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

Inspection Manual

Fruits and Vegetables Processing Industry

2002

Fruit and Vegetable processing Industry
Inspection Manual

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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

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 fruit and vegetable processing 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 fruit and vegetable processing 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 fruit and vegetable processing industry. Chapter five gives examples of pollution abatement techniques and measures applicable to the fruit and vegetable processing 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 fruit and vegetable processing 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 fruit and vegetable processing industry

The fruit and vegetable processing 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 as well as solid waste .

1.2.1. Egyptian SIC code for the fruit and vegetable processing industry

The Standard Industrial Classification (SIC) code for the food industry is 15 and the fruit and vegetable processing industries are part of sub-sector 154, which includes other food industries as well.

The CAPMAS (Central Agency for Public Mobilization and Statistics) 1997 data, which is based on the 1996 census, shows that the total number of facilities is 18842.

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 the table that 94% of the facilities are operating with less than10 workers and 0.9% have more than 40 employees. Table 2 shows the distribution of facilities by manpower for each governorate.

Table 1: Size distribution of facilities in of sub-sector 154

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	1516	1631	2128	2491	8430	1554	492	183	97	98	39	85	72	11	15

Table 2. Size distribution of industries included in sub-sector 154 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	N.Sinai	SSinai	*Total*
001	283	251	16	6	48	118	77	65	41	61	46	65	25	156	36	26	72	36	28	25	15	5	4		5	4	2	1516
002	298	285	23	18	63	118	109	81	27	84	46	71	16	154	31	21	43	45	23	16	24	8	10		10	3	4	1631
003	359	291	20	24	53	139	159	104	62	143	71	84	34	214	37	24	69	58	49	55	35	7	8	2	19	5	3	2128
004	339	319	20	34	70	152	184	165	65	156	77	107	47	269	45	47	82	77	95	66	28	10	7	1	15	12	2	2491
005	1315	934	53	98	192	391	476	684	191	432	340	280	147	789	161	220	625	325	299	220	107	35	36	19	22	26	13	8430
010	397	120	20	14	25	57	79	97	26	97	41	31	18	171	28	54	95	36	41	65	19	3	8	3	3	1	5	1554
015	173	32	11	4	3	17	29	23	4	25	9	7	11	56	16	8	31	11	6	5	7	3		1				492
020	47	19	1	2	1	8	14	3		6	5	5	3	22	15	5	15	3	2	3	3	1						183
025	23	9	2	1	2	6	5	6	1	2		2	1	15	6		11	1	2	2								97
030	21	13	2	1		5	7	4	1	1	3	2	2	16	1	2	7	1	5	2	2							98
040	11	8			1	1	1			3	2	1	1	5	2				1		1			1				39
050	14	12	3		2	2	10	4		5	1	2	1	14		1	2		3	2	7							85
100	9	13	2			1	15	4		1	3	2	3	13		2			2		2							72
500	3	2					3							3														11
1000		4							1					1			1		1	5	2							15
Total	3292	2312	173	202	460	1015	1168	1240	419	1016	644	659	309	1898	378	410	1053	593	557	466	252	72	73	27	74	51	29	**18842**

2. Description of the industry

The fruit and vegetable processing 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 fruit and vegetable industry, which is 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 facilities use 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, products and utilities.

The main ***raw materials*** used are categorized as follows :

- Fruits such as mangoes, figs, dates, pears, apples, oranges, strawberries, apricots, grapefruit, tomatoes, lemons, pineapples and peaches.
- Vegetables such as okra, molokhya, sweet potatoes, potatoes, artichoke, and string beans.
- Beans such as peas, lentils, and fava beans, black-eyed beans.
- Other materials such as citric acid, concentrates, honey, sugar, molasses, pectin, inks, varnish, solvents, soldering flux, sodium benzoate, rubber, and aluminum.

Chemicals are consumed at the facility for different purposes:

- In the lab for quality control and effluent analyses such as organic solvents (ether, chloroform), acids, alkalis, culture media for microbial growth.
- For pH control such as dilute hydrochloric acid, sodium hydroxide
- For corrosion inhibition.
- As additives such as sodium benzoate and citric acid
- As detergents and antiseptics for cleaning and sterilization (sodium hydroxide, nitric acid, sodium hypochlorite).

Lube oil is used in the garage and workshops.

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

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 large facilities for electric power generations.

Water is used as process water , as rinse water for equipment and floor, as boiler feed water, as cooling water and for domestic purposes. Boiler grade water is pretreated in softeners to prevent scale formation.

Water may be supplied from public water lines, wells or canals. 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 can 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 fruit and vegetable processing

Production Lines	Service Units
Tomato paste production line Frozen vegetables and fruit production line Juice and syrup production line. Jam production line Canned fava beans production line Canned vegetables production line Lentil soup production line Agar production line	Boilers Cooling towers Refrigerators Tin can manufacturing plant Laboratory Mechanical & electrical workshops Garage Storage facilities. Wastewater Treatment Plant Restaurant and Housing complex.

2.2.1. Tomato paste production line:

Fig (1) presents the main operations in the production line, the inputs to the units and the pollution sources. The line is operated either on a semi-continuous or on batch basis. The main processes are:

Receiving of fresh tomatoes Tomatoes are received in containers. They are visually tested for quality. If accepted they are dumped into a washing basin.

Washing of fresh tomatoes Tomatoes are washed using clean water and water from secondary wash. Air /steam is introduced to improve mixing. Tomatoes are transported by belt conveyors to a secondary wash zone that uses sprays of clean water for a final wash. Wash water is recycled (Clean In Place, CIP system) after allowing the sedimentation of dirt, settleable and suspended impurities. Floating material is removed manually with a net. Some facilities use rotary filters for both types of impurities.

Manual sorting Workers seated on both sides of the moving belt conduct visual inspection. They sort and discard rotten tomatoes. Solid waste from this step is a potential pollution source.

Preparation of tomato juice Tomatoes are then fed to a large jacketed vessel where they are heated with indirect steam (in the jacket) and squeezed. A sieve separates the juice, which is fed to the evaporators for concentration after addition of salt.

Concentration of tomato juice Concentration must be performed under vacuum so that vaporization can be achieved at low temperature (about 65^{o}C). The vaporization temperature is an important quality control parameter. A higher temperature will cause overcooking (brown color). Vacuum is produced by barometric leg condensers, which use large amounts of cooling water. The waste cooling water is hot (60^{o}C) and will be contaminated with organic matter since it comes in direct contact with the water vapors from the tomato juice.

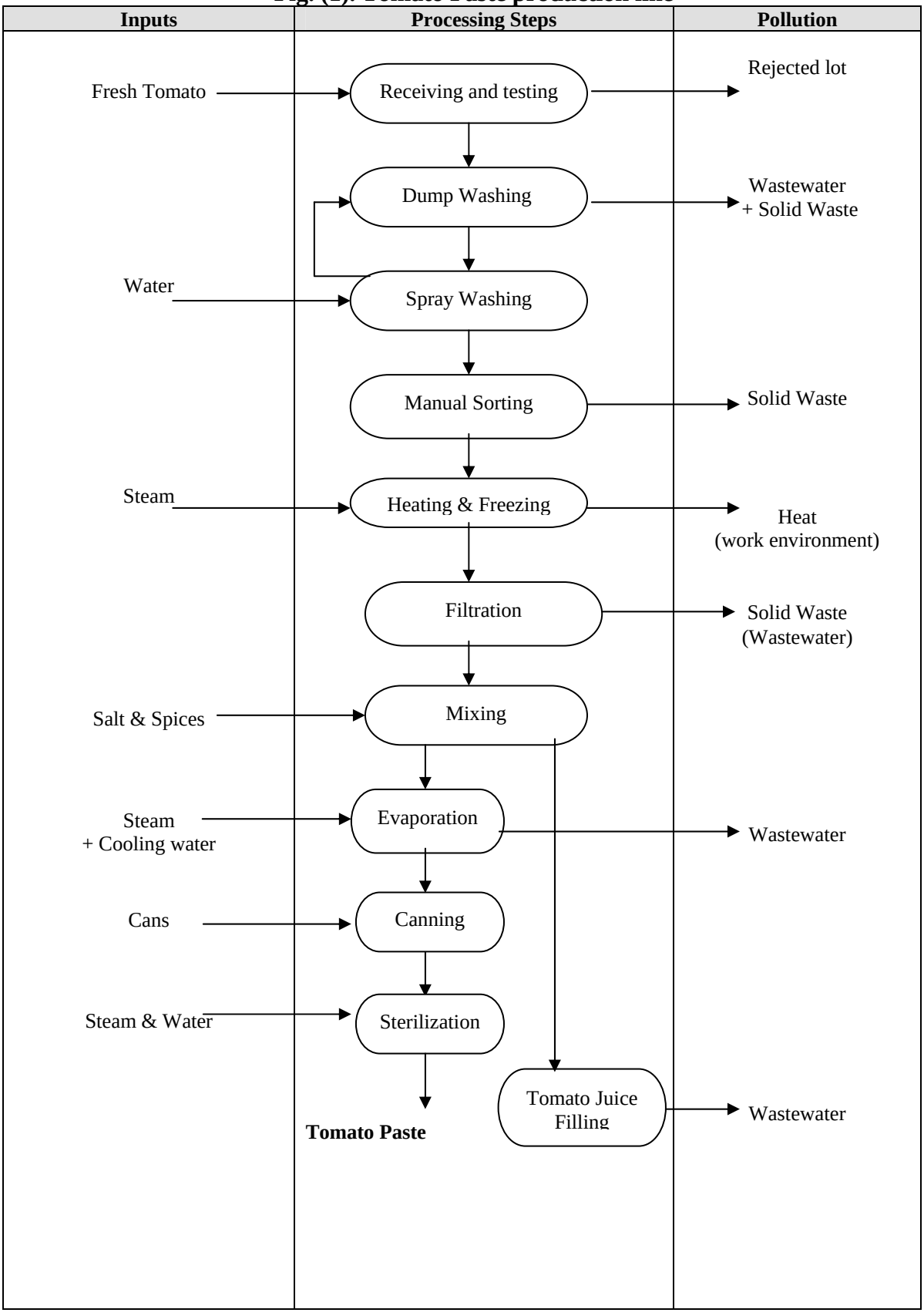
Canning and sterilization The tomato paste is then canned, sealed and sterilized using successive heating and cooling methods. The sterilizers use water heated with live steam that fills the workplace then cooling water. Heat and humidity limits for work environment should be checked.

Tomato juice production Sometimes the same line is used to prepare tomato juice adding salt to the cooked juice. The juice is packed, sterilized, and stored.

Note: Find out:

- What happens to tomato reject ?
- When is the CIP basin emptied?
- What type of detergent and/or antiseptic is used?
- Are there screens on the gutter to prevent solids discharge to sewer?
- What happens to the solid waste from the filtration unit?
- How is sterilization performed? In open or closed equipment?

Fig. (1). Tomato Paste production line



2.2.2. Frozen vegetables production line

Fig (2) presents the main operations in the production line, the inputs to the units and the pollution sources. The main processes are:

Receiving and washing Fresh vegetables are weighed and manually sorted. They are then dumped in a water basin using re-circulated water and then washed by a water spray while transported on a belt conveyor. The wash-water from spraying operation is used as make up to the basin, which is continuously purged. The wastewater from this operation is high in suspended solids, BOD and floating material such as hay.

Preparation The vegetables are peeled, trimmed and cut depending on the type of vegetable. This step generates a large amount of solid waste. Another washing step is performed, by dumping the prepared vegetables in water.

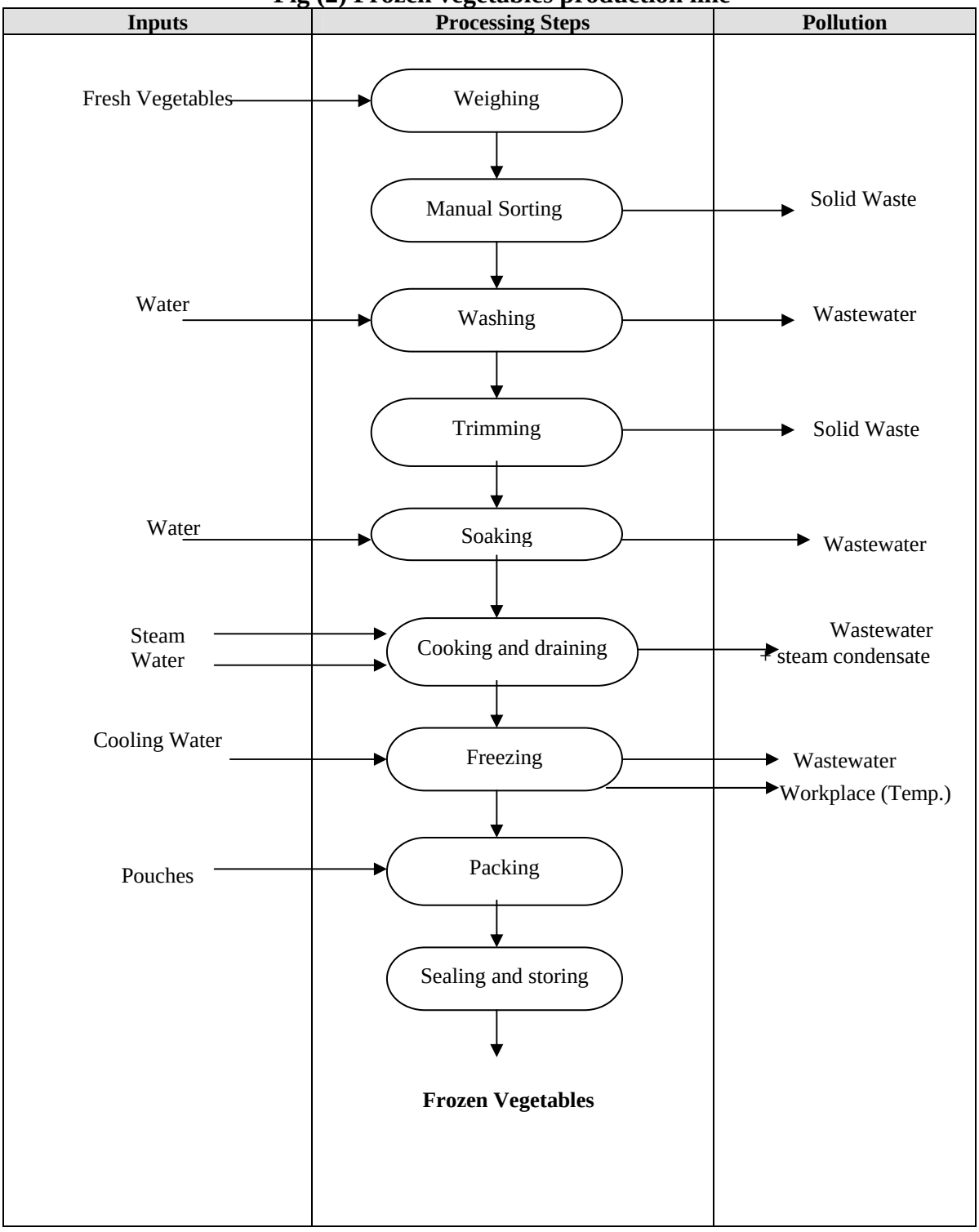
Cooking and freezing The prepared vegetables are partially cooked in a jacketed vessel where steam is introduced in the jacket to provide heat. Some facilities use live steam injected directly in the vessel. The half-cooked vegetables are strained. Cold water (5-6º C) is passed over the half cooked vegetables and then introduced on a belt conveyor into a tunnel freezer where quench cooling occurs at a temperature less than –20ºC. This process takes 20 minutes and preserve the vegetables. Only the outer surface of the vegetables freezes without affecting its properties. Boiled molokhya leaves are minced and packed prior freezing.
Heat and humidity could impact work environment if steam leaks occur.

Packaging and storing Frozen vegetables are packed manually in pouches and stored in freezers. Cooling water is used for the compressors of the freezers. Freon (commercial name for CFCs) and ammonia are usually used as a refrigerant.

Note : The sources of pollution are:

- Waste water from the washing and cooking steps.
- Solid waste from vegetable preparation.
- Spent cooling water.
- Humidity, if steam leaks occur, and noise at the compressors.

Fig (2) Frozen vegetables production line



2.2.3. Juice and syrup production line

Fig (3) presents the main operations in the production line, the inputs to the units and the pollution sources. The juice is prepared from fresh fruits when in season, otherwise stored juice concentrate is used. The main processes are:

Fruit sorting and washing Fresh fruits are delivered in boxes, which are emptied on a long belt conveyor where manual sorting takes place. Rejected fruits are discarded as solid waste. The fruits are dump usually-washed in a basin and come out of the basin on an inclined conveyor that moves the fruits under a spray of fresh water for final washing. The basin is emptied daily. The wastewater generated is high in suspended solids and organic matter.

Preparation Fruits are peeled and pitted either manually or automatically. Some fruits need to be preheated for easier pip and seed removal. The equipment usually used is a steam jacketed screw conveyor.

Cooking and fiber removal The fruits are then cooked for ¾ of an hour, in a steam-jacketed drum at 100^{o}C. Steam condensate is generated and discharged to sewer

The batch is then fed to a centrifugal to separate pulp and uncooked material from the juice. The solid waste from this step is sold as animal fodder.

Dilution and sugar addition The batch is diluted to the syrup or the juice concentration then sugar is added in steam-jacketed mixers (more sugar is needed for syrup preparation), where temperature reaches 70^{o}C.

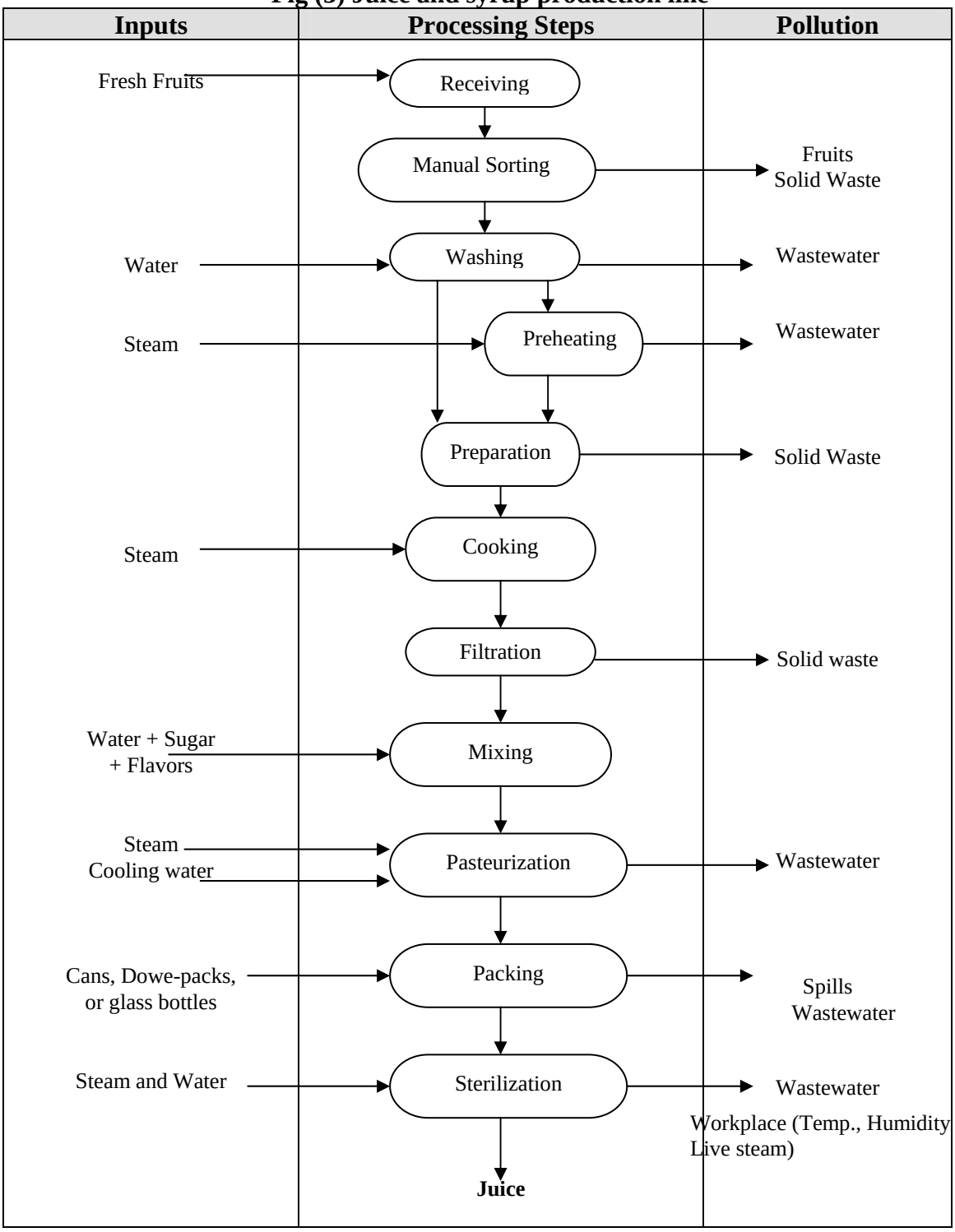
Pasteurization Pasteurization takes place in a plate-type heat exchanger by successive heating to 100^{o}C then sudden cooling using cooling water.

Packing and sterilization Juice is filled in glass bottles, tin cans or Dowepack. Syrup is filled in glass bottles. Glass bottles are washed prior filling generating large amounts of wastewater. Juice and syrup losses from the filling machines are responsible for the organic load of the generated wastewater in this line.

Sterilization is performed in covered troughs or in autoclaves.

- **Troughs**: The sealed cans and bottles are placed on a belt conveyor that passes in a loosely covered trough filled with water. The first part of the trough is heated by live steam that bubbles in the water, which heats up to 100^{o}C, while in the second part sprays of cooling water cause the sudden cooling of the containers. Large amounts of steam fill the workplace.
- **Autoclaves**. Heating is performed in closed drums using steam. Then, cooling is preformed using showers of cooling water. Steam release to air is minimal in this case.

Fig (3) Juice and syrup production line



2.2.4. Jam production line

Fig (4) presents the main processes in the production line, the inputs to the units and the pollution sources. Jam production goes through the same steps as juice production but instead of water addition, water vaporization takes place.

Juice preparation The steps for sorting, washing, pitting, peeling, preheating if necessary and juice extraction, are performed in the same way as for juice production. The amount of sugar added depends on the type of fruit. Citric acid is added as a preservative.

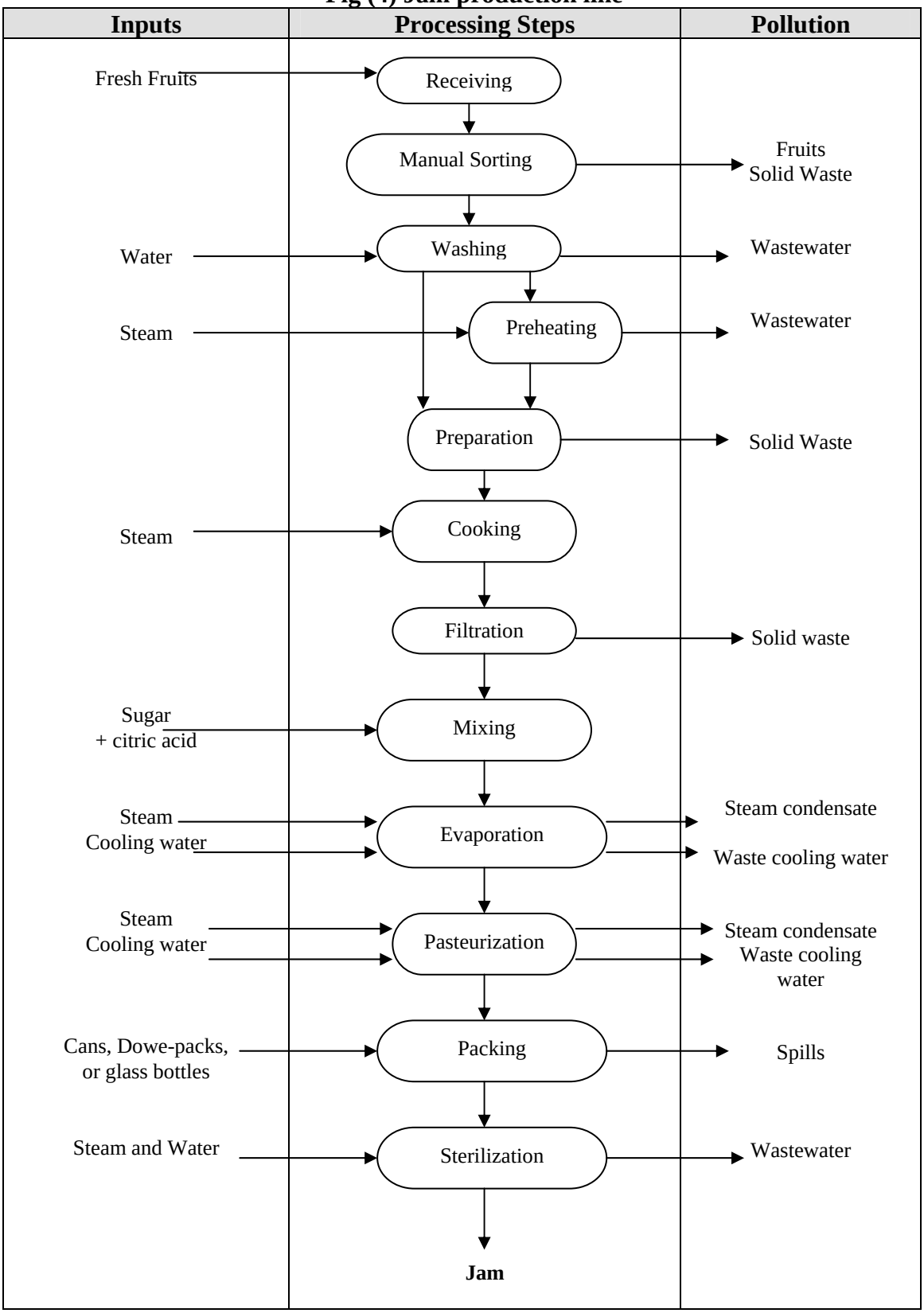
Juice concentration A multistage evaporator operating under vacuum is used. Vacuum is performed by jet ejectors, which use cooling water to produce the vacuum effect. The pressure in the evaporator reaches 0.2 bars and the temperature 65^{o}C. The lower the pressure the lower the cooking temperature. The concentration system increases the solids concentration in the jam to 65%. Concentration is usually measured using an optical device. A sample is spread on a piece of glass and the device is calibrated to give the reading for the solids concentration.

Pasteurization and packing Jam is pasteurized by heating to 90^{o}C for half an hour then suddenly cooling. Both operations are usually performed in the same equipment used for evaporation by passing steam in the jacket at first, then passing cold water.
Jam is then packed in glass containers or tin cans the sterilized by the same procedure explained in the previous section.

Note:

- The evaporation temperature is an important parameter for quality control.

Fig (4) Jam production line



2.2.5. Canned beans production line

Fig (5) presents the main processing steps for the production line, the inputs to the units and the pollution sources. The same line is also used for canned peas. These steps are:

Sorting and washing of beans Fresh beans are weighed, screened using mechanical shakers to remove any impurities, and sorted manually. They are then washed by soaking in a water basin, and then spray washing. CIP process may be used for water recycling.

Soaking and cooking The clean beans are then fed to pots where they are boiled. Heat is supplied either by steam introduced in the pot jacket or direct fire (LPG). When boiling starts, heating is stopped and the beans are left to soak for about 10 hours. Beans are then moved to steam jacketed vessel where they are pre-cooked for 2-3 hours then introduced to the feeding hopper of the canning machine.

Packing and sterilizing The canning machine consists of a closed tunnel in which a belt conveyor carries the open cans. At the feeding end, the cans are filled with water and pre-cooked beans. Steam is used in the tunnel to cook the beans as they travel along the tunnel. Oil and spices are then added.
At the outlet of the tunnel the cans are sealed, cooled and washed.
The cans are then sterilized in an autoclave where they are heated to 100^{o}C using direct steam then suddenly cooled by water sprays.

Note:

- Raw beans are sprayed with a volatile pesticide that completely evaporates before cooking. Does the law allow the use of this insecticide?
- Soaking removes the sulfur from the beans.

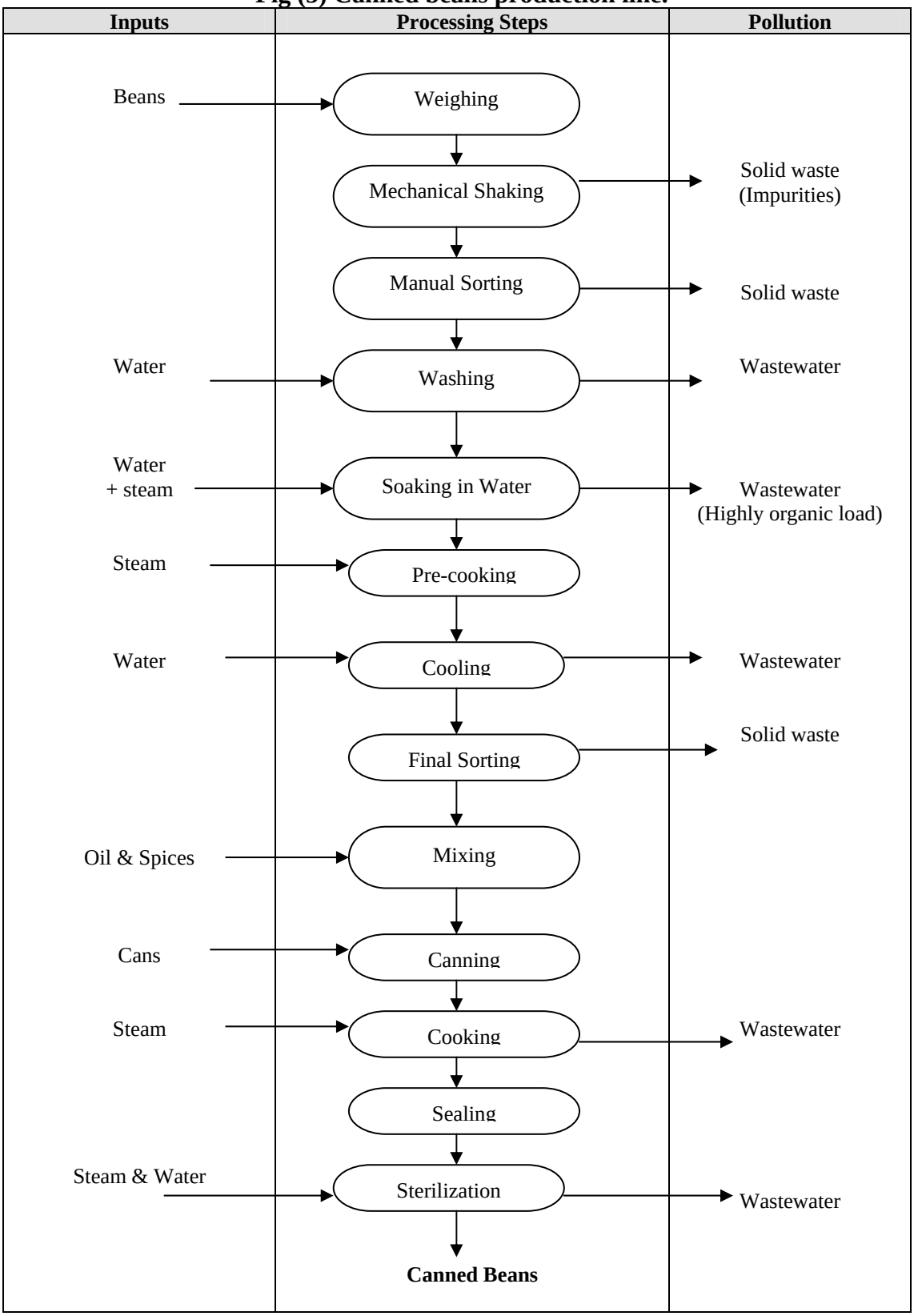
2.2.6. Lentil soup production line

Lentil soup production undergoes almost the same processing steps as those for canned beans. The main steps being:

Screening, washing and cooking Lentils are first screened to remove impurities, then washed with water, and cooked in steam-jacketed pots. The cooked lentils are drained then spices are added before feeding the lentils to the canning machine.

Sterilizing The sealed cans are sterilized in the same manner as for beans.

Fig (5) Canned beans production line.



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. Fig (6) 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 gas 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.

Due to bad insulation of boiler body and steam lines, high temperature in the workplace can be observed.

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 filter 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.(Not widely used in Egypt)

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 purifying 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) either ammonia or feron 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.
- The spent lube oil which is used for the compressors.

2.3.5. Clean in Place

The Clean in Place (CIP) system consists mainly of a wash tank and recycling pumps. Its main purpose is to minimize wash water consumption by recycling part of the spent wash water. Detergents, acids and/ or alkalis are added to the wash water when equipment washing is performed. In this case, the use of CIP will also minimize the consumption of these additives. For washing fruits and vegetables no addtitives are used.

After using the spent wash water for a number of cycles, it is discharged to the factory sewer system causing a shock load of pollutants. The nature of the pollutants depends on the material or equipment being washed and the additives used. The most important parameters are O & G, BOD, COD, TSS.

2.3.6. 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 dried in furnaces then sterilized before filling.

Environmental violations could be due to:

- 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(usually only dry cleaning is performed with no wastewater)
- Air emissions (VOC’s) in workplace
- Heat generated from paint dryer.

2.3.7. 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.

Note:
If the industrial and domestic discharge lines are segregated the wastewater from the lab must be discharged to the industrial line

2.3.8. 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
- Spent 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 discharge of spent oil to the sewer lines or selling it to recycling stations.

2.3.9. Storage Facilities

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

- Fresh fruits and vegetables are delivered daily and are stored in shaded areas for not more than 8 hours.
- Canned or bottled products are packed in carton boxes and stored in product storing buildings.
- Frozen vegetables are packaged either in plastic bags and stored at about ($-18^{o}C$) in freezers.
- Some of the chemicals used in the lab . 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. Fuel storage requires safety measures and spill prevention plans.

2.3.10. 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 . Fruit and vegetable processing discharges mainly 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:

- Fruit & vegetable reject and filterate solid waste which can be processed and reused as animal fodder .
- Treated water which represents a water pollution problem if not complying with relevant environmental laws.

2.3.11. Restaurants, Washrooms and Housing Complex

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

Fig (6) Service Units and Their Related Pollution Sources

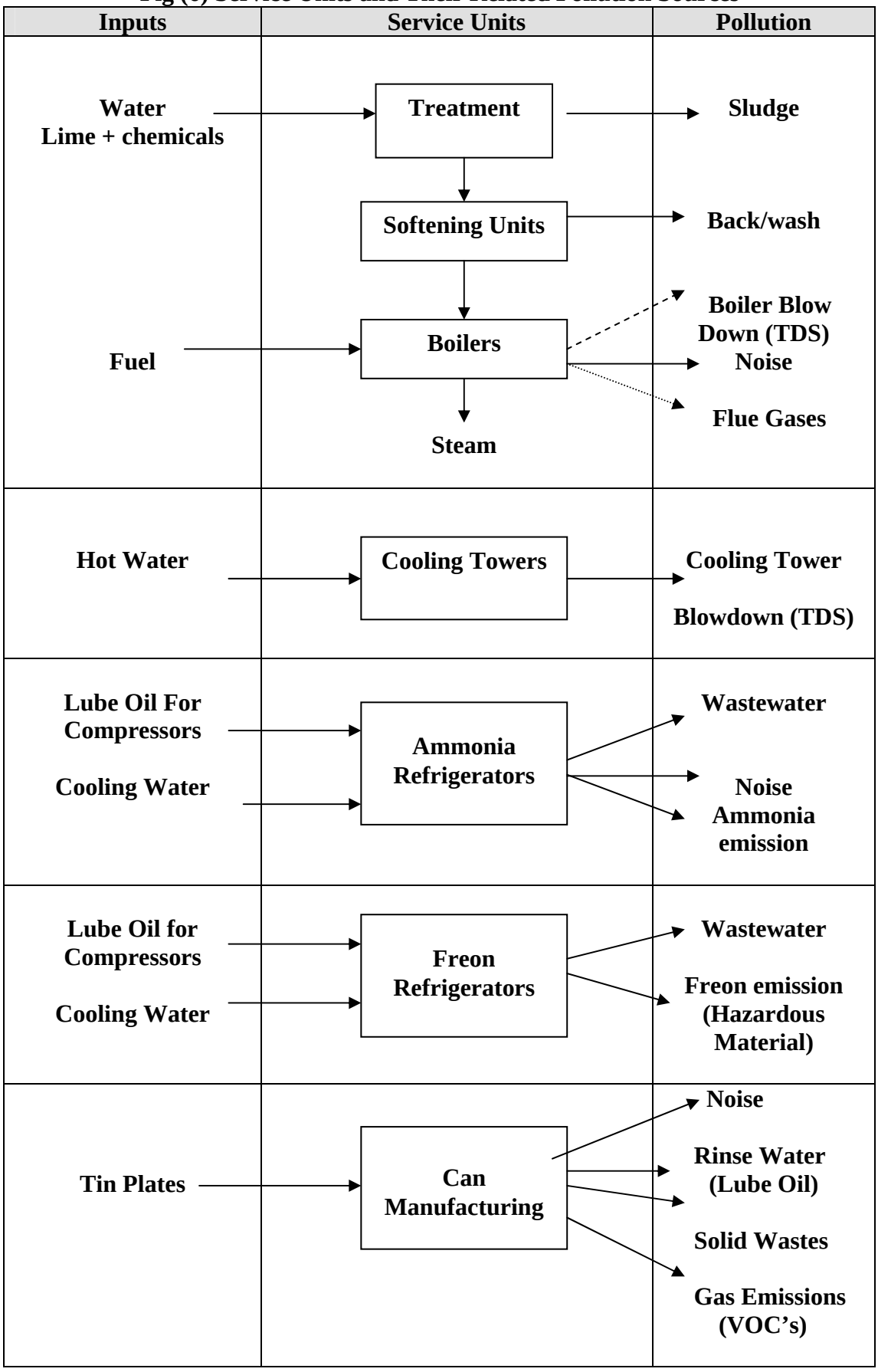
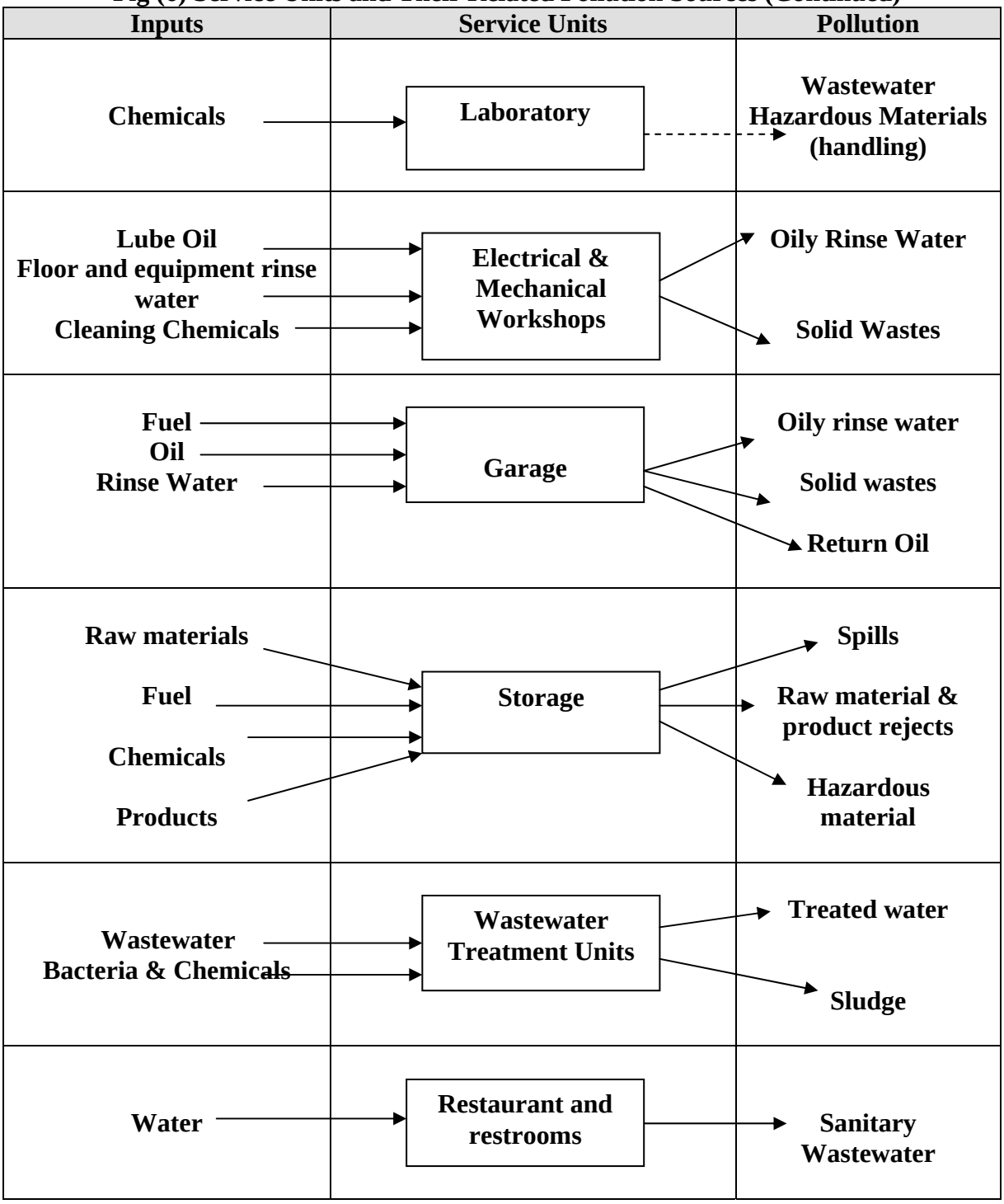


Fig (6) Service Units and Their Related Pollution Sources (Continued)



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

The sources of air emission in the fruit and vegetable industry are:

- Exhaust gases resulting from fuel consumption used to generate steam from boilers and generators . The violating parameters would be: particulate matters (PM10), sulfur oxides, nitrogen oxides and carbon monoxide.
- Freon (trade-name CFCs) resulting from leaks in refrigeration tubes and is considered an ozone depleting substance.
- Steam leaking from heating tubes or used as live steam has a negative impact on air quality of workplace with respect to heat and humidity.
- Odor problems can occur with poor management of solid wastes and effluents.

2.4.2. Effluents

The fruit and vegetable processing industry typically generates large volumes of effluents that contain high organic loads, cleansing and blanching agents, salt and suspended particles such as fibers and soil particles. They may also contain pesticide residues washed from the raw materials. The various sources of pollution are:

- Fruit and vegetable wash-water, which is expected to be high in suspended and dissolved solids.
- Juice, tomato paste and jam filling machines, which are responsible for spills that raise the BOD level in the wastewater.
- Cooling water associated with the jet ejectors that generate vacuum in the evaporators. The wastewater will be contaminated with organic matter.
- 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 fruit and vegetable industry are shown in table (5). Typical pollution loads per ton of production are given in table (6). It is clear that the main impact will be due to high organic loads. The effluent is violating Egyptian environmental laws as shown in section 4.2.

Table (4). Pollutants Per Process

MAJOR POLLUTING PROCESS	PROCESS INPUTS	PROCESS OUTPUTS	POLLUTANTS	IMPACT
Raw material inspection and sorting	Fresh fruits and vegetables	Accepted		
		Reject	Solid waste	Soil
Washing	Fruits and vegetables	Clean fruits and vegetables		
	Water	Wash water	Suspended solids, BOD	Water
Peeling, coring, and trimming	Fruits and vegetables	Prepared fruits and vegetables		
		Solid waste	Solid waste	Soil
Filtration	Juice	Juice		
		Pulp	Solid waste	Soil
Concentration	Juice + cooling water + steam	Concentrate		
		water	BOD	Water
Filling	Juice/ tomato paste/ jam	Cans, bottles		
		spills	BOD	Water
Cooking	Fruits/ vegetables	Cooked product		
	Steam	Steam leaks	Temperature, humidity	Workplace
Sterilization	Cans, bottles + steam + cooling water	Sterilized product		
		Steam +cooling water	Temperature, humidity	Workplace
Refrigeration with Freon	Frozen Products	Refrigerated Products		
	Freon + cooling water	Freon leaks	Freon (hazardous) + noise from compressors	Air and Workplace noise, Temperature
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, Noise
Cooling Towers	Water	Blowdown	TDS, TSS	Water
WWTP	Process WW	Treated effluent	BOD, COD, TSS, Color	Water
		Sludge	TSS, HM	Soil

Table (5) Typical chemical analysis of effluent from fruit and vegetable processing facilities

	pH	BOD mg/1	COD mg/1	TSS mg/1	TDS mg/1	Oil& Grease mg/1
Final effluent	6.17	1680	2750	9000	3570	100

Table (6) Typical organic pollution loads per day

	Effluent flow rate, m^3/d	BOD, kg/d	COD, kg/d
Final effluent	1617	2716	4446

2.4.3. Solid wastes

Solid wastes are generated from the following operations:

- The fruit and vegetable trimming, peeling and sorting.
- Filtration of juice for pulp removal
- Scrap at the workshops and garage, which is usually sold.
- Biological wastewater treatment plant, which generates sludge.
- Domestic solid waste (garbage)

There are no hazardous wastes discharged from the fruit and vegetable processing plants except the empty ink and paint containers.

2.5. Characteristics specific to the fruit and vegetable processing industry

Processing (canning, drying, freezing and preparation of juices, concentrates, syrups, and jams) increases the shelf-life of fruits and vegetables. There are some characteristics specific to the industry that should be taken into consideration when conducting inspection and/or self-monitoring of fruit and vegetable processing facilities.

- Due to the introduction of the market economy in Egypt and its implication on increased import and product diversity, most facilities operate upon market demand. Consequently the generated effluents have daily fluctuations in flow-rate as well as concentration of organic load.
- Production lines are operated on a semi-continuous basis with parts of the production lines operating in batches.
- Due to the special nature of food processes, washing and sanitation are performed at least once a day for both operating modes (batch or continuous).
- Pollution loads are expected to be higher during start-up and shutdown.
- The industry uses large amounts of water. International values are given in table (7). Egyptian industry uses even larger amounts.

Table (7) Water Usage in the Fruit and Vegetable Processing Industry (m^3/t product)

Product category	Water Use
Canned fruit	2.5-4.0
Canned vegetables	3.5-6.0
Frozen vegetables	5.0-8.5
Fruit juices	6.5
Jams	6.0

3. Environmental and health impacts of pollutants.

3.1. Impact of air emissions

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.

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.

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

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.

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).

Ammonia Ammonia vapour is a sever irritant to eyes, causes vomiting, diarrhea, sweating and coughing. High concentration can cause respiratory arrest.

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

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 fruit and vegetable industry are BOD, COD,.TSS and TDS.

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 fruit and vegetable processing 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 carbon 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

parameters	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, article 37 and article 38 of the executive regulations 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.
- 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	—	—

The limits for the relevant pollutants are presented in Table (11):

Table (11) Permissible limits as time average and for short periods

Material	Limits			
	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 fruit and vegetable processing industry does not generate any hazardous wastes. 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 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.

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 following CP and EoP measures have been identified for the fruit and vegetables processing 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

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

5.2. Water pollution abatement measures

In-plant modifications

- The installation of product-capture systems for filling machines can reduce product losses.
- The installation of screens and grates on the drains prevents solid waste to reach the wastewater
- Provide simple treatment options (sedimentation, coalescing plate filters, etc..) to allow water to be recycled.
- Improve the distribution chain by carefully managing temperatures and other important variables through the last cycle stage of the product.
- 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…
- Use dry methods such as vibration or air jets to clean raw fruits and vegetables. Dry peeling methods reduce the effluent volume (by up to 35%) and pollutant concentration (organic load by 25%).
- Install DAF unit to recover suspended material.
- Recover useful materials from the wastes, such as recovering oil from skins and seeds.
- Introduce a fermentation operation to produce alcohol.
- Use countercurrent systems where washing is necessary.
- Replace batch processes with continuous ones.
- Modernize the equipment.
- Introduce controlled atmosphere packaging. This technique allows food to retain its quality for a longer time thus, passing through the distribution chain without getting spoiled.
- Use of packaging material with the right strength ensures protection of the final product from the factory gate to the final consumption.

End-of-pipe treatment

Because of the typically high content of suspended solids, COD and BOD in the fruit and vegetable processing 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. Other possible biological treatment methods include trickling filters, rotating biological contactors and activated sludge treatment.

The flows are frequently seasonal, and robust treatment systems are preferred for onsite treatment.

5.3. Abatement measures for solid waste pollution

Fruit and vegetable process wastes

- Cleaning and preparation of raw fruit and vegetable in the farm will reduce the amount of material, which has to be transported and which eventually have to be disposed of by the factory. If crop grading, trimming, selection, culling and inspection can take place in the field, the amount of solid waste generated by the factory will be further reduced. A further advantage to the producer is that these residues may be usefully employed in situ, as fertilizer or animal feed.
- The raw fruits and vegetables delivered to the factories are often damaged. The soft fruits and the tomatoes are often bruised, crushed and rotting. In addition to costing the factory money due to lost raw materials, these losses will also unnecessarily increase the pollution load. Tainting of the final product may also occur. The factory should refuse to accept goods delivered in an unacceptable condition.
- Organic waste from the factory should be used in the production of animal feed or organic fertilizers

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

- Procure clean fruits and vegetables, thus reducing the concentration of dirt and organic materials (including pesticides) in the effluent and reducing water usage.
- 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.
- Adjust the power factor

6. Industrial inspection

The inspection of the fruit and vegetables processing 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 Fruit and Vegetables Processing Industry.

The overall purpose of inspections is to enforce environmental laws. Table (12) lists the various types of inspections and the objectives that have to be fulfilled for each type.

Table (12) 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 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
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-2002).

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 Fruit and Vegetable Processing Industry

Taking the comprehensive inspection as an example, the objectives stated in Table 12 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 fruit and vegetable processing facilities, about 94% of facilities are operating with less

than 10 workers and 0.9% have more than 40 employees. However, sub-sector 154 includes many other industries. Therefore, more information is required about the size, geographic distribution and type of products so that planning at the inspectorate level can be possible. Small facilities are expected to 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 that probably cannot afford the cost of wastewater treatment. Large facilities are expected to have most production lines and most service units. These facilities can most probably, sustain pollution abatement measures.

Note to inspectorate management:
Usually small and medium size facilities cannot afford the cost of 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 fruit and vegetable processing 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. 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 leader, 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 is parallel. Each task is rotated among the inspectors to diversify their experience.

Small facilities Small fruit and vegetable processing facilities will probably produce fruit juices. Most of the service units described in section (2.3.) will not be present. The major pollution problem would be the discharge of wastewater with high BOD to surface water bodies or the public sewer system. 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 (EPAP-GIM 2002), 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

This manual presents the case of a comprehensive multi-media site-inspection of a large fruit and vegetable processing 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 fruit and vegetable processing 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 (C) of the General Inspection Manual, GIM (EPAP-2002), 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 fruit and vegetable processing industry as presented in section 2.5, and their implications on the inspection process of the targeted facility.

Note to inspector:

- *Some facilities dilute its contaminated wastewater with water before discharging to sewer. Degree 44/2000 explicitly prohibits this behavior.*

8.2. Preparation of the inspection plan

An example of an inspection plan is included in Annex (E) of the General Inspection Manual (EPAP-GIM 2002). The plan should take into account the following:

- For large fruit and vegetable processing 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 (G) of the General Inspection Manual (EPAP-2002).
- The results of the analyses included in the environmental register should be checked at the end of the field visit (if suspicion arises about them) and copies of these results should be obtained.

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 fruit and vegetable processing 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 fruit and vegetables 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.

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 fruit and vegetable processing 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.

9. Performing the field inspection

9.1. Starting the field visit

The General Inspection Manual, GIM (EPAP, 2002) 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 polluted wastewater and solid waste generated. 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 (H) in the General Inspection Manual, GIM (EPAP, 2002) 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 a holding tank is not properly lined, contamination of 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 1to 5, check the following:

Production Lines

Tomato Paste production line

- What happens to rejected tomatoes?
- Are there screens on the gutter to prevent solids discharge to sewer?
- What happens to the solid waste from the filtration unit?
- How is sterilization performed? In open or closed equipment?
- Check for temperature and humidity at the sterilizers?

	- How much wastewater is generated from this process? - Check for the presence of a cooling tower for recycling cooling water.
Frozen Vegetables production Line	- What is the quantity of wastewater generated from the washing and cooking step ? - What happens to the solid waste generated from vegetable preparation ? - Check for heat and humidity, if steam leaks occur. - Check for noise from refrigeration compressors.
Juice and Syrup production Line	- What happens to solid waste generated from fruit sorting ? - What happens to solid waste generated from fruit preparation and filtration? - Check for temperature and humidity from the sterilization step? - What is the amount of water used for fruit washing ? - Is there a water recycling system in place? - What are the estimated losses at the juice filling machine?
Jam production Line	- What happens to solid waste generated from fruit sorting ? - What happens to solid waste generated from fruit preparation and filtration ? - What is the amount of water used for fruit washing ? - Check for temperature and humidity at the pasteurization and sterilization steps
Canned Beans Production Line	- What happens to solid waste generated from mechanical shaking and sorting ? - Inspect the color of wastewater in the inspection manhole - What is the amount of water used for beans washing ? - Check for temperature and humidity at the sterilization step
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.
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 4.
	-	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 legal report, but it 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 (K) of the General Inspection Manual, GIM (EPAP, 2002). 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)

References

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- Egypt cleaner production opportunities, Food processing sector SEAM project, 1999.
- National Industrial Pollution Prevention Program – Support for Environmental Assessment and Management, Food industry sector study, 1999.
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- Compliance Action Plans for Food Industry Facilities, EPAP, 1997.
- General Inspection Manual, GIM, EPAP 2001.
- Fundamentals and Background Manual (FBM) – EI/01, EPAP 1999.
- Guidelines for Inspectorate Management – EI/02, EPAP 1999.
- Guidelines for Team Leader – EI/03, EPAP 1999.
- Guidelines for Inspectors – EI/04, EPAP 1999.

Annex (1)

Inspection Checklist for Fruits and Vegetables Processing Facility

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Basic Data Sheet

Date of visit:……. Visit number:…….

Facility name:……

Commercial name:…….

Licensed Activity:……... Days off:……

Legal status:……

Address of facility

Area of facility:…… Governorate:…….

City:…… Zone:…….

Phone no. :…… Fax no.:…….

……... …….

Year of operation :…….. Postal code:……

The Facility Representative:……..

Environmental management representative:…….

Chairman/Owner:……

Address of Administration

e-mail:……..

Phone no. :…… Fax no.:…….

……... …….

The industrial sector:……

No. of male employees: …… No. of female employees:……

Do they work in production …….

Total no. of employees: …….

Number of shifts/day:…….……shifts/ day

Duration of shift:……..…hrs/ shift

Environmental register:…….. Hazardous waste register:…….

EIA:…….. Self monitoring:…….

Nature of Surrounding Environment

Industrial ❑	Coastal ❑	Coastal/ Residential ❑
Industrial/ Residential ❑	Residential ❑	Agricultural ❑
Agricultural/ Industrial ❑	Agricultural/ Residential ❑	Desert ❑

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Basic Data Sheet

Power Consumption

Electricity ❑ Fuel ❑

Electric power: ……...kWh/(day-month-year)

Type of fuel	Fuel consumption	
Mazot	…….	Ton/(day-month-year)
Solar	…….	Ton/(day-month-year)
Natural gas	…….	Ton/(day-month-year)
Butagas	…….	Ton/(day-month-year)
Other ….	…….	Ton/(day-month-year)

The GPS (Global Positioning System) reading for Gaseous Emissions

1- LAT(Latitude):..……. LONG(Longitude):…….
2- LAT(Latitude):…… LONG(Longitude):…….
3- LAT(Latitude):…… LONG(Longitude):…….

Production

Product	Quantity/ (day-month-year)
……	……
……	……
……	……
……	……
……	……
……	……
……	……
……	……
……	……
……	……
……	……

Water Supply

Artesian well ❑ Municipal water ❑ Treated water ❑ Nile water ❑

Canal water ❑ Other…….. ❑

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Basic Data Sheet

Water Consumption

Amount of water consumed in operation (day-month-year):

Process ……..m^3/ Boilers……..m^3/

Domestic usage……....m^3/ Cooling……....m^3/

Other…….. …….m^3 /

Total amount of water consumed (day-month-year)…… ……..m^3/

Type of waste water:
Industrial ❑ Domestic ❑ Mixed ❑

Wastewater Treatment:
Treated ❑ Untreated ❑

Type of Treatment:
Septic tanks ❑ pH adjustment ❑ Biological treatment ❑
Chemical treatment ❑ Tertiary treatment ❑

Amount of treated water/ (day-month-year)……..m^3 /
Amount of waste water/ (day-month-year)…….m^3 /

Final wastewater receiving body:
Nile ❑ Lakes (fresh water) ❑ Drain ❑
Groundwater ❑ Public sewer system ❑ Canals❑
Agricultural Land ❑ Desert Land ❑ Other……❑

The Global Positioning System(GPS) reading for final disposal
1-LAT(Latitude):……. LONG(Longitude):…….
2-LAT(Latitude):……. LONG(Longitude):…….

Engineering Drawings for the Facility
Gaseous emissions map Yes ❑ No ❑

Sewer map: Domestic ❑
Industrial ❑
Mixed ❑
Factory Layout ❑
Production process flow diagram ❑

Ministry of Environmental Affairs-EEAA
30 Misr Helwan Agricultural road - Maadi- Cairo 11728
Tel. (02)5256452-(02)5256453 Ext.8849 Fax(02)5256490

Raw material consumption

No.	Trade name	Scientific name	CAS no.	UN no.	Physical state	Type of container	Amount	Classification	
								Hazardous	Non-Hazardous

Inspection Team Member:

Team member	Position

Date: Inspector signature:

Annex (1- B)

Inspection Checklist for Production Lines and Service Units

Checklist for Cooling Towers and Refrigeration Systems

1.General	
1.1 Number and capacity of cooling towers	…… …… ……
1.2 Cooling tower make-up rate Note : Blow down = 10-15% of make-up	Rate = …… Blow down = ……
1.3 What is the type of refrigerant used in the refrigeration system	☐ Ammonia ☐ Freon ☐ Others
1.4 If Freon is used which is prohibited by the law, is there a possibility for replacement	☐ Yes ☐ No
2. Status of Work Environment	
2.1 Measure the noise next to the compressors of the refrigeration unit	Result ……
2.2 Measure noise and check exposure time	……
2.3 Do you smell ammonia odor If yes perform analysis to check compliance	☐ Yes ☐ No
3. Status of the Effluent	
3.1 Cooling water for the compressors is performed in	☐ Closed cycle ☐ Open cycle
Note : If performed in open cycle it will dilute the final effluent	
3.2 Record the amount of open cycle cooling water of the refrigeration system	…… ……

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 Note :	☐ Mazot ☐ 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 ☐ Ion exchange ☐ Reverse osmosis
2. Status of Air Pollution	
2.1 What is the height of the chimney	.....
Note : the height of the chimney must be 2.5 times the height of adjacent 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	
3. Status of Effluent	
3.1 What is the blow down rate from the boilers	..... m^3/d
3.2 What are the blow down and back wash rates for the treatment units	..... m^3/d ..... m^3/d

3.3 Steam condensate is	☐ Recycled to the boilers ☐ Discharged to sewer
4. Status of Solid Waste	
4.1 If the lime method is used, sludge is generated. What is the amount of sludge produced 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 Measure heat stress near the boilers	Result .....
6.2 Measure noise and check exposure time	Result .....

Checklist for Garage

1. General	
1.1 Is there any detergent or solvent used for washing equipment parts, trucks, floor,….etc	☐ Yes ☐ No
1.2 What is the amount of oil and grease used per day?	.....
1.3 What is the amount of spent lube oil produced per day ?	.....
1.4 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	
1.1 What is the amount of wastewater produced ?	.....
1.2 What is your visual observation for the inspection manhole of the workshop ?	.....
1.3 Check for O&G	.....
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	☐ Yes ☐ No
3.2 Are there any measurements for noise If not Perform measurements	☐ Yes ☐ No
3.3 Check exposure time	.....

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 2.2 Check exposure time	☐ Yes ☐ No .....
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 Wastewater Treatment Units

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 chemicals and their quantities 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 used in liquid or dry form, in agriculture	
3.2 If a third party is involved in disposal, get documents for proof	☐ Found ☐ Not found Comment .....

Checklist for Frozen Vegetables Production Line

1. General	
1.1The housekeeping status Floor condition Water leaks	---------- ----------
1.2 Make sure that the production line is operated	----------
2. Status of the Work Environment	
2.1 Are there steam leaks	❑ Yes ❑ No
2.2 <u>If Yes</u> Check for humidity	----------
2.3 Check for noise near the compressors	----------
2.4 Check the exposure time	----------
2.5 Check for heat near the freezing unit	----------
Note : If suspicious perform your own measurements	
3. Status of Effluents (Wastewater)	
3.1 What is the amount of wastewater produced from this unit ?	----------
3.2 what is the percentage of waste water produced from the washing and cooking steps ?	----------
Note : Washing and cooking steps are the main sources of pollution in this unit	
4. Status of Solid Waste	
4.1 What happens to the reject vegetables	----------
4.2 What happens to solid waste generated from vegetables manual sorting	----------

Checklist Tomato Paste Production Line

General	
1.1 The housekeeping status Floor condition Wash water leaks Piling of solid waste	 ---------- ---------- ----------
1.2 Make sure that the production line is operated	----------
1.3 How is sterilization performed ?	----------
2. Status of the Work Environment	
2.1 Check for heat from heating and squeezing step	----------
2.2 Check for heat from sterilization step	----------
2.3 Does the facility have a heat stress measurements ?	❑ Yes ❑ No
***Note**: In case of suspecious, make your own measurements.*	
3. Status of Effluents (Wastewater)	
3.1 Is there a CIP system for equipment washing?	❑ Yes ❑ No
3.2 what is the amount of wastewater produced from this unit ?	----------
3.3 When during the shift is equipment & floor washing performed ?	----------
3.4 When during the shift, is the CIP discharged to sewer ?	----------
3.5 How much rinse water is used for equipment and floor washing ?	----------
3.6What type of detergent is used for floor washing ?	----------
3.7 Which chemicals are used in CIP ?	----------
3.8 When is the CIP basin emptied ?	----------
3.9 Are there screens on the gutter to prevent solid discharge to sewer ?	----------
4. Status of Solid Wastes	
4.1 What happens to tomato reject ? 4.2 What happens to the solid waste from the filtration unit ? 4.3 What happens to solid water generate from tomato manual sorting ?	---------- ---------- ----------

Checklist for Frozen Vegetables Production Line

1. General	
1.1The housekeeping status Floor condition Water leaks	---------- ----------
1.2 Make sure that the production line is operated	----------
2. Status of the Work Environment	
2.1 Are there steam leaks	❑ Yes ❑ No
2.2 <u>If Yes</u> Check for humidity	----------
2.3 Check for noise near the compressors	----------
2.4 Check the exposure time	----------
2.5 Check for heat near the freezing unit	----------
Note : If suspicious perform your own measurements	
3. Status of Effluents (Wastewater)	
3.1 What is the amount of wastewater produced from this unit ?	----------
3.2 what is the percentage of waste water produced from the washing and cooking steps ?	----------
Note : Washing and cooking steps are the main sources of pollution in this unit	
4. Status of Solid Waste	
4.1 What happens to the reject vegetables	----------
4.2 What happens to solid waste generated from vegetables manual sorting	----------

Checklist Jam Production Line

General	
1.1 The housekeeping status: Floor condition Wash water leaks Piling of solid waste	 ---------- ---------- ----------
1.2 Make sure that the production line is operated	----------
2. Status of the Work Environment	
2.1 Check for heat from evaporation and sterilization steps ?	----------
2.2 Does the facility have a heat stress records ?	❑ Yes ❑ No
<u>If no</u> Make your own	
3. Status of Effluents (Wastewater)	
3.1 Is there a CIP system for equipment washing?	❑ Yes ❑ No
3.2 what is the amount of wastewater produced from this unit ?	----------
3.3 When during the shift is equipment & floor washing performed ?	----------
3.4 When during the shift, is the CIP discharged to sewer ?	----------
3.5 How much rinse water is used for equipment and floor washing ?	----------
3.6What type of detergent is used for floor washing ?	----------
3.7 Which chemicals are used in CIP ?	----------
3.8 When is the CIP basin emptied ?	----------
3.9 Are there screens on the gutter to prevent solid discharge to sewer ?	❑ Yes ❑ No
4. Status of Solid Waste	
4.1 What happens fresh fruit reject ?	----------
4.2 What happens to the solid waste generate from the filtration unit ?	----------
4.3 What happens to solid water generate from fresh fruit manual sorting ?	----------

Checklist for Juice and Syrup Production Line

1. General		
1.1The housekeeping status Floor condition Water leaks		---------- ----------
1.2 Make sure that the production line is operated		----------
2. Status of the Work Environment		
2.1 Are there steam leaks	❑ Yes	❑ No
2.2 If there is live steam generate from sterilizer. Check for temperature and humidity	❑ Yes	❑ No
2.3 Does the facility have a temperature and humidity records	❑ Yes	❑ No
Note : If suspicious perform your own measurements		
3. Status of Effluents (Wastewater)		
3.1 What is the amount of wastewater produced from this unit ?	----------	
3.2 Are there screens on the gutter to prevent solids discharge to sewer ?	❑ Yes	❑ No
4. Status of Solid Waste		
4.1 What happens to the reject fresh fruit	----------	
4.2 What happens to solid waste generated from fresh fruit manual sorting	----------	
4.3 What happens to solid waste generate from filtration step	----------	

Checklist Canned Beans Production Line

General	
1.1 The housekeeping status: Floor condition Wash water leaks Piling of solid waste	 ---------- ---------- ----------
1.2 Make sure that the production line is operated	----------
2. Status of the Work Environment	
2.1 Check for heat near the sterilizer	----------
2.2 Does the facility has heat records ?	❑ Yes ❑ No
3. Status of Effluents (Wastewater)	
3.1 Is there a CIP system for beans washing?	❑ Yes ❑ No
3.2 what is the amount of wastewater produced from this unit ?	----------
3.3 When during the shift is equipment & floor washing performed ?	----------
3.4 When during the shift, is the CIP discharged to sewer ?	----------
3.5 How much rinse water is used for equipment and floor washing ?	----------
3.6What type of detergent is used for floor washing ?	----------
3.7 When is the CIP basin emptied ?	----------
3.8 Are there screens on the gutter to prevent solid discharge to sewer ?	❑ Yes ❑ No
3.9 Do you observe oil on the surface of the inspection manhole	❑ Yes ❑ No
4. Status of Solid Wastes	
4.1 What happens to solid waste generated from mechanical shaking ?	----------
4.2 What happens to the solid waste generate from beans sorting ?	----------

Checklist for Juice and Syrup Production Line

1. General	
1.1The housekeeping status Floor condition Water leaks	....
1.2 Make sure that the production line is operated	.....
2. Status of the Work Environment	
2.1 Are there steam leaks	☐ Yes ☐ No
2.2 If there is live steam generate from sterilizer. Check for temperature and humidity	.....
2.3 Does the facility have a temperature and humidity records	.....
Note : If suspicious perform your own measurements	
3. Status of Effluents (Wastewater)	
3.1 What is the amount of wastewater produced from this unit ?	.....
3.2 Are there screens on the gutter to prevent solids discharge to sewer ?	.....
4. Status of Solid Waste	
4.1 What happens to the reject fresh fruit	.....
4.2 What happens to solid waste generated from fresh fruit manual sorting	.....
4.3 What happens to solid waste generate from filtration step	.....