1 Are there any noise in work place If yes 3.2 Are there any measurements for noise 3.3 Check the exposure time If not Perform measurements	☐ Yes ☐ No ☐ Yes ☐ No .....

Check list for Laboratories

1. General	
1.1 What is the amount of wastewater produced per day	.....
1.2 List the chemicals and materials used in the laboratories	....
2. Status of the work Environment	
2.1 Are there any odor/ gases/noise in the work environment	☐ Yes ☐ No
2.2 Check the exposure time	.....
3. Handling of Hazardous Material	
3.1 Inspect storage of hazardous material. Is it in compliance with the requirements of law 4	☐ Yes ☐ No
3.2 Are there any first aid measures in place	☐ Yes ☐ No

Checklist for Hard Cheese Production Line

1. General	
1.1 The housekeeping status Floor condition Wash water leaks Leaking steam Foul odors	....
1.2 Make sure the all units of the production line are operated	....
1.3 Type of operation	☐ Batch ☐ Continuous
1.4 Amount of raw material processed per day and per shift	....
1.5 Amount of cheese whey produced from curding and pressing per day and per shift	....
Note : For each 4 kg of milk 3 kg of cheese whey are produced	
2. Status of the Work Environment	
2.1 Do you smell foul odor ? <u>if yes</u> Is there a ventilation system in place <u>If yes</u> Is the ventilation system operating	☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No
2.2 Are there steam leaks ?	☐ Yes ☐ No
2.3 Does the facility have humidity and temperature (heat stress) records	☐ Yes ☐ No

2.3 Does the facility have noise at the pressing machine? If Yes Check the exposure time	☐ Yes ☐ No .....
Note : If suspicious, measure humidity and/or temperature records	
3. Status of Effluents (Wastewater)	
3.1 Is the cheese whey dumped into the sewer ? If yes Shock load on the sewer is expected. Take the effluent sample when dumping take place 3.2 Are there any certain way of cheese whey using (Comment)	☐ Yes ☐ No .....
3.3 Is there a CIP system for equipment washing and sterilizing ?	☐ Yes ☐ No
3.4 When during the shift is equipment & floor washing performed ?	.....
3.5 When during the shift, is the CIP discharged to sewer ?	.....
3.6 How much rinse water is used for equipment and floor washing ?	.....
4. Status of Solid Waste	
4.1 Are there any accumulation of solid waste ? 4.2 What are the types of solid waste ?	☐ Yes ☐ No ....

Checklist for Ghee Production Line

1. General	
The housekeeping status Floor condition Wash water leaks Piling of solid waste Leaking steam Foul odors	....
1.2 Make sure the all units of the production line are operated	.....
1.3 Type of operation	☐ Batch ☐ Continuous
1.4 Amount of raw material processed per day and per shift	....
2. Status of the Work Environment	
2.1 Do you smell foul odor ? <u>if yes</u> Is there a ventilation system in place <u>If yes</u> Is the ventilation system operating	☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No
2.2 Are there steam leaks ? <u>if yes</u> Do you believe humidity and/or temperature limits are violated ? Does the facility have humidity and temperature records	☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No

Note : If suspicious, measure humidity and/or temperature	
3. Status of Effluents (wastewater)	
3.1 Check the filling and packaging machine during operation Is there a containment measure for ghee losses ? Does management record the percentage loss ? If yes What is the percentage ?	☐ Yes ☐ No ☐ Yes ☐ No .....
3.2 Is there a CIP system for equipment washing and sterilizing ?	☐ Yes ☐ No
3.3When during the shift is equipment & floor washing performed ?	.....
When during the shift, is the CIP discharged to sewer ?	.....
How much rinse water is used for equipment and floor washing ?	.....

Checklist for Ice Cream Production Line

1. General	
The housekeeping status Floor condition Wash water leaks Piling of solid waste Leaking steam	....
1.2 Make sure the all units of the production line are operated	.....
1.3 Type of operation	☐ Batch ☐ Continuous
1.4 Amount of raw material processed per day and per shift	....
2. Status of the Work Environment	
Refrigerators of Ice Cream 2.1 Does the workers wear the suitable suits when dealing with these refrigerators? 2.2 Does the facility have noise records at the packing machine ? **If Yes** Check the exposure time	....
3. Status of Effluents (Wastewater)	
3.1 Check the filling and packaging machine during operation 3.2 Is there a containment measure for Ice Cream losses ? 3.3 Does management record the percentage loss ?	..... ☐ Yes ☐ No ☐ Yes ☐ No

<u>If yes</u> What is the percentage ?	.....
3.2 Is there a CIP system for equipment washing and sterilizing ?	☐ Yes ☐ No
3.3When during the shift is equipment & floor washing performed ?	.....
When during the shift, is the CIP discharged to sewer ?	.....
How much rinse water is used for equipment and floor washing ?	.....