Birzeit University

Faculty of Graduate Studies

M.Sc. Program in Environmental and Water Engineering

Development of an Environmental Management System Using Cleaner Production in Palestinian Dairy Industries

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September, 2008

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Birzeit, 18 September, 2008

This thesis was submitted in partial fulfillment of the requirements for the Masters Degree in Environmental and Water Engineering from the Faculty of Graduate Studies at Birzeit University-Palestine.

ACKNOWLEDGEMENT

Many people have assisted me during my two years study as a master student and I am very grateful to all.

First of all I am grateful to my supervisor, Dr. Rashed Al-Sa'ed, who guided me skillfully into my research and gave me good advices; he gave his valuable opinions and was always available for discussions. The comments made by the members of the examination committee, Dr. Abu Madi nd Dr. Al- Hamouz are invaluable.

I acknowledge the support of all the Palestinian dairy plants for their cooperation during my field visits, and interviews made and through filling the questionnaires and collecting the data.

Special thanks to the director of Palestinian Food Industries Association Fuad Al-Aqraa, for his cooperation during the interview and for his technical and scientific support.

Furthermore I am grateful to my colleagues in the industrial development department at the Ministry of National Economy, especially my colleagues in the districts offices who helped me collecting the data from dairy industries, and for Saber Al-A~~la~~mleh who has provided technical support and information regarding dairy processing.

My friend Ghadeer Sabri has provided me a great help in using SPSS software to analyze the questionnaire I am very grateful for that.

I am deeply thankful to my loving and caring parents for their support. Finally, I thank my husband, my daughter and my sons for their unconditional love; they have encouraged me and gave me all the support I needed.

ABSTRACT

This research has been carried out to evaluate the current environmental status of the Palestinian dairy industries. The opportunities and measures to reduce and prevent environmental pollution caused by dairy industries were determined.

Data from 14 Palestinian dairy industries were collected during the past three months. Many field visits to dairy industries in different locations in West Bank have been carried out. All processes and activities in these plants have been monitored. Pollution sources in every process and activity have been identified. Check list and guidelines for cleaner production designed by United Nation Environmental Program (UNEP) have been used for this purpose.

All collected data and compiled information were analyzed and evaluated using the Statistical Package for the Social Sciences SPSS and Microsoft Office Excel.

The obtained results showed that Palestinian dairy industries consume large amount of resources. They consume 29,530 ton of raw milk annually, 120 ton of cleaning materials and 125,700 m^3 of water. Cleaning processes consume 83% of water consumption and it is discharged to the sewer system without any treatment.

The Palestinian dairy industries produce annually 149,000 ton of wastewater with high biological organic load almost 8900 mg/l. It's caused because of the spilled of 560 ton of milk, and 38,000 ton of whey. Whey produced from labneh and cheese processing and discharged in to the sewer system which causes negative impacts on the environment.

The research shows that the consumption of raw materials, water and energy can be reduced through practicing cleaner production in dairy industries. The opportunities to reduce the consumption of water, raw milk, energy, cleaning material have been identified.

The conclusion of this research shows that's to protect the environment, save resources, reduce the production cost, the human factor should be considered. Technological changes to increase efficiency should be done. The environmental regulations and law should be applied.

الخلاصة

لقد تم القيام بهذا البحث من اجل دراسة وتقييم الواقع البيئي في مصانع الألبان الفلسطينية من اجل إيجاد الفرص والإجراءات اللازمة لحماية البيئة من التلوث الناجم عن هذه الصناعة. و في إطار تحقيق الهدف المذكور أعلاه تم جمع البيانات والمعلومات اللازمة عن طريق تعبئة استمارات خاصة أعدت لهذا الهدف. تم تعبئة الاستمارات من قبل 14 مصنع ألبان في الضفة الغربية. كما تمت زيارات ميدانية لجميع المصانع، تم خلالها مراقبة جميع العمليات والنشاطات التي تتم داخل المصانع، وتم تحديد مصادر التلوث الناتجة عن كل نشاط أو عملية والفرص الممكنة للحد والتقليل من تأثير هذه الملوثات على البيئة والإنسان، كما تم إجراء مقابلات مع أصحاب العمل والعمال للاطلاع على الإجراءات والطرق والأنظمة المتبعة في إدارة النفايات والمخلفات الناتجة عن التصنيع. ولقد تم خلال هذه الزيارات الاعتماد على قوائم و إرشادات خاصة بالإنتاج الأنظف صادرة عن برنامج البيئة التابعة للأمم المتحدة. كما تم تحليل النتائج باستخدام برنامج ألرزمة الإحصائية للعلوم الاجتماعية SPSS و برنامج أل Microsoft office Excel.

بينت نتائج البحث أن مصانع الألبان الفلسطينية تستهلك كميات كبيرة من المصادر، فهي تستهلك 29530 طن من الحليب الخام سنويا، و 120 طن من مواد التنظيف، و 125,700 م^3 من المياه. يتم استخدام 83% من هذه المياه في عملية التنظيف، و يتم التخلص منها عبر نظام الصرف الصحي دون معالجتها.

كما بينت النتائج أن مصانع الألبان الفلسطينية تنتج 134,500 م^3 من المياه العادمة سنويا. تحتوي المياه العادمة على نسبة عالية من المواد البيولوجية المستهلكة للأكسجين BOD تصل تقريبا إلى 8300 غم /لتر\. و السبب في ذلك يعود إلى تسرب 560 طن من الحليب سنويا وتصريف 38000 طن من الشرش الناتج عن عملية تصنيع اللبنة والجبن إلى المجاري مما يؤثر سلبا على البيئة.

عرض البحث الفرص المتاحة التي ستنتج في حال تطبيق الإنتاج الأنظف في مصانع الألبان الفلسطينية للحد من تأثيرها على البيئة وتقليل كلفة الإنتاج. تعنى هذه الأساليب بتنظيم استهلاك المصادر، كالمياه والحليب الخام والطاقة ومواد التنظيف.

يخلص البحث إلى أنه يجب الاهتمام بالعاملين في هذا القطاع، حيث أن توعية وتدريب العاملين وأصحاب العمل، وتطوير التقنية المستخدمة في الإنتاج وعملية التنظيف، بالإضافة إلى تطبيق الأنظمة والقوانين الخاصة بالبيئة من شانه حماية البيئة وتقليل الخطر على الإنسان وتخفيض كلفة المنتج.

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LIST ABBREVIATIONS

ARIJ	Applied Research Institute of Jerusalem
AUSEPA	Australian Environmental Protection Association
BOD	Biological Oxygen Demand
CFCs	Chloro-fluoro carbon
CIP	Clean in Place
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CP	Cleaner production
DELTA	Developing Environmental Leadership Towards Action
ELV	Environmental Limit Values
EMS	Environmental Management System
Eop	End-of-pipe
EPA	Environmental Protection Agency
FiFo	First In First Out
HACCP	Hazardous Analysis& Critical Control Point
ISO	International Organization for Standardization
MEnA	-Ministry of Environment Affair
MNE	Ministry of National Economy
MPN	Most probable number
NEQS	-National Environmental Quality Standard
NO_x	-Nitrogen Oxides
O&G	Oil and Grease
PA	Palestinian Authority
PCBS	Palestinian ~~Centre~~ Central Bureearou for Statistics
PPA	Pollution Prevention Abatement
PSI	Palestinian Standard Institute
P2	Pollution Prevention
PWA	Palestinian Water Authority
SD	Sustainable Development
SO_x	Sulfur Oxides

SPSS	Statistical Package for the Social Sciences
TDS	Total Dissolved Solids
TQM	Total Quality Management
UHT	Ultra High Temperature
UN	United Nation
UNCED	United Nations Conference on Environment and Development
UNDP	United Nation Development Program
UNEP	United Nation for Environmental Program
UNIDO	United Nation for Industrial Development Organization
US EPA	United States Environmental Protection Association
VOCs	Volatile Organic Compounds
WB	World Bank

CHAPTER ONE
INTRODUCTION

1 1.1. Background

Palestinian dairy industries have negative impacts on the environment. These are due to their consumption of large amount of water, energy for heating and cooling, chemicals in processing, packaging disposal, dairy products scraps and refuses, and there discharging for large amount of wastewater in to the sewer system without any kind of treatment.

The wastewater has high organic load because its contents of milk components. High level of nitrogen and phosphorous caused from the using of cleaning and disinfection materials during cleaning processes. Variations in pH due to the waste of acidic and alkaline solutions produced from the cleaning operations and laboratory. High conductivity because of the presence of sodium chloride waste produced from salting the cheese. Variations in temperature and other wastes produced from hot and cool water.

Utilities activities also cause environmental pollution by the emissions of gases, which produce from boilers during the production of steam or hot water required for production and cleaning operations and the noise.

There are Palestinian environmental law and water law to protect the environment and reduce risks on human. Moreover, there are environmental and water policies and standard for industrial effluent wastewater to determine the concentrations of pollutant materials in wastewater. Unfortunately, there is no enforcement of rules and regulations so the wastewater is been discharged to the sewer system without any treatment.

No environmental management plans practiced in Palestinian dairy industries, and there is lack of awareness and training regarding environmental issues and their importance on manufacturer, on employees, and on public.

Many pollution preventive measures are been identified in Palestinian dairy industries to protect the environment, minimize the cost of production, and improve the efficiency of processes.

2 1.2. Main Goal and Objectives

The main goal of this research study is to minimize and prevent pollution on environment, and reduce risks to humans through an evaluation of the existing dairy process, practices and recommend ways to minimize its environmental impacts.

In order to achieve this main goal, the following objectives should be accomplished:

- Study the present status of Palestinian dairy industries.
- Monitor the production processes, activities, and the attitude of workers in dairy industries and there effect on the environment.
- Determine the quantity of the used resources in production.
- Develop measures to use resources more efficiently.
- Determine the environmental quality parameters.
- Identify the main opportunities to prevent or reduce pollutions at the source.
- Develop waste management system.
- Identify the feasibility of practicing clean production in dairy plant.

3 1.3. Methodology

The following research methodology is been adopted in order to achieve the objectives of this thesis:

- Collecting, studying and analyzing all available related studies on dairy industry, scientific papers, reports and published data locally and internationally.
- The applications of cleaner production practices in Palestinian industries were been studied.
- Guidance Materials for the UNIDO/ UNEP National Cleaner Production Centers & Audit and Reduction Manual for Industrial Emissions and Wastes Technical Report Series No. 7 was been used as a base for questionnaires design (UNEP, 1999).
- A questionnaire for collecting related information from dairy industry plants is been designed and filled. It includes general information about the plants, questions on the resources, processes, equipments, productions….etc.

- Field visits for fourteen dairy plants; manufacturing processes in these plants were monitored depending on Good Housekeeping checklists (DELTA, 2004). Personnel in dairy industries were been interviewed and notes were recorded.
- Interviews with manufacturers, workers, experts in food industry, and governmental decision makers were been carried out.
- The filled questionnaires were analyzed using Excel sheets.
- The out coming results have been evaluated.
- The pollution prevention opportunities were been identified.

1.4. Thesis Outline

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The thesis is been divided to the following parts:

- Overview of cleaner production, its definition, principles, practices benefits and summary for environmental pollution are been presented in chapter two. The quality parameters related to dairy industry in addition to the past Palestinian applications of cleaner production practices in Palestinian industries are been summarized also in this chapter.
- General view of the existing status of dairy industry in Palestine is been shown in chapter three. This is followed by the research methodology in chapter four.
- Chapter five entails information and data analysis obtains for the 14 dairy industries under study, discussion and analysis of the results. In addition, the potential and the feasibility of cleaner production applications within the Palestinian dairy industries are been presented and discussed.
- Finally a presentation of the conclusions, the recommendations to the government, manufacturers and researchers are included in chapter six.

CHAPTER TWO
CLEANER PRODUCTION LITERATURE

2.1 Cleaner Production Definition and Concepts

The definition of Cleaner Production that is been adopted by UNEP is the following:
Cleaner Production is the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase overall efficiency, and reduce risks to humans and the environment (UNEP, 2004).

The concept of cleaner production is been known by several names, waste minimization, reduction at source, pollution prevention, eco-efficiency… etc.

For production processes, Cleaner Production aims in particular at conserving raw materials and energy, eliminating toxic raw materials, and reducing the quantity and toxicity of all emissions and wastes before they leave the process.

For products, Cleaner Production aims to reduce the environmental, health and safety impacts of products over their entire life cycles, from raw materials extraction, through manufacturing and use, to the 'ultimate' disposal of the product.

For services, Cleaner Production implies incorporating environmental concerns into designing and delivering services.

Cleaner production application requires responsible environmental management, to correct treatment or disposal alternatives, it is about attitudinal and technological changes to increase efficiency and reduce risks to humans and the environment.

Cleaner Production related to several other environmental management concepts such as pollution control, waste minimization, pollution prevention …etc. (Van Berkel, et.al, 1997). Figure 2-1 shows Cleaner Production in relation to other preventive environmental management concepts.

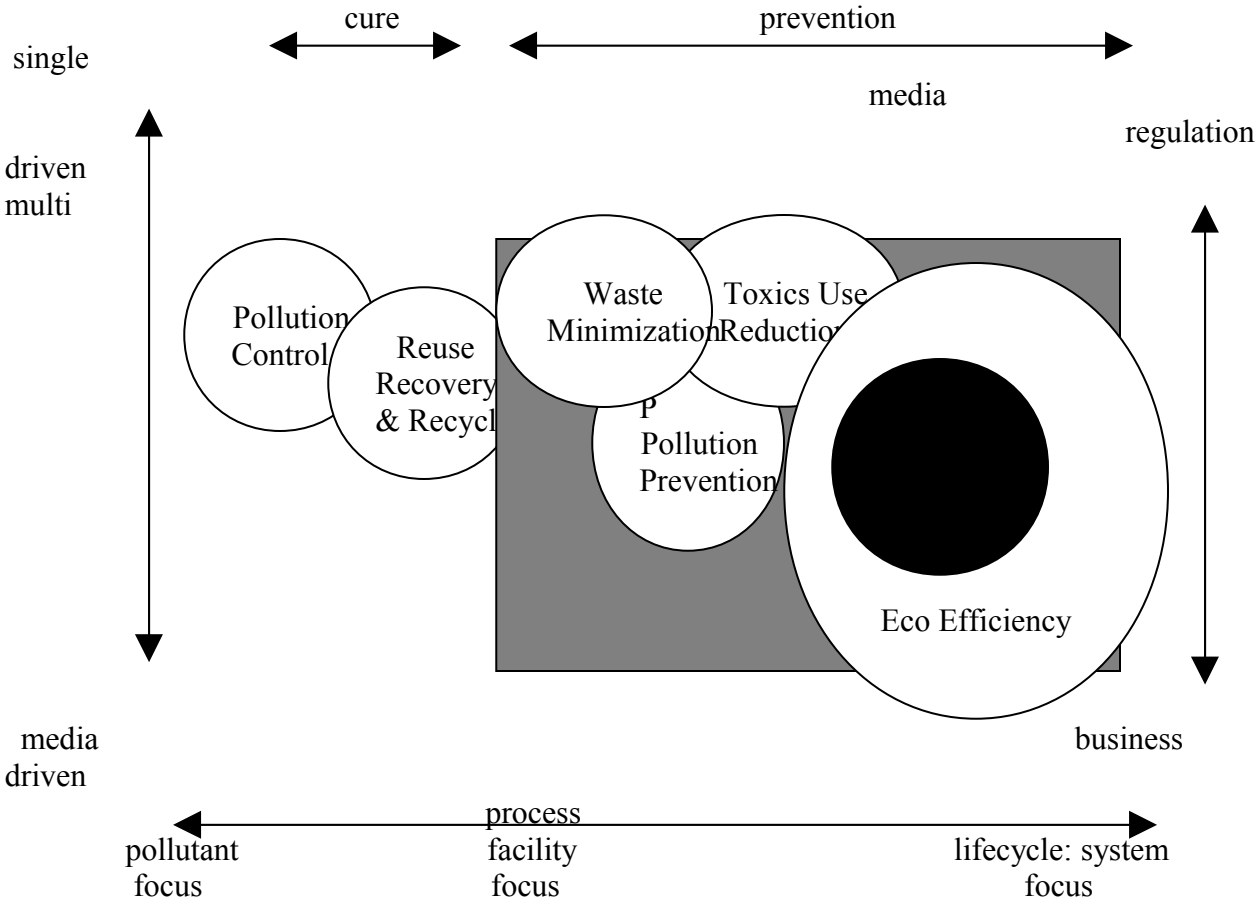

Figure 2-1: Cleaner Production in relation to other preventive environmental management concepts (Van Berkel, et.al, 1997).

5 2.2. Cleaner Production Practices

Cleaner Production aims to use natural resources more efficiently such as raw materials, energy and water, and reducing the generation of wastes and emissions at the source (Siebel, 1999). A division in five prevention practices is most common for achieving that (UNEP, 2004).

1. Good Housekeeping

Practicing good housekeeping in dairy industry; through taking appropriate managerial and operational actions in plants will reduce the production cost, and will reduce the negative impacts

of the plants on environment, and reduce health risks on the employee (DELTA, 2004).

2. Raw Material Substitution

Replace raw materials with less toxic and hazardous one.

3. Better Process Control

Run the processes more efficiently will lead to a reduction in the resource consumption and will generate less waste and emission rates.

4. Equipment Modification

According to Carawan (1977), this can achieve by modifying the existing equipments or adopting new technologies to improve processes efficiency that will lead to reduction in the quantity of wastes and emission.

5. Product Modification

Modify the product characteristics and quality will minimize its environmental impacts during its use and after disposal (Carawan, 1977).

6 2.3. Cleaner Production Benefits

Some dairy industry manufacturers are aware that through practicing cleaner production in their plants, their work will improve and they can gain the following benefits (Cagno, et.al, 2005):

1. Increase their profits by reducing the unit cost by managing the effective use of resources such as raw materials, energy and water, and by reducing the costs for waste handling, disposal.
2. Minimize the negative impacts on the environment and that will reduce the risk to workers and to the community.
3. Improve the cooperation in workplaces between workers.

7 2.4. Cleaner Production and Sustainable Development (SD)

Cleaner Production can contribute to sustainable development, as endorsed by Agenda 21 (The United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro in June 1992). Cleaner Production can reduce or eliminate the need to trade off environmental protection against economic growth, occupational safety against productivity, and consumer safety against competition in international markets.

Setting goals across a range of sustainability issues leads to 'win–win' situations that benefit everyone. Cleaner Production is such a 'win–win' strategy: it protects the environment, the consumer and the worker while also improving industrial efficiency, profitability and competitiveness. Cleaner Production can be especially beneficial to developing countries and those undergoing economic transition. It provides industries in these countries with an opportunity to 'leapfrog' those more established industries elsewhere that are saddled with costly pollution control (Robert, et.al, 2002).

2.5.

Cleaner Production Quality and Safety

Food safety and food quality are very important aspects of the food industry, so cleaner Production should operate with quality and safety systems.

In order to manage food safety and food quality Hazard Analysis Critical Control Point (HACCP) is used. It is been based on preventing microbiological, chemical and physical hazards in food production processes by preventing the problems, rather than depending on inspection of the finished product. Other quality system, which is been used to improve product quality while lowering costs is Total Quality Management (TQM) (Daugherty, 1996).

8 2.6. Cleaner Production and Environmental Management Systems (EMS)

An EMS provides a company with a decision-making structure and action programmed to practice Cleaner Production in the plants to solve environmental problems.

The International Organization for Standardization (ISO) initiated series of generic standards. ISO 14001 is one of these standards, which provide company management with the structure for managing environmental impacts (ISO, 2004). To achieve that, business action should take place in the manufacturing plants (Voien, and Steven, 1998).

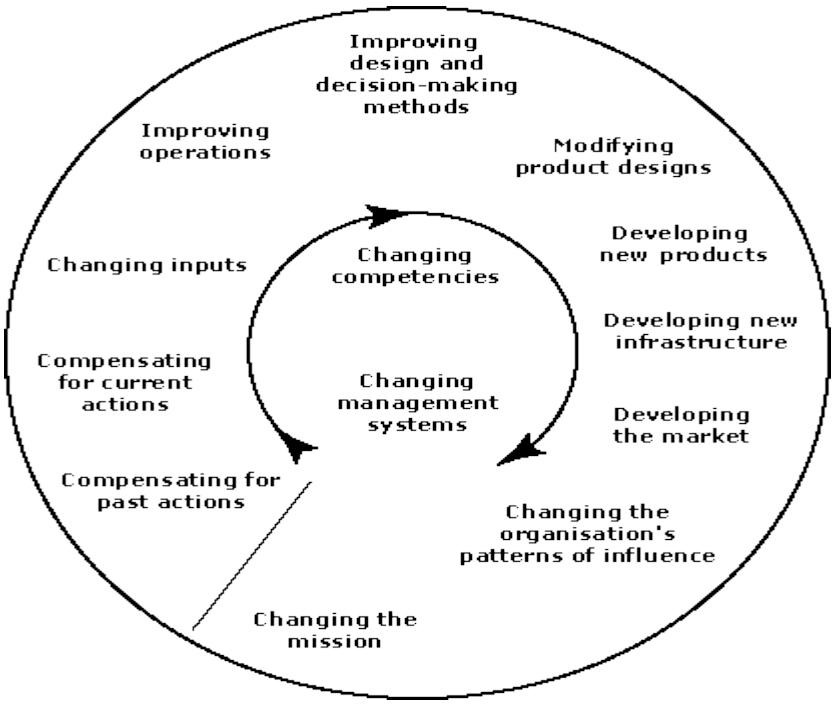

Figure 2-2: Areas for business action on the environment (Van Berkel, et.al, 1997).

2.7. Pollution Quality Parameters

The Pollutants and effluent parameters that should be taken in to consideration in dairy industry include Biological Oxygen Demand (BOD_5); Total suspended solids (TSS); pH (acidity and alkalinity); Temperature; Phosphorus, nitrogen and chloride content; Process wastewater volume; Oil and grease.

The following presents the effluent levels that should achieved:

Table 2-1: Effluents from the Dairy Industry (World Bank Group, 1998).

(milligrams per liter, except for pH, temperature, and bacteria)	
Parameter	Maximum value
pH	6 –9
BOD	50
COD	250
TSS	50
Oil and grease	10
Total nitrogen	10
Total phosphorus	2
Temperature increase (a)	≤ 3° C (a)
Coliform bacteria	400 MPN/100 ml

Note: Effluent requirements are for direct discharge to surface waters.

(a) The effluent should result in a temperature increase of no more than 3 C ° at the edge of the zone where initial mixing and dilution take place. Were the zone is not defined, use 100 meter from the point of discharge.

9 2.7.1. Biological Oxygen Demand (BOD $_5$)

Biochemical Oxygen Demand (BOD_5) is one of the wastewater quality parameters that can determine waste load. BOD_5 is a measure of the amount of oxygen needed to degrade the organic matter under specific conditions measured at five days and is been expressed in milligrams per liter (mg/l). The higher the BOD_5 value, the more oxygen depletion will caused in the water, and that will cause negative impacts on the aquatic life, and cause extinction of certain species and reduce the normal oxygen-consuming bacterial population.

Sources of BOD_5 in the wastewater dairy plants are milk, cleaners, sanitizers and lubricants that released from the mechanical conveying systems (Hale, et.al, 2003).

The BOD_5 concentration of raw wastewater in the dairy products processing industry typically the average ranging from 0.8 to 2.5 kilograms of wastewater per ton of milk in the untreated effluent (US EPA, 1992).

It is known that 1 Kg of BOD_5, is equivalent to 9 kg of milk (Carawan, and Stengel, 1996). Thus if the BOD_5 level in dairy plant's wastewater is known the volume of how much product is going down the drain could be estimated.

10 2.7.2. Chemical Oxygen Demand (COD)

The effects of Chemical Oxygen Demand (COD) are the same as BOD_5.

When the COD concentration in the wastewater is been known, the volume of product lost can be estimated. COD is normally about 1.75 times the BOD level (Kent, et.al, 1997).

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12 *2.7.3. pH*

pH is normally between 6 and 8 in order to protect aquatic life.

The pH from 4.0 to 10.8 with a mean value of around 7.8 will affect the biodegradation of organic varies of dairy wastewater (World Bank Group, 1998). The main factors affecting the pH of dairy plant wastewater is the type and amount of cleansing and sanitizing compounds discharged to wastewater and the amount of whey discharges in wastewater.

2.7.4. Total Suspended Solids (TSS)

Suspended solids, more accurately termed as non-filterable residue, include settleable and non-settleable matter. Suspended solids in water increase turbidity and reduce penetration of light. This affects the photosynthesis process, ultimately destroying plant life.

The amount and nature of suspended solids in raw dairy plant are due to organic waste presence from coagulated milk, particles of cheese curd as well as fat particles, and salts, which are been discharged along from different processing and from boiler blow down (ETPI, 2000).

A total suspended solid in wastewater dairy plant is normally at 100–1,000 milligrams per liter (mg/l) (World Bank Group, 1998).

2.7.5. Total Dissolved Solids (TDS)

Most of the dissolved solids are undesirable in the receiving water. Dissolved minerals and organic constituents may produce aesthetically displeasing color, taste and odor. Some dissolved chemicals may be toxic and some of these organic constituents might be carcinogenic in nature.

Dissolved chemicals are contributed from different detergents such as nitric acid and sodium hydroxide, and disinfection materials such as hydrogen peroxide (Wright, and Romney, 1990). Other source of chemicals is from laboratories.

13 2.7.6. Chloride

Chloride in the wastewater comes from sanitizing agents and brine from cooling and refrigeration. Milk and its products contribute to a very small part of the chloride load. Thus, at a 1 % concentration of milk in the wastewater, milk would contribute 10 mg/l of chloride compared to the normal range of chloride concentrations of between 1.9-0.05g/l (World Bank

Group, 1998). High concentration of chloride in water may cause salinity of agricultural land and it will not be suitable for agricultural.

14 *2.7.7. Phosphorus*

Phosphorus in wastewater originates from the detergents and cleansing solutions and small part comes from the milk or milk products, which typically contain significant amounts of this substance. Phosphorus between 10 to 100 mg/l, reflect the variation in the use of detergents and in the recycling of cleaning solutions.

Wastewater containing 1 % milk would normally contain about 12 mg/l of phosphorus, determined as phosphate PO_4^{-3} (World Bank Group, 1998).

2.7.8. Nitrogen

A typical ammonia nitrogen concentration in milk processing wastewater is about 6% of the BOD level. Milk would contribute about 55 mg/l of nitrogen. Ammonium compounds and certain other detergents and sanitizing agents further contribute to nitrogen concentrations in dairy processing wastewater (World Bank Group, 1998).

2.7.9. Wastewater

A large quantity of contaminated wastewater is been discharged from a number of dairy processes. The major contaminants in dairy processing wastewater are milk solids that contain milk fat, protein, lactose and lactic acid. Other minor constituents include sodium, potassium, calcium and chloride.

Sources of wastewater include the cleaning operation, steam-condensate-discharge, water-condensate from milk plant, steam-formation, boiler's blow-down as well as general cleaning of floors, tankers, and vessels...etc (US EPA, 1994).

11,000 kg of milk produced by dairy processing will equivalent to 542-9,000 liters of wastewater. The waste load equivalents of specific milk constituents are 1 kg of milk fat = 3 kg COD; 1 kg of lactose = 1.13 kg COD; and 1 kg protein = 1.36 kg COD (World Bank Group, 2007).

2.7.10. Oil and Grease

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The concentration of oil and grease in wastewater is of special concern for facilities discharging to surface waters or municipal treatment systems. Discharge limits for oil and grease in some industrialized countries are around 150 mg/l (US EPA, 1998).

16*2.7.11.* **Temperature**

The temperature of the wastewater stream is affected by hot water and steam recycling operations and the temperature of the cleaning solutions. Typical temperature values of raw dairy wastewater range between 8 and 38°C with a mean value of around 24°C (World Bank 2007).

17 **2.7.12. Noise**

Noise levels in most of the areas in dairy production facilities are very high. The running of electric motors of different pumps, boilers, refrigeration, and ventilation….etc, creates noise. The noise should not exceed 70 decibel in industrial areas during night and day.

The following Table 2-2 shows the maximum allowable noise in different areas and during different time:

Table 2-2: Maximum Allowable Noise in dB (World Bank Group, 1998)

Receptor	Day (07:00–22:00)	Night(22:00–07:00)
Residential, institutional, Educational	55	45
Industrial, commercial	70	70

2.7.13. Air Emission

Air pollution usually is not among major environmental problems at a dairy plant. However, overall environmental planning and management should include air pollution abatement and management. Dairy industry produces air emissions from the burning of gas or diesel for heating,

and from refrigeration, which use ammonia gas as cooling agent. The following Table 2-3 shows air emission from burning gas. In addition, Table 2-4 shows air emission produces from fuel oil.

Table 2-3: Air Emission by Burning Gas (World Bank Group, 1998)

Process	Air emission	Air emission (kg/ton processed milk)
Heating by burning gas	CO	0.03
	CO_2	92
	No_x	0.1
	SO_2	0.05

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Table 2-4: Emissions from the combustion of fuel oil (WB, 1998)

Input		Outputs	
Fuel oil (1% sulphur)	1 kg	Energy content	11.5 kW.h
		Carbon dioxide (CO_2)	3.5 kg
		Nitrogen oxides (NOx)	0.01 kg
		Sulphur dioxide (SO2)	0.02 kg
1 kg of oil = 1.16 liter of oil (0.86 kg/L) 1 kW.h = 3.6 MJ			

2.8. Cleaner Production Practices in Palestine

In Palestine, there were few efforts to apply the cleaner production in some industrial sectors. Efforts aimed at exploring the feasibility of applying cleaner production principles as a tool for improving the environmental and economical quality. One major experiment research conducted by (Nazer, et.al, 2006), aimed at reducing the environmental impact of the unhairing-liming process in the leather tanning industry. The research deals with applying cleaner production practices in Palestinian tanning industries. It shows that low cost modifications to current tanning practices by four times reuse of the unhairing-liming liquor reduce the production costs by reducing the amount of sulfides and other materials discharged with the wastewater without visibly affecting the quality of the final product of leather.

In year 2004, some Palestinian industries applied cleaner production preventive practices through DELTA program. The results of the practices revealed the feasibility of applying cleaner production principles as a Good Housekeeping tool for reducing raw material wastage, reusing the waste and saving money. The practices and the results were as following:

- The practice was on recycling and minimizing solid wastes in a biscuits factory without investment. The wastes used as animal food and the annual saving was equal to 7,800 dollar.

- Other practice carried out on reducing the overall consumption of water and reusing wastewater in a beverage factory. The amount of investment was about 2,000 dollar in implementation of a closed circuit to collect and use wastewater for general services (bathrooms and cleaning). The results show that the annual saving was about 3,454 dollar and 59% of wastewater reused.

- There was also a practice on a chemical factory in order to reduce raw materials wastage. The factory invest 3,000 dollar to achieve that. The factory has save 1,150 dollar annually because of this practice.

- A dairy factory also applied a cleaner production practice in order to reduce the loss of raw materials. The factory invest 600 dollar in installing a control valve to reduce the spill of milk during the filling of the bottles. The annual saving from this practice was 8,000 dollar.

CHAPTER THREE

STATUS OF THE DAIRY INDUSTRY IN PALESTINE

19 3.1. General Information on Palestinian Industry

The number of Palestinian industrial enterprises are 11,351 (PCBS, 2006) with a number of employee of 49,990. Almost 91.7 % of these industries are small enterprises with less than 10 workers, 7.9% with number of workers between 10-49, and 0.4% with more than 50 workers.

The number of food and drinks processing plants reached 1,532 plants and represent almost 12 % of the manufacturing industries with 7745 workers and that represent 15% of the workers in food sector (Annex 1).

The industrial activity consumed large amount of water every month. In year 2006, the amount of consumed water reached amount of 1,612,900 m^3 per month (PCBS, 2006).

Most of the wastewater produced from the industrial activities is been discharged without any kind of treatment. 62.8% of the wastewater is been discharged through sewer system; the other 37.2 % is discharged through cesspits (PCBS, 2006). The industries charged monthly for their wastewater discharge to the sewer system depending on the meters of their water consumption.

The industrial activities produced monthly 45,800 ton of solid waste (PCBS, 2006). The solid waste is collect in municipality solid waste containers. The municipalities collect and transfer the solid waste to dump sites. The municipalities collect the waste daily or every few days against annually charge. The annual charge does not depend on the quantity, or quality of waste but on kind of industry. Many times the industries workers burn the solid wastes.

20 3.2. General Information on Palestinian Dairy Industry

The dairy industry is been defined as the manufacture of foods based on milk or milk products.
The annual milk production in Palestine is 172.2 thousand m^3 with a value of 96.6 million dollar. The annual milk production in Gaza is 24.3 thousand m^3 with a value of 12 million dollar. The annual milk production in West Bank is 147.9 thousand m^3 with a value of 84.6 million dollar; these quantities include cows and goats milk (PCBS, 2006). The amount of cow milk in Gaza is 19.7 thousand m^3 annually, and the amount in West Bank is 69.6 thousand m^3 (PCBS, 2006).

There are currently 45 dairy industries in Palestine these industries include ice cream industries and unarranged sector, the family industries (PCBS, 2006). Dairy industries represent 3% of the food and drinks processing sector, with a number of workers 882, that represents almost 11% from the worker in food industry sector (PCBS, 2006). The annual dairy production amount is 28,223 million us dollars (PCBS, 2003).

The number of registered and licensed dairy plants in the Ministry of National Economy is 16 industries. The designed annual production capacity is 78,710 ton, and the real annual production capacity is 27,885 ton (MNE, 2006). That means that the Palestinian dairy industries are working with almost 35 % of their production capacity. Their share in Palestinian market is about 50%, and the other 50% covered by Israeli products (PALTRADE, 2008).
Most of the Palestinian dairy industries use modern and automates technology (MNE, 2006).

The other industries are small family industries. No data or information is available about these industries. These family industries produce almost 20% of the Palestinian dairy products, and most of their products are labneh and white cheese (Alaqraa, 2008).

Most of the dairy production is concentrated in Hebron district and that because most of the Palestinian raw milk that is used as raw material in this industry produced in Hebron district.

Regarding the quality of raw milk and dairy products eight standard and technical regulation has been issued from PSI on year 1999.

The Palestinian dairy industries are distributed in nine districts. There are no dairy industries in Jenin and Bethlehem districts. In these districts, there are just small family industries with traditional production process, marketing directly to the consumer. Some investor tried to establish dairy industries in Jenin, but unfortunately, they failed (MNE, 2006).
The following table shows the distribution of industries that are registered in MNE:

21 Table 3-1: The Palestinian Industries Distribution (MNE, 2008)

No.	Palestinian District	Number of plants
1.	Ramallah	3
2.	Jericho	1
3.	Jerusalem	1
4.	Tulkarm	2
5.	Qalqilya	3
6.	Salfit	1
7.	Hebron	3
8.	Nablus	1
9.	Gaza	1
	Total	16

3.3. Raw Materials

The main raw material used in dairy plants is fresh cow and goat milk with amount of 47, 07 ton (Alraee, 2005). The other raw materials used in this industry are powder milk, salt. Small amount of additives such as sugar, rennet, starter for yogurt, flavors, colors, and preservatives are also used. Some dairy by products are also used as raw materials like cream, whey, etc (MNE, 2002).

The packaging materials used in this industry are Tetra Packs use for UHT milk; plastic bottles and containers produced from polythene of high and low density, silver foil, shrink-wrap nylon, cartoons and pre-formed plastic boxes.

For cleaning purposes several kinds of cleaning materials are used such as caustic soda, hexona, sulfuric acid, nitric acid (MNE, 2002). The costs for packaging materials are about three million dollar annually (MNE, 2002).

22

23 **3.4. Dairy products**

The Palestinian dairy industries are producing different kinds of dairy products with amount of 33,403 ton annually (Table 3-2).The products are as follows:

1. Milk, in two kinds Pasteurized and UHT milk with 3340 ton annually.
2. Cultured milk products. Cultured milk is the collective name for products prepared by lactic acid fermentation or by a combination with yeast fermentation.

The cultured milk products in Palestinian dairy industries are Yoghurt, Drinking yoghurt (laban up), Fruit drinking yogurt and labneh.

3. Cheese

In Palestine, the dairy industries produce soft and hard white cheese.

4. Sour cream (Chemenet)

It produced by using the cream, which is by product from milk manufacturing.

5. Qareesh cheese

It is a kind of cheese produced by using whey that is by product from labneh and cheese manufacturing.

Table 3-2: Palestinian dairy products and their quantity (MNE, 2002)

Products	Quantity in tons
Pasteurized milk	3340
Yogurt	8350
Labneh	6680
Laban up	5010
White cheese	6830
Fruit yogurt	60
Others	3133
Total	33403

3.5. Palestinian Dairy Industries Processes

This is a summary for the processes that are applied during the manufacturing and production of the dairy products in the Palestinian dairy industries.

3.5.1. Production of Pasteurized Milk

The applied dairy processes and techniques for producing pasteurized & UHT (Ultra Heat Treated) milk are as follow and it described in figure 3-1.

3.5.1.1. The receiving and Testing Process for Raw Milk

Raw milk is received to the plant by stainless steel tank Lorries, tanks or milk containers, then Samples are taken, to test the quality of the milk. The quality of the milk depends on fat, protein contents, and pH. The milk then passes through strainers then to a volume-measuring device for quantification. Milk is then cooled to 6-8 C^0 and stored in storage tanks.

The milk is filtered in order to eliminate visible foreign solids and clarified by the removal of dirt and protein coagulates.

3.5.1.2. Filtering and clarification

In this process organic, inorganic particles, and coagulates of proteins are separated by using centrifugal devices or mechanical filters.

3.5.1.3. Skimming and standardization

40 % of the milk fat is separated from the milk during this process. In order to standardize the fat content of the milk as required completely low fat or skim milk cream will be added to the skim. The remaining cream is used in the production of sour cream.

3.5.1.4. Homogenization

Milk is then homogenized by reducing the size of fat globules to prevent containing cream layer on the surface when cooled to 7 C^o for 48 hours.

3.5.2. Heat treatment

This process destroys the microorganisms contained in the milk. One of the following two processes is used:

3.5.2.1. Pasteurization

Milk is heated to 65 C^{o} (PSI, 1999) for few seconds to ensure total destruction of all pathogenic microorganisms, to guarantee public safety. The milk is then cooled to less than 8C^{o}.

3.5.2.2 Ultra High Temperature treatment (UHT) milk

Pasteurized milk is sterilized by raising the temperature to 135 – 150 ^{o}C for 4 seconds (Ultra High Temperature, UHT). This treatment process is used to conserve fresh milk for long period and it can be stored at room temperature. Figure 3-1 clarifies the production process of pasteurized milk.

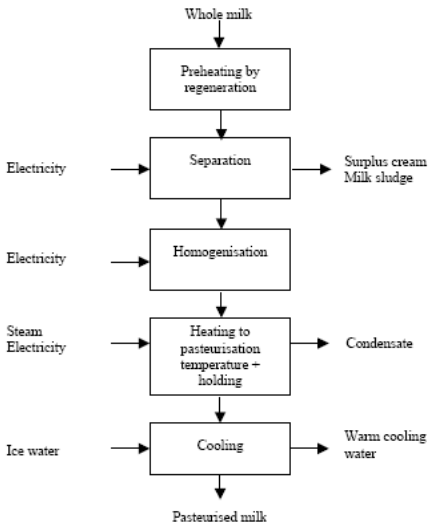


Figure 3-1: Input and Out put of production of pasteurized milk (Korsström, and Lampi, 2001).

3.5.3. Fermented milk production

Fermented milk is the collective name for products prepared by lactic acid fermentation or by a combination with yeast fermentation.

The production of cultured products involves incubation of the heat-treated and standardized milk with a starter culture, followed by incubation for a certain time.

Following is the production processes for the fermented milk products produced in Palestinian dairy industries:

3.5.3.1. Yoghurt Production Processes

The milk used for yoghurt production must first pasteurize, homogenized and standardized to the desired fat content.

The content of dry matter is standardized by adding milk powder; deaeration is a part of the process. Starter cultured added to the milk and then incubated in order to e fermented. After incubated it is cooled Figure 3-2 clarify this process.

Yoghurt is divided into the three types:

• Incubated and cooled in plastic packages.

• Incubated in tanks and cooled before packaging.

• Drinking yoghurt, the coagulum is broken down to a liquid, like laban up, fruit drinking yogurt.

3.5.3.2. Production of sour cream

It goes under the same processes for yogurt production, cream will added to the product in order to raise fat content and its known in Palestine as laban chemenet. Figure 3-2 clarifies the production process of Cultured Product.

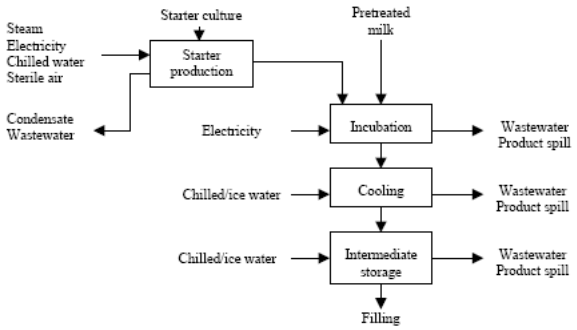


Figure 3-2: Input and Out Put of Cultured Product (Korsström, and Lampi, 2001).

3.5.4. Production processes of cheese

Cheese is generally defined as a milk concentrate obtained by coagulation by adding starter culture like rennet and adding salt. After pre-pressing and cutting, the residual liquid is drained out. It is called whey. The cheese after that is cooked and stirring (Lucey, and Kelly, 1994).

Some industries use whey as raw material to produce qareesh cheese, which is low fat cheese.

In Palestine, dairy industries produce two kinds of cheese, soft and hard white cheese with salt content almost 2%. Figure 3-3 clarifies the production process of cheese.

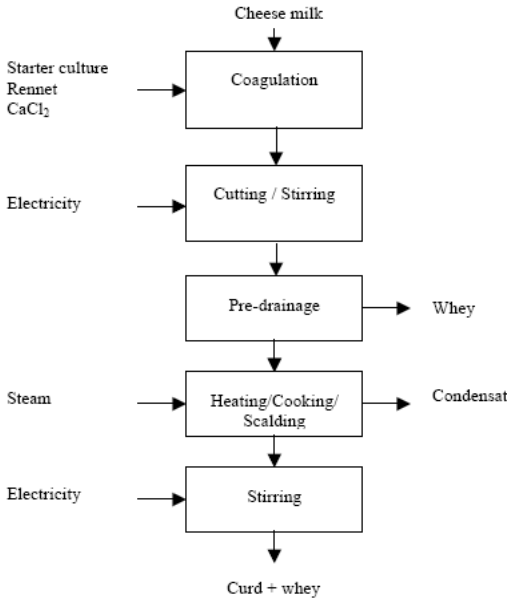


Figure 3-3: Input and Output of Production for Cheese ((Korsström, and Lampi, 2001).

3.5.5. Filling and Packaging process

Milk and dairy products are filled in modern industries in an automatic filling machine, and are filled manually in traditional industries in several types of containers. After filling, the packaged

products are usually stored and transported in wire or plastic crates. Figure 3-4 clarifies the filling process of cheese

Figure 3-4: Input and Out Put of Production for the Filling Step (Korsström, and Lampi, 2001).

3.5.6. Refrigerated storage process

Milk is stored in refrigerated storage tanks until packaging, in order to control the quality of the milk before packaging. Other products stored after been packaged.

Ammonia is used in Palestinian dairy industries as refrigerant.

3.5.7. Cleaning and Disinfection Process

The objective of cleaning dairy processing equipment is to achieve chemical and bacteriological cleanliness. There are two cleaning systems used in Palestinian dairy industry, which are manual cleaning and CIP.

The following figure clarify clearing process

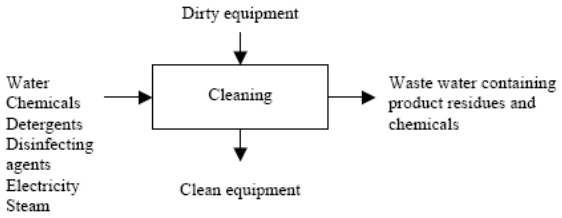


Figure 3-5: Input and Output of Production for the Filling Step (Korsström, and Lampi, 2001).

3.5.7.1. Cleaning in place system (CIP)

This system finds in modern dairy industries, eight Palestinian dairy industries use this method. It allows cleaning and disinfecting to take in place. Rinsing water and cleaning solutions are pumped through all the components that are in contact with the product(Romney, 1990).

The main system steps are as follow:

- Pre-rinsing with water, the equipment is rinsed with warm water to remove any product residues for 3 – 10 minutes (Schmidt, 2003).
- Cleaning by circulation of alkaline solution, (sodium hydroxide of 0.5 – 1.5 %,) and at 75°C for about 10 minutes. Equipment like pasteurizers, with hot surfaces takes circulation time of 30 minutes and stronger solutions such as caustic soda and nitric acid of 0.3 – 0.7% concentration circulated for about 5 minutes at 65°C (Schmidt, 2003).
- Some industries follow alkaline cleaning by cleaning with acid. Follow by rinsing with warm water between the cleaning steps to rinse out the alkaline solution.
- Final rinsing with water.
- Disinfection, the disinfection step is carried out immediately before the production line is to be used again. This done by using disinfecting agent as phosphoric acid with hot water 90-95°C and circulating it for about 10 minutes (Schmidt, 2003).
- Cooling with water.

3.5.7.2. Manual cleaning

Manual cleaning system is used in traditional Palestinian dairy industries. The floors and the production equipments are manually cleaned by using detergents substances and foams with low-pressure cleaners and brushes.

3.5.8. Steam

Steam of 140-150°C is the most frequently used heating medium in dairy processing. It is produced in a steam boiler and is distributed to the processing area by insulated pipes.

3.5.9. Laboratories

Just four modern Palestinian dairy industries have laboratories. A laboratory in dairy industries is very important and used for:

1. Test the quality of the raw materials.
2. Control the quality of the products.
3. Research.

The other industries that have no labs send their samples to an accredited lab to be tested.

3.5.10. Storages

There are different types of storages in dairy plant

1. Refrigerator tanks for storing raw milk, Pasteurized milk that is used as raw material for producing milk products.
2. Refrigerators for storing dairy products.
3. Storage for storing raw materials, cleaning materials, and packaging materials.
4. Fuel tank for storing the boilers fuel.

3.6. Palestinian laws and regulations

3.6.1. Palestinian laws

Environmental Law No 7, 1999 regulates all environmental issues to protect the environment; however, law enforcement is not been effectively implemented. This law includes the protection of natural resources, forestry, archaeological and tourist sites, and drinking water, and the control of sewage, marine pollution, air pollution, industry, fishing, urban development, municipal and hazardous waste disposal. It also covers environmental planning and enforcement and incorporates the 'polluter pays' principle (MEnA, 2000).

There is lack in this law regarding environmental quality standards and economic measures, and in pollution regulations, water resources protection, industrial discharge, agrochemical use, waste disposal, etc.

Articles 28, 29 and 30 of Environmental Law, covers water resources, which address the need for quality standards for drinking water; wastewater treatment; and effluent disposal. Some water quality standards are been issued, however neither the monitoring nor the enforcement of these standards has been addressed in any By-Law.

A standard regarding industrial effluent discharges is been issued (Annex 2) (PSI, 1998). The monitoring and enforcement of applying these standards are been not properly implemented, and industries are not requested to conduct self-monitoring and compliance.

The Palestinian Authority has not adopted a legal framework for an effective solid waste management; whiles the Environment Law provides a framework to provide a legal framework for the sector. Articles 7, 8, 9 and 10 for non-hazardous, and articles 19, 20, 22, 23 and 24 cover air quality standards, industrial emissions, unlicensed waste incineration and ozone depletion.

Water Law No 3-2002 provides for the sustainable development of water resources and the protection of all water resources from pollution. According to the law National Water Utilities will be establish based on the desire of local committees and water users associations, to provide water and wastewater services.

PWA recognizes the importance of establishing proper Environmental Limit Values (standards and guidelines) for effluent from domestic wastewater treatment plants as well as the industrial standards for wastewater to be discharge on the sewage systems.

The Palestinian Standards Institute (PSI) (Annex 2) and the PWA prepare environmental Limit Values (ELV). However, these Limit Values are not been enforced so far.

3.6.2. Palestinian environmental policy

Environmental protection and the integration of sustainable environment concerns into national policies is a recent concern in Palestinian Authority.

Environmental considerations were firstly included in the Palestinian Authority's first five-year Palestinian Development Plan, 1999- 2003. In 2000, the Palestinian Authority proceeded to the development of a ten-year environmental strategy for 2000-2010, and adopted a national environmental action plan (NEAP).

There is also an Environmental Impact Assessment Policy. An EIA policy is been developed. EIA regulations describe when and how to perform EIA studies and how to evaluate and enforce the studies.

3.6.3. National Environmental Strategy

The Ministry of Environment Affairs (MEnA), in cooperation with the Dutch Development Institution drew up a National Environmental Strategy and a decimal plan in 2000 for the environment. The main concern of this strategy and decimal plan is to sort out and analyze the main environmental problems and their causes in the West Bank and Gaza Strip, in addition to determining certain environmental aims and presenting a set of procedures to achieve them.

The strategy lists nine urgent issues that should to be following up during the period 2000-2010. The measures to reduce the industrial pollution are as follows:

- Setting standards for treated wastewater that is been used in industry and estimating, the amount of pollution caused by the air emitted from factories.
- Issuing legislations on the use of fuels and preventing the use of any fuel that has lead or any other pollutants.
- Issuing legislations to protect the environment from wastes of quarries.
- Issuing legislations related to management of hazardous industrial wastes.
- Issuing legislations on industrial areas, such as setting standards for environment protection and reducing of noise caused by means of transportation.
- Running surveillance and control system to guarantee implementation of the previous laws and legislations.

Regarding water and wastewater management the Palestinian Water Authority (PWA) has developed a Strategic Master Plan for Wastewater Management, within the framework of a national strategy for sustainable development to protect the natural resources at the national, regional and global levels.

Industries should be regulated through discharge permits from PWA and comply with other PNA regulations (e.g., municipal, Environmental Quality Association). The discharge permits should include assurances that industrial effluents must have an acceptable quality for flows being discharge into water bodies or domestic wastewater systems.

CHAPTER FOUR

RESEARCH METHODOLOGY

All the related literature, studies, reports, thesis, dairies industries guidelines, and industrial self-monitoring manuals are been studied in order to collect information about the cleaner production and its application in other countries.

In order to collect information about the present status in Palestinian dairy industries regarding topics affecting environment and caused pollution, a questionnaire (Annex 3) has been prepared and deigned. The collected data was about the following:

- General information about the industries and that's include the quantity of raw materials, packaging, cleaning materials water and energy, etc.
- Information about the all ongoing manufacturing processes and activities in Palestinian dairy industries.
- Output material and that include finished products, emissions, solid and liquid wastes.

The research sample is been identified; it was the licensed dairy industries, which produced 80% of the Palestinian main dairy products consumed daily by Palestinian families.

The ice cream industries is been excluded in this research because many of their products do not use milk as raw material. The unregistered industries is been excluded too, because they are

unarranged, small workshops, family industries. Their products sold directly to the costumers, not through market. No data or studies are available regarding these industries, and they produce only 20% of the Palestinian dairy products (Alaqraa, 2008).

There are 16 industries licensed by the Ministry of National Economy (MNE, 2008). Fifteen of these industries are in West bank and one in is Gaza. Some of these industries used modern technology and some used traditional manufacturing process.

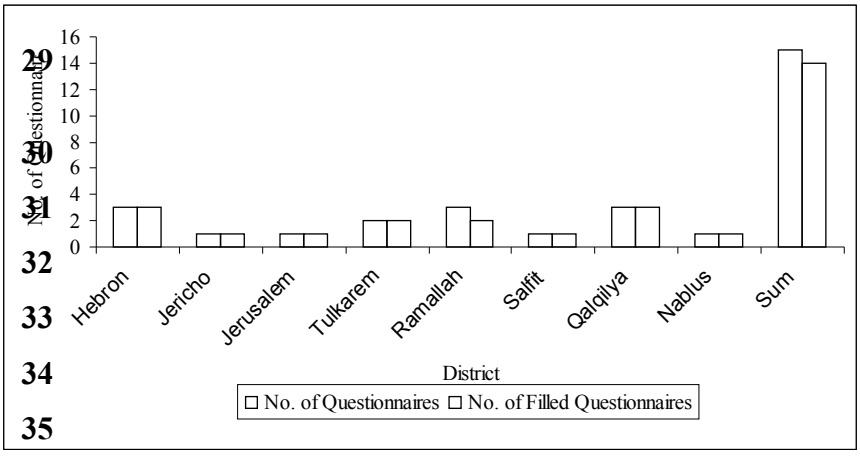
The dairy industry in Gaza is been excluded in this research because it is difficult to visit Gaza in the recent political situation.

Field visits were been arranged to the 15 industries in West Bank. The questionnaires were been distributed and filled by 14 of 15 industries. One industry did not fill the questionnaire, because it was during reconstruction process, so it was been excluded too.

The questionnaires were distributed and filled as clarified in Table 4-1 and in Figure 4-1.

Table 4-1: The Questionnaires Distribution

District	Hebron	Jericho	Jerusalem	Tulkarem	Ramallah	Salfit	Qalqilya	Nablus	Sum
No. of Questionnaires	3	1	1	2	3	1	3	1	15
No. of Filled Questionnaires	3	1	1	2	2	1	3	1	14



40 Figure 4-1: The Questionnaires Distribution

During the field visits, the production processes and activities are been monitored. Notes are been registered. Individual Interviews with manufacturer and workers took place.

The questionnaires help to determine the information for Palestinian dairy industry:

- The environmental management practices.
    - The pollution prevention measures or any cleaner production tools practiced or applied in the dairy industries.
- The level of awareness regarding environmental issues for workers and manufacturers.
- The applied regulations or standards related to environment.

The following good housekeeping tables are been used as a help tool to collect the information during field visits to Palestinian dairy industries:

41 Table 4-2: Checklist of General Good Housekeeping Ideas (Delta, 2004).

• Maintain good inventory control to avoid waste of raw ingredients.
• Ensure that employees are aware of the environmental aspects of the company's operations and their personal responsibilities.
• Train staff in good cleaning practices.
• Schedule regular maintenance activities to avoid breakdowns.
• Optimize and standardize equipment settings for each shift.
• Identify and mark all valves and equipment settings to reduce the risk that they will be set incorrectly by inexperienced staff.
• Improve start-up and shutdown procedures.
• Segregate waste for reuse and recycling.
• Install drip pans or trays to collect drips and spills

The following table is been used in order to collect information regarding water saving consumption to protect resources:

42 Table 4-3: Checklist of Water Saving Ideas (UNEP, 1999).

• Use continuous rather than batch processes to reduce the frequency of cleaning;
• Use automated cleaning-in-place (CIP) systems for cleaning to control and optimize water use;
• Install fixtures that restrict or control the flow of water for manual cleaning processes;
• Use high pressure rather than high volume for cleaning surfaces;
• Reuse relatively clean wastewaters (such as those from final rinses) for other cleaning steps or

in non-critical applications;
• Recirculate water used in non-critical applications;
• Install meters on high-use equipment to monitor consumption;
• Pre-soak floors and equipment to loosen dirt before the final clean;
• Use compressed air instead of water where appropriate;
• Report and fix leaks promptly.

For identifying if their any saving practices in energy consumption in dairy industries in order reduce the cost and protect the resources, the following information contents in has been checked:

43 Table 4-4: Checklist of Energy Saving Ideas (UNEP, 1999).

• Implement switch-off programs and installing sensors to turn off or power down lights and equipment when not in use;
• Improve insulation on heating or cooling systems and pipe work;
• Favor more energy-efficient equipment;
• Improve maintenance to optimize energy efficiency of equipment; boilers;
• Maintain optimal combustion efficiencies on steam and hot water
• Eliminate steam leaks;
• Capture low-grade energy for use elsewhere in the operation.

The following Checklist ideas for reducing pollutant loads in wastewater have been checked if the dairy industries practiced it all or some:

44 Table 4-5: Checklist of Ideas for Reducing Pollutant Loads in Effluent (UNEP, 1999).

• Ensure that vessels and pipes are drained completely and using pigs and plugs to remove product residues before cleaning;
• Use level controls and automatic shut-off systems to avoid spills from vessels and tanker emptying;
• Collect spills of solid materials (cheese curd and powders) for reprocessing or use as stock feed;
• Fit drains with screens and/or traps to prevent solid materials entering the effluent system;
• Install in-line optical sensors and diverters to distinguish between product and water and minimize losses of both;
• Install and maintain level controls and automatic shut-off systems on tanks to avoid overfilling;
• Use dry cleaning techniques where possible, by scraping vessels before cleaning or pre-cleaning with air guns;
• Use starch plugs or pigs to recover product from pipes before internally cleaning tanks.

CHAPTER FIVE

RESULTS & DISCUSSIONS

45 5.1. Questionnaire analysis

The basic information obtained from the questionnaire regarding the status in Palestinian dairy industries includes the following:

5.1.1. General information

General information were collected by the questionnaire are summarized in Table 5-1, and in Annex 4, Table A-1 contains case summaries.

46 Table 5-1: General Information

Item	Value	The Unit
Capital	11,5	Million dollar
Number of worker	632	Worker
Designed Capacity in year	130	Thousand Ton
Real capacity in year	38	Thousand Ton
Average of working days	284	day

- **Capital**

The data shows that the investment in Palestinian dairy industries is almost 12 million dollar.

- **Production capacity**

Palestinian dairy industries have designed capacity of almost 130 thousand ton annually, but they are working with almost 30% of their capacity with amount of almost 38 thousand ton annually. Working with this capacity will raise the production cost.

- **Workers**

The number of workers as seen in the above table is 632. That represents 72% of the worker in dairy industries, and 1.3% of the worker in industrial sector. Lack in awareness regarding environmental issues been noticed during field visits. Some bad attitudes of workers have been noticed such as leaving water open during all cleaning process, leaving electricity on when not needed, bad handling for packaging and cleaning materials…etc. These behaviors will raise the cost of production and produce more wastes.

Working days

- The average working days in Palestinian dairy industries are 284 working days.

5.1.2. Technology

The collected data shows that ten industries used modern technology in their plants, and that represents 70% of the dairy industries. The other four industries used traditional productions method and that form 30 % of the industries (Annex 4).

5.1.3. The consumption amount and cost of raw materials

The collected data shows the consumption of raw materials is almost 30,100 ton without water. The amount of raw materials with water used in production will be 44,710 ton annually with cost of 20 million dollar and water is used as raw material with amount of 14,610 m^3 (Table 5-2).
Raw milk is the main raw material in the dairy industry. It has consumed in two kinds' cow milk and goat milk. Raw milk consumed annually with amount of 29,530 ton with a cost of 18 million dollar that represents 65% of the consumed raw materials, water as raw materials is 33% and the other raw materials is just 1% that is clarified in Figure 5-1.

The amount of consumed cow milk is 29,310 ton annually, and goat raw milk consumed with amount of 220 ton annually.
The amount of cow milk produced in West Bank is 69,599 m^3 annually, and 19, 691 m^3 in Gaza (PCBS, 2006). This means that these industries consume 40% of the raw milk, which produced in the West Bank.

One ton of cow milk almost equal to one m^3, then the collected data shows that Palestinian dairy industries consume almost 42% of the produced cow milk in West Bank.

47 Table 5-2: The Consumption amount and value of Raw Materials

Raw Material	Raw milk	Powder milk	Sorpate	Starter	Renee	Salt	Additives	Colors	Water
Amount in Ton	29,530	230	5	1	1	255	9	0	14,610
Value in Thousand Dollar	18,000	1,293	39.3	77.9	20.7	50	71.5	2.66	18

The collected data by the questionnaire shows that 2% of the consumed milk in the Palestinian dairy industries is lost annually. In addition, this amount is almost 560 ton of milk with cost of 341,348 dollar. They use also as small amount of raw material starch, sugar and fruits.

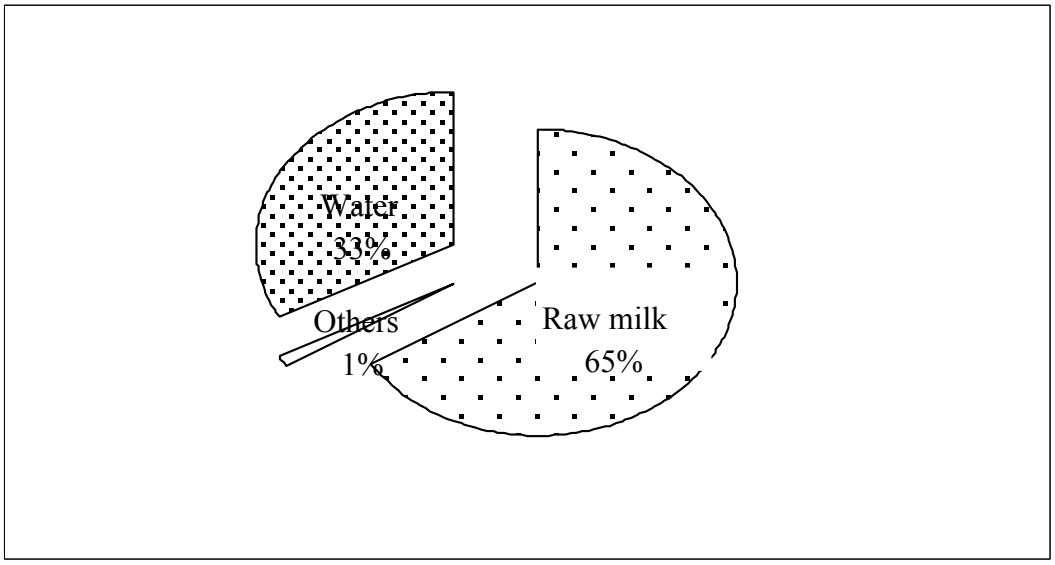


Figure 5-1: The Consumption Amount of Raw Material in Percentage

The annual cost of raw materials is almost 20 million dollar. Almost 18 million dollar is the cost of raw milk, and that's represent 94% of the total cost of the raw materials (Figure 5-3), follows by powder milk with 5.5%, and all the other raw materials cost is just with 0.5% (Table 5-2).

Figure 5-2: The Percentage Cost of Raw Materials

5.1.4. Packaging material

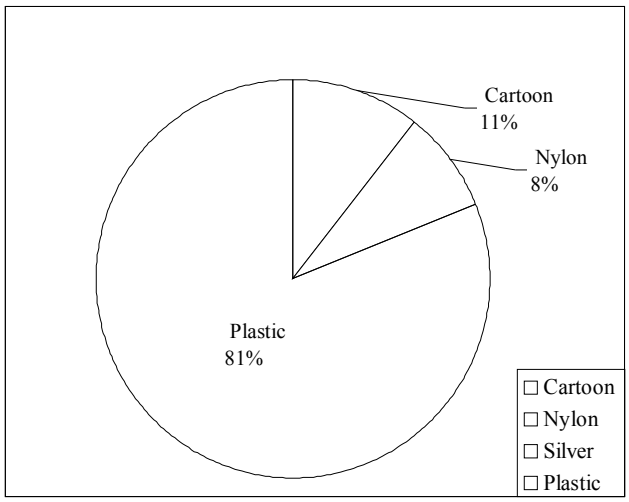
The collected data shows that the total cost of the consumed packaging materials in Palestinian dairy industry is 3,096,806 dollar annually (Table 5-3). Plastic materials represent 81% of the packaging material cost in Palestinian dairy industries with almost 2.5 million dollar.

48 Table 5-3: Packaging Materials Cost in Dollars

Packaging Material	Cartoon	Nylon	Silver	Plastic	The Total Cost
Cost in Thousand Dollars	328.8	252.9	6	2509	3,097

The following figure clarifies the cost percentage of every packaging material per total cost of the packaging materials.

49



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51 Figure 5-3: Cost Percentage of Packaging Material

52 **5.1.5. Cleaning material**

Cleaning materials has been used to clean surfaces, pipes, tanks, equipment and floor. All cleaning materials enter to the sewer system with rinsing water.

The collected data shows that dairy industries use acidic or alkaline cleaning materials. Acidic material is as nitric acid and phosphoric acid. Alkaline material is as caustic soda. These materials cause large variation in pH. It also raises the level of nitrogen and phosphorus in wastewater.

Alkaline detergents cause fat to emulsify, which makes them easy to remove, while acidic products dissolve and eliminate incrustations formed by accumulation of salts from milk and water. It is with rinsing water will enter the sewer system and raise the organic load in wastewater.

The result shows that the consumption of cleaning material is 120 ton annually with a cost of 111 thousand dollar.
Caustic soda and normal detergents is the most consumed cleaning products in Palestinian dairy industry with 43% and 36% respectively as shown in Table 5-4.

Consumption of one ton of raw milk in Palestinian dairy industries will consume 0.4 kg of cleaning materials.

Table 5-4: The Consumption of Cleaning Materials

Cleaning Material	Hexona	Caustic Soda	Nitric Acid	Detergent	Phosphoric acid	Sum
Consumption in tons	2	51	7	44	16	120
Cost in Thousand Dollars	1.2	47.2	10.6	29.6	23.6	11.1
Consumption in Percentage	2%	43%	7%	36%	12%	100%

5.1.6. Dairy industries products

The Palestinian dairy industries are producing 23,870 tons of products annually with value of 48 million dollar (Table 5-5).

Yogurt represents 25% of the dairy products with amount of 6,035 ton annually, follows by labneh with 17%, and white cheese with 16%. There are just two industries produce qareesh cheese from the whey. The qareesh cheese produced in small amount with almost 8 ton annually.
The following table represents the products amount and there percentage from the total products amount.

53 Table 5-5: The Dairy Products Quantity and Percentage

Product	Pasteurized	UHT	Yogurt	Labneh	Yogurt Drink	Sour cream	Fruit milk	Fruit yogurt	Pudding	Cheese	Qareesh
Amount in Thousand Tons	1.1	2	6	4.1	3.4	1.4	0.7	0.8	0.7	3.8	0.008
% of total Production	4%	8%	25%	17%	14%	6%	3%	4%	3%	16%	0%
Cost in million $	1.1	1.8	16.8	3.7	2.7	1.1	1.1	1.1	3.4	15.2	0.06

5.1.7. Water consumption

The total consumption of water in the 14 industries is 125,700 m^3 annually. The Palestinian industrial sector consumed 19,354,800 m^3 of water annually (PCBS, 2006). That means that Palestinian dairy industries consume almost 0.6% of the industrial water consumption annually.

- Consumption of water per kind of use

The water in dairy industry used for three purposes. It is been used in production processes such as cooling and heating, as raw material in some dairy products such as yoghurt drinks. It is used in cleaning processes, both manual and CIP cleaning. It is also been consumed in domestic use.

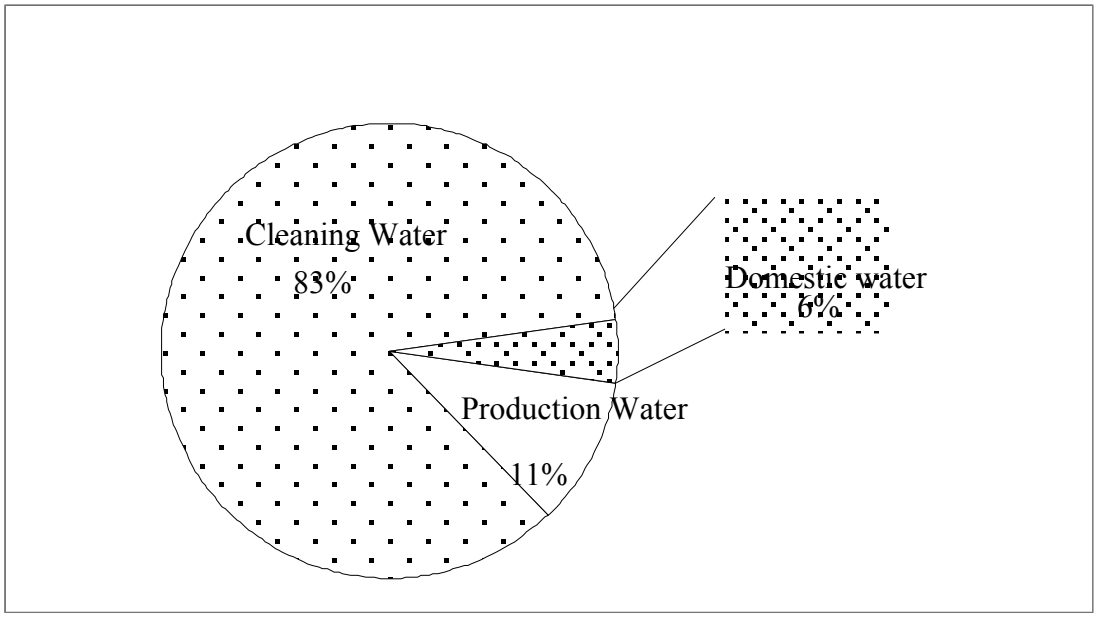
The results from questionnaire show that Palestinian dairy industries do not measure the water consumption exactly in every process; five of the industries include their consumption of domestic water and production water with cleaning water.

The consumption of water for production process is just 14,610 m^3 annually. This represents 11% of total water consumption. For domestic use the consumption of water was 6,840 m^3 annually, 632 workers are working in these industries; every worker consumes 11 m^3 of water annually. The following table clarifies the consumption of water per kind of use.

Table 5-6: The Water Consumption per Kind of Use

Consumption of Water	Water Consumption in Thousand m^3	Water Consumption in percentage	Water Cost in Thousand Dollar
Production	14.6	11%	17.6
Cleaning	104.3	83%	124.7
Domestic Water	6.8	6%	7.2
Total Consumption of Water	125.7	100%	149.4

From Table 5-6 it is included that most of water consumed in the Palestinian dairy industries in the cleaning process. Its amount is almost 104,250 m^3 annually. That represents 83% of the total water consumption as clarify in Figure 5-4.



54 Figure 5-4: Water Distribution per Kind of Use

- Consumption of water per consumption of raw milk

Assuming that the density of milk is 1000 Kg/ m^3 then the results show that 4.3 m^3 of water is consumed for process of one ton of raw milk.

If we compare the annual consumption of cleaning water to the consumption of raw milk, 104,250 / 29530 = 3.6 m^3, it means that one ton of milk in Palestinian dairy industry will consumes 3.6 m^3 for cleaning process. The following figure clarifies the consumption of water per consumption of milk

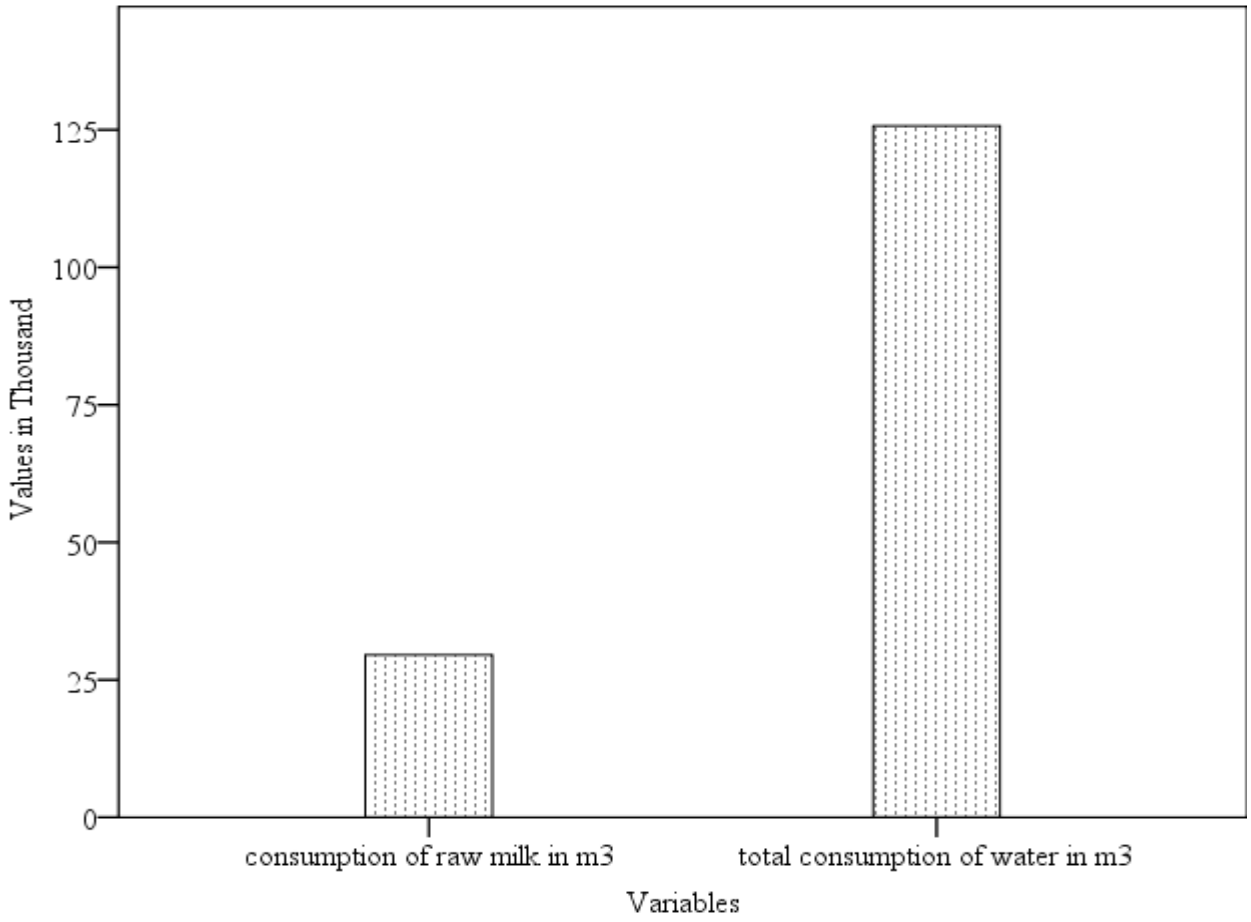


Figure 5-5: The Consumption of Water per the Consumption of Milk

- Consumption of water and technology

The total water consumption for the industries used traditional technology is 3300 m^3 of water with raw milk consumption 600 ton annually. The modern industry manufacture 28,900 ton of milk with water consumption 122,400 m^3 annually. That has clarified in Table 5-7.

The consumption of water to process one ton of raw milk by using traditional technology is 3300/600 =5.5 m^3.

When using modern technology the consumption of water to process one ton of raw milk is 122400/28930 = 4.2 m^3. Figure 5-6 clarify this relation.

The results show that it is better to use modern technology in Palestinian dairy industries to save water. Manufacturing one ton of raw milk by using modern technology will save 1.3 m^3 of water consumption.

Table 5-7: Water Consumption of Water Regarding Technology

Production System	Consumption of Raw Milk in m3	Total Consumption of Water in m3
Automatic	28930	122400
Traditional	600	3300
Total	29530	125700

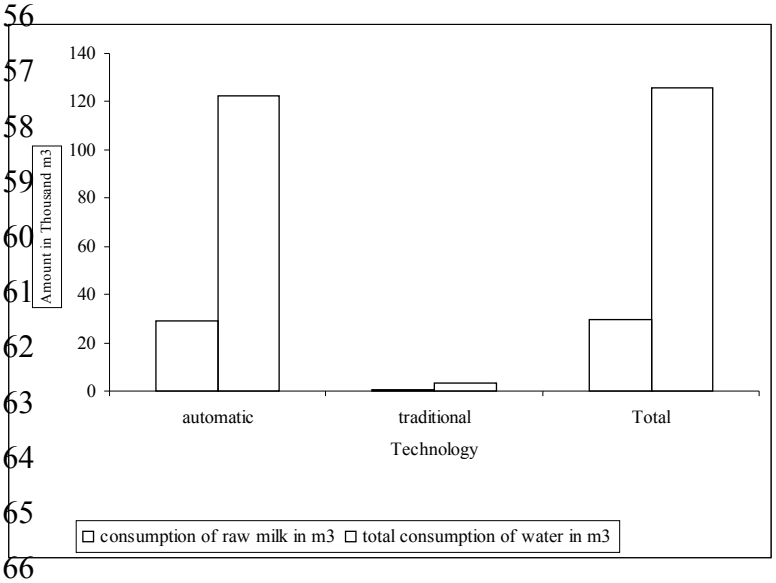
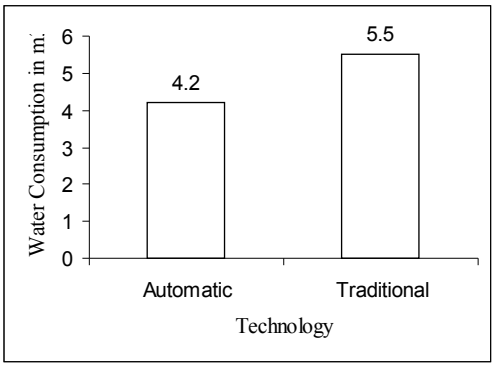


Figure 5-6**:** Water Consumption in m^3 Regarding Technology

The following Figure 5-7 clarifies the relation between water consumption and the used technology.



73

74 Figure 5-7: The Consumption of Water per ton of Milk Regarding technology

5.1.8. Cleaning systems

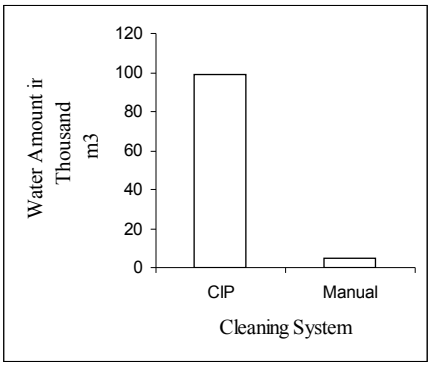
There are two methods applied in Palestinian dairy industries for cleaning the production lines, which are cleaning in place (CIP) and manually cleaning.

Effect of the industrial cleaning method on consumption of water:
The collected data shows that 50% of the dairy industries are using manual cleaning, and 50% are using CIP method. The following table represents the data.

75 Table 5-8: Cleaning system Technology

Technology	Frequency	Percent	Valid Percent
CIP	7	50.0	50.0
Manual	7	50.0	50.0
Total	14	100.0	100.0

The Industries with CIP cleaning system consumes 99,060 m^3 annually, and the dairy industries with manual cleaning consuming 5,190 m^3 annually as shown in the following figure:

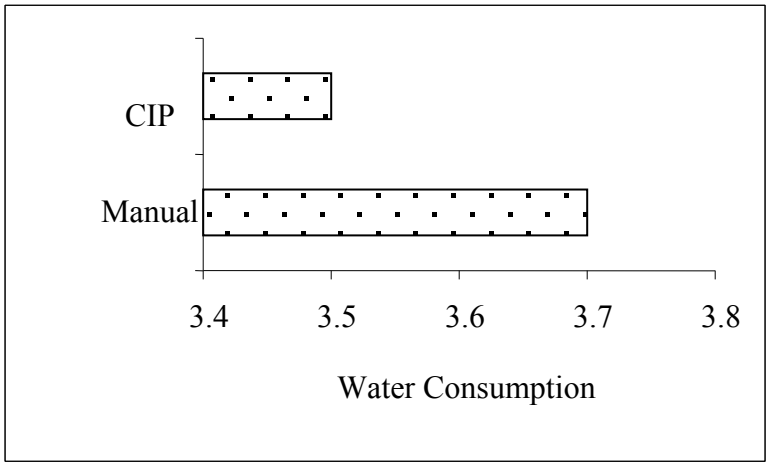


76

77 Figure 5-8: Dairy Industries Cleaning Systems and amount of Water Consumption in m^3

The amount of water used in the industries that use CIP is 99,060 m^3 annually, with raw milk consumption of 28,110 ton annually, and that's mean that every ton of milk in Palestinian dairy industries with CIP method consumes 3.5 m^3 cleaning water. The industries of manual cleaning system consume 5,190 m^3 of cleaning water annually, with raw milk consumption of 5,190 ton. The result shows that one ton of milk in Palestinian dairy industries with manual cleaning consumes 3.7m^3 cleaning water (Figure 5-9).

The results show that using CIP system instead of manual system in Palestinian dairy industry will save 0.2 m^3 of cleaning water consumption to manufacture one ton of milk.



78 Figure 5-9: Water Consumption in Cleaning Systems to Manufacture One Ton of Milk

5.1.9. Energy consumption

There are three kind of energy sources used in Palestinian dairy industry, electricity with amount of 3,284,873 KW annually which represent and a cost of 741,000 dollar, and diesel with amount of 921,115 liter annually and a cost of 848,000 dollar, and gas with amount of 8.56 ton annually and cost of 11,100 dollar.

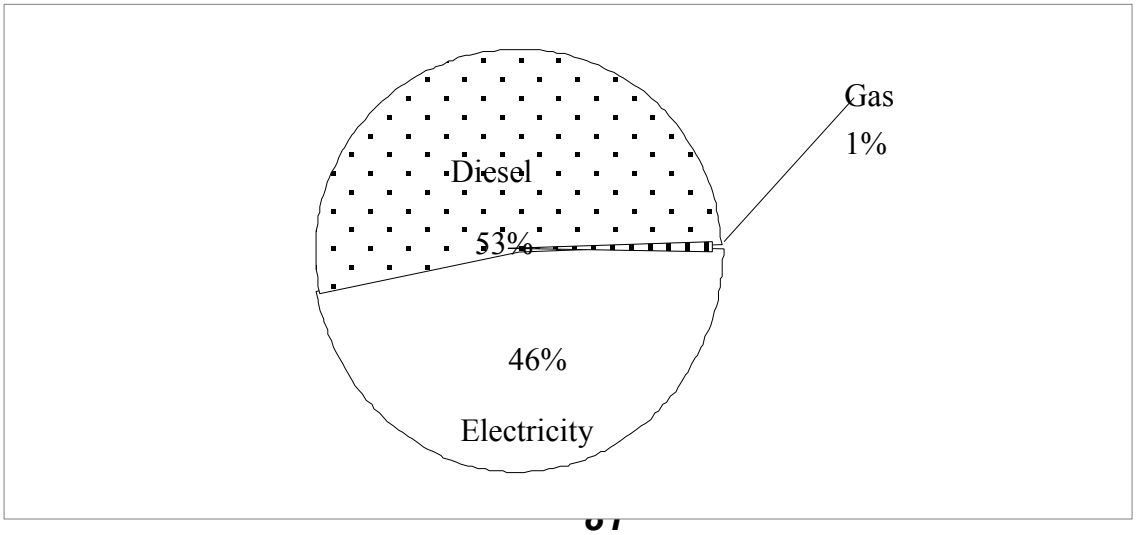
The total energy cost in Palestinian dairy industry is 1,599,663 dollar annually. The energy is been used for lightening, heating, cooling, refrigerating.

Table 5-9 shows the distribution of the energy consumption regarding it cost, and Figure 5-9 shows the distribution of energy regarding its cost.

79

80 Table 5-9: Energy consumption Amount and Cost

Energy Resource	The Amount	Unit	Amount Percent	Cost in Thousand dollar	Cost in Percent
Electricity	3,284,873	KW	78%	741	46%
Diesel	921,115	LITER	22%	848	53%
Gas	8.56	Ton	0	11	1%
Total			100%	1,600	100%



81

82 Figure 5-10: Distribution of Power Kind Amount Percentage

- Consumption of energy per consumption of raw milk

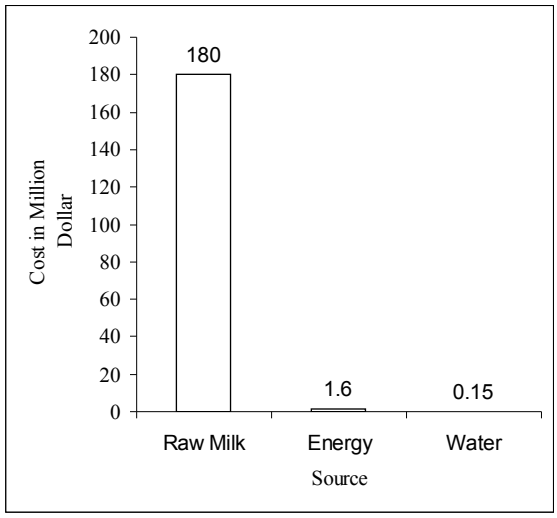
  The Palestinian dairy industries consume annually raw milk with amount of 29,530 ton and with cost of 18 million dollar. It consumes energy with cost of 1,600 thousand dollar annually. That means the cost of energy is almost 10% the cost of raw milk.

- Consumption of energy per consumption of water

  The dairy industries consume energy with cost of 1,599,663 dollar annually and consume water with cost of 149,411 dollar annually (1,599,663/149,411 = 10.7).

The results show that the cost of energy is almost eleven times more than the cost of water.

The following figure shows the relation between cost of raw milk, cost of energy and cost of water:



83

84 Figure 5-11: The consumption Cost of Raw Milk, Energy, Water

5.1.10. Laboratories and quality tests

Laboratories have an important role in the food industry. They are responsible to:

• Test 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 (EPAP, 2003).

The questionnaire data shows that just six industries have laboratories in their plants, and make daily quality tests especially to test the quality of received raw milk. The other eight industries send their samples to accredited laboratories to test the quality of products. Table 5-10 shows the quality tests and their annually number.

85 Table 5-10: The Dairy industry Tests

Test	Total Acidity	pH	Fat	Bacteria Count	Fungi	Coliform	Anti biotic	other
Number of Tests in Thousand	35	25	23	13	13.7	14.3	4.7	1.6

86

87 In Annex 4 Table A-2, there is a summary to all collected data by questionnaires regarding laboratories tests numbers.

5.1.11. Storing system

The collected data shows that five industries use storing system in their industries; four of them used first in first out system (FIFO). Just one industry use good manufacturing practices (GMP), and the other nine industries did not use any system regarding storing (For more information see Annex 4 Table A-4 questions analysis results).

The storing material is the following:

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

• Pasteurized milk used as raw material for manufacturing milk products. It stored for shorter periods.
• Pasteurized and UHT milk sold as product is packaged and stored in refrigerators.
• Dairy Products are stored in refrigerators.
• Chemicals are been used as additives, for washing and disinfecting purposes, for the lab.
• Fuel is been 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 diesel or gas.

5.1.12. Environmental policy

The results show that four industries are applying some practices related to Good Housekeeping in their industries; most of these practices are been related to storing.

5.1.13. Environmental Training

Just two industries trained their workers about environmental issues.

5.1.14. Leakage Measuring

Just one industry did measure the leakage. It was been found that the milk leakage is almost 2%.
If we assume that all Palestinian dairy industry have 2% milk leakage, then the amount of leakage will be .02*29530 = almost 591 ton of raw milk annually. This amount enters the sewage system without any kind of treatment.

5.1.15. Maintenance

Seven industries out of fourteenth are applying preventive maintenance in their industries and there work did not stop during last year. The collected data shows that the cost of the maintenance works in Palestinian dairy industries is 276,200 dollar annually.
19 times the production in dairy industries stopped last year, and the cost of these stops were 55,502 dollar last year.

5.1.16. Wastes and waste management

The wastes from Palestinian dairy industry are either solid waste or liquid waste, or gas waste.
Solid waste contains packaging materials, some dairy products, domestic wastes, and fine particles. Liquid waste contains of lost of raw milk, some dairy products, whey, domestic and clean water.

• Solid waste

There are many sources of solid waste. Packaging materials are the main form of solid waste deriving from the Palestinian dairy industries with amount of 2,241 ton. It consists of cartoons, plastic materials, nylon …etc. Solid wastes are been produced also from the incoming raw material, from the production line damage and mistakes, during the filling process. Return products are also a source of solid waste, dairy industries produce amount of 144 + 395 = almost 540 ton annually.

Solid organic waste in dairy processing also originates from production processes e.g. fats from filter residues with amount of 50 ton annually. Office waste is also a source of waste. The result shows that the Palestinian dairy industries produce solid wastes with amount of 2830 ton annually. 79 % of the solid waste is from packaging materials.

Dairy solid waste is collected and dumped together with domestic waste; the municipality collects it and transfers it to uncontrolled dumping sites with annual charge of 200 dollar, most of these sites are unplanned and the waste is burned there causes air pollution (Data resource is Al-Bierah municipality, annual industrial solid waste charge). Some times the employee burning the solid waste in open air near the industry, thus many dangerous materials such as PVC release toxic substances.

The total quantity of solid waste produced by dairy industries is 2830 ton annually. That is mean one ton of milk produces 0.1 ton of solid waste.

Figure 5-13 clarify types of solid wastes produced in dairy industries and their quantity.

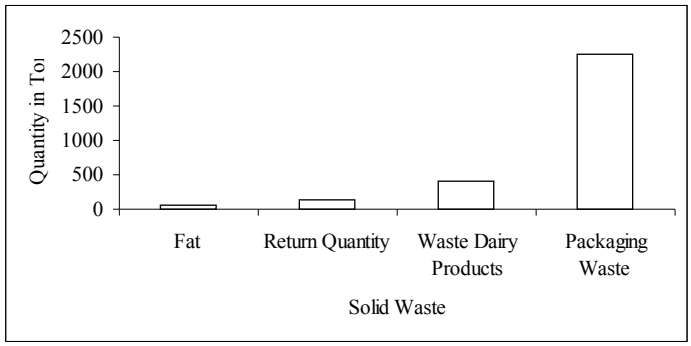


Figure: 5-13: Solid waste distribution and Amount

5.1.17. Wastewater

Wastewater produced from dairy industries originates from the following resources:

- Wastewater is from tank, truck and storage tank washing, pipeline washing and sanitizing. It contains milk solids, detergents, sanitizers and milk wastes.
- Wastewater is mainly produced during cleaning operations. Especially when different types of products are produced in a specific production unit, clean-up operations between product changes are necessary. In developing countries, the main problem is pollution through spoilage of milk.
- Waste results mainly from the production of whey, wash water, curd particles etc. The amount of fine particles in the wash water increases when mechanical washing processes are used.

To determine the quantity of Palestinian dairy industries wastewater the following data should be determined:

- The amount of whey

To determine the amount of whey produced from dairy industries the following data should be known (Alaqraa, 2008):

One ton of cow milk produces 150 kg of white cheese and 850 kg of whey

One ton of goat milk produces 250 kg of white cheese and 750 kg of whey

One ton of cow milk produces 200 kg of labneh and 800 kg of whey

One ton of goat milk produces 250 kg of labneh and 750 kg of whey

One ton of whey produces 0.3 ton of qareesh cheese.

Palestinian industries produce 3,764 ton of cheese annually, all of them produced from cow milk and that needs to 25,093 ton cow milk annually.

The produced whey from producing cheese is almost 21,329 ton annually.

Palestinian industries produces 4,166 ton of labneh, 2 ton from it is from goat milk.

2 ton labneh from goat milk consumes 6 ton of goat milk and produced 4 ton of whey.

Labneh from cow milk consumes 20,820 ton of milk, and produces 16,656 ton whey.

The produced whey from manufacturing labneh is 16,660 ton of whey.

The data shows that Palestinian industries produced 8 ton of qareesh cheese annually.

This amount consumed almost 26.6 ton of whey.

The result will be that the Palestinian dairy industries produce (21,329+16,660- 8=37,981) almost 38,000 ton of whey annually and that is 27% of the wastewater content.

- The amount of spills milk

  Spills milk is from filling or packaging machine, leaks from filling, and from rejected milk.

  The collected data shows that leakage milk is 560 ton; the rejected milk is 298 ton.

  There is no measure to milk loss during other process.

- The amount of cleaning and domestic water

  The dairy industries consume almost 110,000 m^3 of domestic and cleaning water annually.

  The results show that the liquid wastewater is almost 149 thousand m^3 annually.

  Dairy industries do not do any kind of treatment for wastewater. Therefore, there is no kind of reuse for water in any process.

- The amount of wastewater produces per ton of milk

  The liquid waste in dairy industry has high organic load due to the presence of milk in wastewater. The results show that one ton of milk produces 4.8 m^3 of wastewater.

- The wastewater flow per industry

  The average wastewater produced by Palestinian dairy industry is almost 10,000 m^3 / year. That means that wastewater flow per Palestinian dairy industry is about 35 m^3 /day.

  Wastewater is also has high levels of nitrogen and phosphorous, because the using of cleanings materials. In addition, wastewater is high in conductivity because of discharging brine without any kind of treatment or recovery of salt.

  The following table shows the sources of liquid wastes and the quantity of each liquid waste in ton:

88

89 Table 5-11: The Dairy Industries Liquid Wastes

Liquid Wastes	Whey	Waste Milk	Cleaning water	Spill Milk	Sum
Quantity in ton	38,000	298	110,000	560	149,000

5.2. Palestinian Dairy Industries Pollutant

5.2.1. The amount of BOD5

Milk Equivalent, a unit derived from the correlation that 100 kg BOD5 (processed) is equal to ton of whole milk (received), which is approximately 10% by weight (UNEP 2000)

- The lost milk is 560 ton

560 * 0.1= 56 ton BOD_5

- Return and waste dairy products is almost 300 ton.

That means 30 ton BOD_5

BOD_5 from dairy products is 86 ton

- One ton of whey has BOD_5 of 30,000-40,000 mg/l = 0.03-0.04 kg/ l

38,000 ton of whey has =38,000*0.03 =1,140 ton BOD_5

- Domestic wastewater has BOD_5 concentration of 250-300 mg/l

The 14 dairy industries consume about 6840 m^3 domestic water, BOD_5 concentration in the 14 industries = 6840*.00025=1.7 ton BOD_5

- The sum of BOD_5 is almost 1,228 ton BOD_5 annually.

The organic load in wastewater = 1228/138,500= .0089 ton BOD_5/m^3 = 8900 mg BOD_5/ liter. The Palestinian standard for industrial water to discharge it in natural water resources is 150 mg BOD/liter (PSI, 1998).

Typical pollutant loads in Palestinian dairy industries per ton of production BOD_5 kg/day= 1,228/ 284 is about 4,300 kg/d.

- Typical daily pollutant loads in Palestinian dairy industry BOD5 kg/day is about 4,300 / 14 = 307 kg/d.

5.2.2. The amount of COD

COD is normally about 1.75 times the BOD_5 level in dairy industry (Kent, et.al, 1997).

307 kg/d * 1.75 = 537 Kg COD/ day.

High values reflect the presence of whey from the production of cheese and labneh.

The COD of whole milk is 210,000 mg/L (Marshall, and Harpel, 1984).
The result shows that the Palestinian dairy industries wastewater has high organic load and that due to the amount of whey, which discharged directly to the sewer system.

The major high organic load (BOD_5) and chemical oxygen demand (COD) wastewater of the dairy industry due to the presence of milk solids (e.g. protein, fat, carbohydrates, and lactose) in the wastewater from the rejected milk and milk spills discharged to the plant sewer system during filling and emptying
milk, and from
discharging produced whey from cheese and labneh production process to the sewer system.

5.2.3. The amount of phosphorus water pollution

Most of the wastewater generated within the plant is from cleaning process, it contains acids, alkaline detergents. For cleaning processes & cleaning floor detergent such as caustic soda and nitric acid are , for sanitizing process phosphoric acid is used; and disinfectants including chlorine compounds, hydrogen peroxide, and quaternary ammonia compounds are used. These chemicals will cause high content of nitrogen and phosphorus & fluctuations in pH and temperature in wastewater.

Traditional detergents contain between 10 and 20 % phosphorous, acidic detergents using a single phase contain between 0.1 and 0.2 % and alkaline detergents contain between 0.2 and 0.3 % phosphorous (Lopez, and Hernandez, 1995).

The assumption is that all detergent used in Palestinian industry contains 20% of phosphorus.

- The amount of detergent is 120 ton annually.
- The amount of phosphorus in alkaline detergent is 51*0.002=~ 100 kg.
- Acidic detergent: 7 *0.001*1000=7.28~7 kg
- Traditional detergent: 44*0.1= 4.4 ton
- Acidic detergent 16*0.001*1000= 16 kg
- Total amount of phosphorus is almost 4.5 ton.

- The phosphorous load in wastewater discharged from Palestinian dairy plants is 4.5/ 120+111000 = 0.033 kg/liter. The phosphorous amount in wastewater is 3,300 mg/liter.
- The phosphorous load in wastewater discharged from Palestinian dairy plant 3,300 mg/liter /14= 235.7 mg/l.

The Palestinian standard to discharge industrial water is 15 mg phosphorous/liter.

5.2.4. Noise

Noise levels in most of the areas in dairy production facilities are very high. The running of electric motors of different pumps, centrifuges, homogenizers, and filling and packing machinery create noise. The noise level did not measure in the Palestinian dairy industries because there are no equipments to measure it.

5.2.5. High in TDS and TSS

High salinity levels in wastewater result from salting activities during cheese production.

Waste water in the plant are also producing from boiler blow downs and from water used as cooling water on the milk pasteurization equipment as well as backwash of softeners are high in TDS and TSS.

The concentrations of suspended solids in raw dairy plant wastes vary widely among the different dairy operations. Dairy products wastewaters typically contain up 2,000 mg/l of suspended solids, most of which are organic particulate derived from the milk (AUS EPA, 1997).

5.2.6. Microbiological load

Wastewater may have a significant microbiological load and may contain pathogenic viruses and bacteria.

In most cases, the effluents from the Palestinian dairy plants are discharged to the municipal sewage treatment plant without any treatment, and no tests regarding effluent pollution characteristics or quality took place.

5.2.7. Air emissions

In dairy plants, air pollution mainly caused because of the consumption of energy. In the process, exhaust gases such as CO_2, CO, NO_x and SO_2 discharged.

There are three sources of air emission in the Palestinian dairy industry, which are:

• Fuel oil or diesel in boilers.

• Ammonia resulting from leaks in refrigeration tubes

• Steam leaking from heating tubes will cause a negative impact on air quality

There are three used sources of energy in Palestinian dairy industries. They are electricity, gas and diesel. There is no information regarding emission from electricity in the plants so it is neglected in this research. The emission from gas is also neglected because it is used in very small amount almost 1% of the used energy. The research concentrate on the emission produced from the combustion of diesel.

The consumed fuel oil in Palestinian dairy industries is 921,115 liter and that equivalent to 794 ton, and by using table 5-9 to calculate the amount of emissions produced from the combustion of this amount of diesel the result was as following:

90 Table 5-12: Emissions from the Combustion of Diesel

Input		Outputs	
Fuel oil (1% sulphur)	794 ton	Energy content	9,131,744 kW.h
		Carbon dioxide (CO2)	2,779 ton
		Nitrogen oxides (NOx)	8 ton
		Sulphur dioxide(SO2)	16 ton
1 kg of oil = 1.16 liter of oil (0.86 kg/L) 1 kW.h = 3.6 MJ			

5.2.8. Odor & Dust

Problems regarding odor from filling and emptying milk tankers, storage silos, are been occurred. During field visits to dairy plants, the odor was not significant extent.

91

92 **5.3. The Result of Monitoring the Production System**

During the field visits the sources of environmental pollution during the production processes and activities is been noticed. The results were as follows:

5.3.1. The sources of environmental pollution in receiving stage

The detected Sources of environmental pollution in this process are the following:

1. During the receiving stage, some milk is lost on the floor during emptying and filling the milk and it entered the sewage system.
2. The leak in pipes, hoses and tanks causes spills of milks.
3. Sometimes milk is been rejected when it does not meet the standard and the required quality. The rejected milk normally discharged in sewer system.
4. Electricity is been consumed during the cooled storage of milk.
5. Rinsing and cleaning for Lorries, hoses, pipes and storage tanks consume water and detergents and the wastewater discharged directly to sewer system.

5.3.2. The sources of environmental pollution in filtration and clarification processes

1. The filtered organic, inorganic and proteins coagulates particles dumped to the sewage system.
2. There is consumption of electricity during these processes.

5.3.3. Sources of environmental pollution in pasteurized process

1. This operation consumes large amount of energy.
2. The Process sometimes failed, because it does not meet the standard and quality requirements, so the milk will discharge in sewer system.

5.3.4. The sources of environmental pollution in manufacturing cultured products

1. It consumes large amount of energy for heating and cooling processes.
2. Some products spilled during the production and packaging processes.
3. Small amount of products stayed in the machines and spilled during rinsing it.
4. Some times the products do not fulfill the standard and requirements and it discharged in sewer system without any kind of treatment.
5. There are returning products from the markets and it discharged in sewer system.
6. large amount of whey is produced during the production of labneh and in most plants it discharged in to the sewer, system and that will raise BOD and COD in wastewater.

5.3.5. The sources of environmental pollution during cheese production

1. Cheese production produces almost 85% whey, which in most plants discharged in sewer system, just two plants use it to produce qareesh cheese.

2. Solid wastes as small pieces from the residue of cutting the cheese are been discharged in the sewer system.
3. Brine water is been produced and discharged in sewer system and that will raise the conductivity of wastewater.

5.3.6. The sources of environmental pollution during packaging process

6. The packaging machines consumed large amounts of energy.
7. Waste, which generate when problem or stop in the machines, occurred.
8. Milk losses during filling are estimated to be about 2% (manufacturer expectation) and are discharged to sewer.
9. Wastewater is been generated from cleaning operations for packaging machine.
10. Solid waste generated from the package itself.
11. Water that is been used for cooling the machines.

5.3.7. The Sources of environmental pollution in refrigeration process

1. This process consume large amount of electricity.
2. Water that is consume for cooling process.

3.The used refrigerant in Palestinian dairy industries is ammonia. Ammonia could leaks and that will affect the health and safety of the workers and the surrounding environment.

5.3.8. The sources of environmental pollution during cleaning process

1. Cleaning consume large amount of water, almost 80 % of the total water consumption used in this process, especially when manual cleaning system is used.
2. During this process, the residual milk fat and proteins in the machines will enter the sewer system.
3. This process consumes cleaning material. The cleaning detergents and disinfecting agent will enter the sewer system and that will cause fluctuation of the pH of the wastewater.
4. It was been noticed that there were in some plants leaking hoses and taps and that increase the water consumption.
5. The consumption of energy when using CIP cleaning method.

5.3.9. The sources of environmental pollution in boilers

1. Water evaporates during cooling process and that will increase the concentration of dissolved salts in water, which is been controlled by blow-down some water. The blow-down water is high in TDS.
2. Boiler consumes fuel oil and gas for energy producing, and that will produce gas emission, which will pollute the air.

5.3.10. The sources of environmental pollution in laboratories

1. The tested samples which are been discharged in sewer system.
2. Chemicals used in laboratories for tests are hazardous and enter the sewer system with tested samples and during cleaning the tools.

93

94 5.4. Discussion

95 5.4.1. Measures to Prevent and Reduce Pollution

The consumption of water and energy, as well as the discharge of wastewater are the main concerns to this industry regarding the environment.

The environmental pollution caused by dairy processing is mainly due to cleaning operations and product spills, and whey, which are discharging directly to sewer system without any treatment.

In order to save money and reduce impacts on the environment, two major components must be addressed in dairy waste management, first reduction at source based on idea that generation pollutant can be reduced or eliminated by increasing efficiency in use raw materials, energy, water and other resources (Cagno, et.al, 2005).

Second, the waste load shall be reduce. That could be achieved through control the uses of resources such as raw materials and water (DELTA, 2004). Improve the production processes. Preventive maintenance should apply on machines and production lines. Modify the technology in dairy plants. Change the attitude of the workers and manufacturers in their daily work and training them to protect the environment and their health (Ackermann, and Van Donk, 2008).

After analyzing the results and studying the past practicing of cleaner production in Palestinian industries (Nazer, et.al, 2006) many cleaner production opportunities have been detected in order

to lower the consumption of raw materials. Minimize the production cost and reduce the impact on the environment. The opportunities are the following:

5.4.1.1. Reduction of raw materials consumption

1. Reduction of raw milk spills is a main target to reduce the consumption of a resource and to prevent pollution and that could be done by control the reception process of milk and avoiding milk spillage by drained tankers and hoses completely and monitoring and controlling the process will stop milk spillage.

   The amount of received milk loss reaches in Palestinian dairy industries 2%, with amount of 560 ton of received milk. In the world, the amount is between 0.5-2.5 %, and some times, it could reach up to 3-4 %, but the world best practice is 0.5 % (UNEP, 2000).

   If the best practice can be reach in Palestinian dairy, then milk leaks will be dropped to 190 ton annually instead of 560 ton. The saving in raw milk will be 370 ton annually. One ton of milk cost almost 610 dollar, that means the money saving will be 220,700 dollar annually.

   2. Use whey to produce other products (Demott, 1975). The result shows that only two dairy plants use whey to produce qareesh cheese, and one industry use the whey as animal feed.

   For example if the whey used to produce qareesh it can produce from 48,000 ton whey almost 14.40 ton of qareesh cheese. One ton of qareesh could be sold to 7,500 dollar; the profit will be 108,000 dollar from producing qareesh cheese.

   3. Monitor the filling and packaging process because a lot of products and packaging materials lost during this process. There was a practice in one dairy industry by installing a control valve to reduce the spill of milk during the filling of bottles show annual saving with 8,000 dollar (DELTA, 2004).

   4. Use fat as raw material to produce other products like sour cream instead of throwing it and buy other fats.

   5. Use cleaning products efficiently and comply with the instruction of using it. Some manufacturer uses more cleaning materials because they think that's better but that cost more money and consume more water. Recovery of cleaning material could be done. Acid cleaning solution can reused without additional treatment (Kiermier, and Wildbrett, 2000). Saving cleaning materials by recycling cleaning solutions by tangential techniques leads to cleaning materials saving to almost 60%. The used cleaning materials are 120 ton annually then the save in cleaning materials will be 120*0.6= 72 ton annually with cost almost 66,600 dollars.

6. Lower the consumption of packaging materials. That's could be achieved by redesign of packaging material, changes in material and used the recyclable materials like recyclable pallets which can be used 40 times instead of one. Store raw and packaging material under adequate conditions to protect them from damage and use storing system to manage the storing process (Ackermann, 1993).
7. Use preventive maintenance because the result shows that it will protect the production process from stop, and that will reduce the loss.
8. Avoid leaks of refrigerants and protect the refrigerant pipes against external damages.

5.4.2.

Reduction of the consumption of water

Water use in large amount in dairy processing; especially in cleaning process so water, saving is a cleaner production opportunity in this industry. Using water more efficiently will protect this natural source especially with the Palestinian water resources problem. It is found that it is more economical to reduce water use and waste in the plant than to operate pretreatment facilities (Kirsh, and Loobyu, 1999).

Most of the water consumption (80%) is consumed during the cleaning process. The following cleaner production opportunities can be practice during cleaning process to reduce water consumption:

1. From the result, the consumption of cleaning water in is 3.6 liters of water / 1 kg of received milk. Best practice for water consumption in market milk processes is reported to be 0.8-1.0 liter water / kg of milk (UNEP, 2004). Use of best practice will save 2.6 liters of water/kg of received milk. The annual saving will be almost 76,000 m^3, with amount of 92 thousand dollar.
2. Use of automated cleaning-in-place systems (CIP) for cleaning the equipments and pipelines instead of manual cleaning process will save 0.2 liter of water/ 1 kg of received milk.

The results show that CIP system consumes 3.5 liters of water/ 1 kg of received milk and manual cleaning consume 3.7 liters of water/ 1 kg of received milk. Using CIP system instead of manual cleaning will reduce the consumption of water.

3. The last rinsing water from cleaning the equipment can be use in the first rinsing of the second cleaning batch in order to reduce water consumption (Van Berkel, 1994).

4. Changing the cleaning method to use cleaning without water for floors and other surfaces before cleaning with water there will be reduce in water to 4%. Installation of systems of automatic cut-off of water on the hoses cleaning equal to 11% reduced, Reduction of water consumption. Use of pressurized water for cleaning outside areas it will reduce to 8% if we used all the mentioned processes the water amount will reduce to 23 % this is detailed in table 5-14 (UNEP, 2000).

The collected data shows that water consumption for cleaning process is 104, 250 m^3 with cost of almost 149,400 dollar, so if the cleaning process changed as in the following table the cost can reduce water consumption amount:

96

97 Table 5-13: Reduction of water consumption by changing cleaning method

Actions	Reduction Percent	Reduction of Water Consumption m^3	Reduction of Water Consumption Cost $
Cleaning without water of floors and other surfaces before cleaning with water	4%	4000	6000
Installation of systems of automatic cut-off of water on the hoses	11%	11500	16500
Use of pressurized water for cleaning outside areas	8%	8008	12000
Total	23%	24100	34500

A reduction of the time spent in cleaning can result in a large increase in production time. In some cases, a reduction of the cleaning time by 25 % can lead to an increase of production time of 1.5 hours per day (UNEP, 2000).

5. Modifying the technology in dairy industries will save water (Carawan, 1977). The result shows that using modern technology in manufacturing one ton of milk instead of traditional method will save 1.3 m^3 of water. The Palestinian traditional dairy industry manufactures 600 ton of raw milk. So if this entire amount is produced by modern technology. That means saving 780 m^3 of water. The cost saving will be 4,290 dollar annually. Install a pressure gun

to the hose for manual cleaning to reduce water consumption.

6. Improve maintenance to prevent product leaks form valves, piping, and equipment.
7. Train Employees how to use water efficiently.

5.4.3. Efficient use of energy

Dairy processing facilities consume considerable amounts of energy. Approximately 80 % of the energy requirements are used to generate hot water and produce steam for process applications (e.g. pasteurization, evaporation) and cleaning purposes. The remaining 20% is used as electricity to drive processing machinery, refrigeration, ventilation, and lighting. Refrigeration consumes 30-40% of electricity. The consumption of energy depends on type of product (ETSU, 1998).
Overall energy savings usually are a result of small savings in a number of areas. Reductions up to 25% are possible through improved housekeeping and fine-tuning of processes, an additional 20% can be gain by energy-efficient equipment and systems for heat recovery (Winfield,et.al,, 1983). Practicing good housekeeping practices in dairy plants will reduce the consumption of energy and that can be achieved by:

1. Using modern and high efficient pasteurizer and modern boiler, see Table 5-14.

Table 5-14: Energy consumption for a selection of milk plants (Joyce, 1993)

Type of plant	Total energy consumption (GJ/ton milk processed)
Modern plant with high-efficiency regenerative pasteurizer and modern boiler	0.34
Modern plant using hot water for processing	0.50
Old, steam-based plant	2.00
Range for most plants	0.5–1.2

2. Implementation of automatic switch-off programs for lights and equipment
3. Install of sensors for controlling the lights in areas that are less frequently used.
4. Elimination of steam leaks, by daily monitoring.
5. Heat recovery from milk by water-cooled condensing mechanisms is effective and provides a reliable source of heat for preheating water (Winfield, and Gee, 1983).
6. Keeping doors closed in cold areas.

7. Preventive steam leaks.
8. Undertake regular defrosting of cold rooms and regular maintenance of refrigeration systems.
9. Use solar energy for heating.

5.4.4. Reduction of solid wastes

Solid wastes generated by dairy processors include, packaging waste such as cardboard, cartons, paper and plastic, organic waste such reject product, maintenance wastes, and office waste.

A solid management strategy should apply in dairy industry in order to reduce, recycle and reuse the solid wastes (Katzel, 1994).

The suggested measures to reduce the solid waste are the following:

1. Reduce the loss of cheese fines by optimizing knife cutting design and speed in cheese vats Cheese fines can also be prevented from entering effluent streams through the use of screens or settling tanks, and cyclones have been used to recover cheese fines and whey from separator de-sludge (Hale et al. 2003).
2. All collected cheese should use as raw material for manufacturing of processed cheese (where possible) or to be sell as animal feed (COWI, 2000).
3. Process solid wastes into valuable by products, which can be sell as fertilizer, animal feed, and other useful products (US EPA, 1998).
4. Collect solids from floors and equipment by sweeping.
5. Recover salt from cheese.
6. Reduce packaging waste (Kuhn, 1996)

- Reduce the production of solid wastes by minimizing the packaging waste using recycled materials for packaging.
- Reduce the thickness of packaging material without compromising food safety criteria and the quality.
- Ensure efficient handling and storage to prevent damage (Rivera, 2001).
- Segregate solid waste to recyclable materials as plastic. Reuse such as pallets.

5.4.5. Reduce the pollutant of wastewater

To practice cleaner production in the dairy industry, the pollutant load and the amount of wastewater shall be reduce, the world's best practice 0.5 liters of wastewater per liter of milk processed, but in Palestinian industry, it consumes almost 4.8 liters.

In order to reduce the pollutant load in wastewater reduction of wastewater effective waste management programs can reduce BOD as much 33% (Carawan, and Stenge, 1996). This would be about 405 ton BOD annually.

The following opportunities in order to reduce water are been identified:

1. Avoiding the loss of milk and avoiding spills that are will reduce the consumption of raw material.
2. Prevent solid materials entering the sewer system by fitting drains with screens and/or traps.
3. Collect spills of solid materials (cheese and curd) for reprocessing or use as stock feed.
4. Remove fat by using fat traps to prevent fat from entering the sewage system.
5. Improve the cleaning practices by removing the product residues before cleaning. Use dry cleaning techniques where possible, by scraping vessels before cleaning or pre-cleaning with air guns.
6. Improve maintenance to prevent product leaks from valves, piping, and equipment.
7. Reduce the amount of water consumption volume.
8. Neutralize acidic and alkaline waste before dump it in (Neutralize pH).
9. Train the employee on cleaner production practices to minimize water use and wastes.
10. Whey, like municipal sewage, responds to biological treatment, but its waste strength is about 300 times more concentrated. Therefore, whey shall not be discharge to the sewer as such. However, it should process into useful products instead of discharging it to the drainage system such as drinks; animals feed (Gehin, 2008).

Two plants use the whey residue to produce qareesh cheese, and one plant use it as animal feed instead of discharging it as waste to the sewer system. These measures will reduce the wastewater load through minimizing the content of whey in the wastewater which has high organic load and that will reduce the environmental impact and gives the opportunity to sell

further products (Morr, 1992).

5.4.6. Reducing air emission

In order to reduce the air emission the following opportunities are been identified:

1. Use fuel oil with low sulphur content (less than 1%). This increases the efficiency of the boiler and reduces sulphur dioxide emissions.
2. Repair steam leak, losses of steam will causes losses of more oil. In addition, that means more gas emissions (Freeman, et.al, 1992).
3. Reduce energy consumption by insulated hot surfaces.
4. Carry out periodic maintenance of boilers and burners (Harry, 1992).
5. Use solar energy.
6. Train the employees in efficient boiler operation.

CHAPTER SIX

CONCLUSIONS & RECOMMENDATIONS

6.1. Conclusion

The research results determine some important data regarding the consumption of resources by Palestinian dairy industries. The research also determines some sources of pollution in Palestinian dairy industries. It also identified the opportunities and the feasibility of practicing cleaner production in dairy industries.

The consumption of resources as raw milk, water and energy, as well as the discharge of wastewater with high organic load caused environmental pollution. High organic load causes due to milk spills, cleaning process, and the discharge of whey and other wastes directly to sewer system without any treatment.

6.1.1. The main results

The Palestinian dairy industry consumes 0.6% from the industrial water. The number of the worker is almost 1.3 % of the worker in the industrial sector.

The dairy industries consume 29,530 ton of raw milk, and that is almost 94% of raw material in and it is 42% of the cow milk consumption in West Bank.

The consumption of water is 125,700 m^3, 83% of it is for cleaning processes.
The cost of energy is almost 1.3 million dollar, 78% is for electricity consumption.
The following table clarifies some consumed materials by Palestinian dairy industries:

Table 6-1: Consumed Material by Dairy Industries

The Unit	Raw milk	Raw material	Packaging Material	Cleaning Material	Water	Energy
Million Dollar	18	20	3.1	.11	.15	1.6

The following table clarifies the manufacturing of ton of milk per water consumption regarding cleaning process and kind of used technology:

Table 6-2: The Manufacture of One Ton of Milk per Water consumption

The Item	The Average m^3	Modern Technology m^3	Traditional Technology m^3	CIP System m^3	Manual Cleaning m^3
One ton of Milk	4.3	4.2	5.2	3.5	3.7

The following table clarifies what's need to manufacture one ton of raw milk in Palestinian dairy industry:

Table 6-3: The Needs to manufacture one Ton of Milk

The Item	Water m^3	Cleaning Material Ton	Energy Dollar
The Value	4.3	0.4	54.2

Energy cost the Palestinian dairy industry more that ten times of the cost of water.
The dairy industries produce 2830 ton of solid waste annually. It produces 148,500 ton of liquid wastes. The whey content is 27% of the wastewater. The average of dairy industry wastewater production is almost 10,000 m^3/year. The wastewater flow is 35 m^3/day.

The following table clarifies the production wastes of one ton of milk

Table 6-4: Waste Production per One Ton of Milk

The Item	Wastewater m^3	Solid Waste Ton	BOD kg
The Value	4.8	0.1	39

Table 6-5: Palestinian Dairy Industry Pollutant

The Parameter	BOD mg/l	COD mg/l	P mg/l
The Value	8900	12450	4000

Table 6-6: The Air Emissions of Palestinian Dairy Industries

The Emission	CO_2	NO_x	SO_2
The Value in Ton	2,780	7.9	15.9

6.1.2. The feasibility of cleaner production

Several opportunities are been identified in this research and the past applications of practicing cleaner production in Palestinian dairy industries (DELTA, 2004). These opportunities will protect the environment by reducing the consumption of resources and will reduce the cost. The potentials are as follows:

- Saving raw milk consumption

  The results show that practicing cleaner production can save 370 ton of raw milk annually with cost of 220,700.

- Using the Whey

  If the produced whey used to produce qareesh cheese, it could produce 14.4 ton annually with profit of 108,000 dollar.

- Saving cleaning material

  Recovery of cleaning material by recycling the cleaning solutions by tangential techniques leads to cleaning materials saving to almost 60%. The used cleaning materials are 120 ton annually. That's mean saving 72 ton of cleaning material annually. That will save almost 66,600 dollars.

  There are also opportunities from reusing of salts used in cheese manufacturing as proper hygienic conditions are maintained.

- Saving water consumption

  In the best practicing in dairy industries the amount of water consumption will be $1m^3$ instead of $4.3m^3$ that means saving 3.3 liters of water/kg of received milk.

  The annual saving will be almost $97,000m^3$, with amount of 146 thousand dollar.

  Changing the cleaning method by using CIP system instead of manual cleaning will save 24,100 m^3 of water annually with cost of 34,500 dollar.

- Saving energy

  Reductions of 25% are possible through improved good housekeeping. In addition 20% can be saving through used more efficient equipment and systems for heat recovery.

  The energy saving could reach 45% and the saving value will be 720,000 dollar annually.

The research results show also that there is no waste strategy or waste management plan in Palestine. There is no enforcement to apply existing regulations and standards to control industrial emissions. There is no monitoring for the quality of wastewater and it is discharge directly to sewer system without any kind of treatment.

Unfortunately, Palestinian dairy industry is not aware to the environmental issue, the benefits, and the feasibility of practicing cleaner production or the implementation of environmental management systems such as ISO 14001 in dairy industries.

6.2. Recommendation

Several issues should be doing in order to prevent pollution at the source in Palestinian dairy industries to reach sustainable economic development. Cleaner production can be practice in the Palestinian manufacturing for this purpose.

The recommendations in order to reach sustainable development can be dividing in to three categories, to the government, to the manufacturer, and to researcher.

6.2.1. Recommendation to the government

The following are the recommendation to the government in order to improve the current environmental situation in the Palestinian manufacturing:

- The existing legal and regulatory framework and standard should be reviewed and develop. Enforcement mechanism shall be adopt for applying these laws and standard.
- National waste management strategy should issued and applied to manage solid and liquid wastes ISO 14001 can be recommend for this purpose.
- Develop of public awareness campaigns regarding environmental issued.
- Organize environmental training programmers for workers.
- Establish a database on pollution sources, and pollution parameters.
- A program for strengthening national capacities should be developed and include technical assistance and training programs in wastewater treatment and reuse, and solid waste management

- Economic measures should be take to reduce pollution such as polluter pay.
- Encourage the participation to the local communities and private sector.
- Set up legal and institutional framework ensuring clear distribution of responsibilities between stakeholders to ensure cooperation.
- Ensure that every new investment made EIA studies to reduce pollution generated from industries with low consumption of natural resources and less pollution.
- Introduce cleaner production practices in dairy industries and other industries.

6.2.2. Recommendations to manufacturers

The following are recommendations to the manufacturer that they should do to improve the current environmental situation in their manufacturing and to save cost:

- Apply regular monitoring and follow-up of emissions and utility consumption.
- Train and motivate the personnel to practice cleaner production in the manufacturing.
- Modify and improve the used technology.
- Where manual cleaning systems are used, practice good housekeeping measures to reduce water consumption
- Avoid the loss of resources such as raw milk and water, and reduce the loss of packaging materials.
- Use continuous processes instead of batch processes.
- Use milk residues in other products or using it in animal feed, such as whey.
- Establish a pre treatment system for wastewater consisting of homogenization and sterilization process before discharging.
- Introduce measures for recovering energy such as improves the maintenance of boilers, circuits and refrigeration systems.
- Preventive maintenance should be applied to prevent loss of money from unnecessary machinery shut downs.
- Organize environmental awareness promotion and training program for the workers.

6.2.3. Recommendations to Researchers

The following are recommendation about subjects for researches that they should work on:

- Produce of new products using whey and fats as raw materials.
- Reuse of the cleaning material.
- Produce eco- friendly packaging.
- Search on recovering of salt.
- Study and analyze the dairy industries wastewater.
- Study all dairy industry pollution parameters.
- Modify the existing equipments or adopting new technologies.
- Study the dairy industries process in order to develop these processes.
- Study the feasibility of practicing cleaner production at all industries.

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ANNEXES

Annex 1: Number of Enterprises and Persons Engaged and Main Economic Indicators in Remaining West Bank and Gaza Strip by Economic Activity –2006

(Value in US $ 1000)

Economic Activity	.Number of Ent	Number of Persons Engaged	Compensation of Employees	Output	Intermediate Consumption	Gross Value Added	.G. F. C. F
Other mining and quarrying	173	1127	3531.6	48615.7	16436.3	32179.4	1121.6
Manufacture of food and beverages	1558	7746	25295.9	332148.8	245031.9	87116.9	5062.6
Manufacture of tobacco products	14	277	2109.0	77604.6	20693.8	56910.7	0.0
Manufacture of textiles	209	1202	2159.5	17293.3	9312.4	7980.9	110.6
Manufacture of wearing apparel	1022	8820	20118.0	55254.8	19469.8	35785.0	493.4
Tanning of leather; manufacture of bags	279	1634	3594.5	33509.5	15152.9	18356.6	214.4
Manufacture of wood and its products	511	1301	2056.3	24773.4	12886.5	11887.0	90.0
Manufacture of paper and its products	45	408	1214.3	20298.2	11206.1	9092.0	677.8
Publishing, printing and reproduction	204	1017	3244.3	18655.0	13314.2	5340.8	1112.4
Manufacture of coke, refind petroleum prod.							
Manufacture of chemicals & its prod.	140	1717	9946.0	68157.2	35986.1	32171.1	2282.3
Manufacture of rubber and plastic	111	894	3393.3	47358.6	38446.7	8911.9	180.6
Manufacture of non-metallic products	1629	9615	33783.5	431830.7	218940.7	212890.0	4758.4
Manufacture of basic metals	22	122	415.1	3923.7	2383.7	1539.9	0.0
Manufacture of metal products	2795	5881	7801.1	100021.4	62183.6	37837.8	343.7
Manufacture of machinery and equip.	187	530	630.4	5750.5	3391.2	2359.3	37.1
Manufacture of electrical machinery	43	246	559.9	4494.0	2597.6	1896.4	14.1
Manufacture of radio, TV equip.	6	8	0.0	11.2	6.5	4.7	0.0
Manufacture of medical, optical equip.	44	100	191.3	899.3	319.1	580.2	53.2
Manufacture of motor vehicles, trailers	13	65	92.6	426.8	213.1	213.7	0.0
.Manufacture of other transport equip							
Manufacture of furniture	1891	5455	11010.4	86467.4	52927.8	33539.5	2106.1
Recycling	9	39	135.1	9743.4	8026.4	1717.0	14.1
Electricity	9	638	2922.2	58968.2	9722.5	49245.6	0.0
Collection & distribution of water	437	1148	4077.8	28158.9	9114.2	19044.6	3688.4
Construction	460	3908	16934.5	160475.1	24744.5	135730.5	897.1
Sale & repair of motor vehicles	5411	12211	17492.7	108433.5	29126.3	79307.2	2001.2
Wholesale trade & commission trade	1458	6056	17446.6	201452.5	30412.6	171039.9	3508.9
Retail trade, repair of personal goods	37043	65045	55179.0	451684.6	124411.1	327273.5	6784.6
Hotels & restaurants	3464	9494	14100.9	103992.8	55360.1	48632.7	588.1
Land transport	271	2301	7485.9	31820.6	14112.2	17708.4	1992.3

Supporting & auxiliary transport	245	880	1929.3	12313.0	3245.5	9067.5	300.7
Post & telecommunications	82	3058	53374.6	270370.5	51993.8	218376.7	28994.7
Real estate activities	90	216	870.8	8985.4	844.4	8141.1	98.5
Renting of machinery without operator	274	699	821.0	5281.9	1244.5	4037.4	1170.6
Computer & related activities	207	545	2123.7	6352.4	1511.5	4840.9	90.2
Research & development	29	241	1930.8	5133.7	930.5	4203.2	88.7
Other business activities	2308	6063	12872.8	47511.8	16403.3	31108.4	1153.6
Education	1442	12866	77262.1	118124.9	17810.1	100314.8	5781.8
Health & social work	2874	10448	42021.3	110755.3	29605.6	81149.7	8063.5
Sewage and refuse disposal	740	5023	26224.2	36642.0	12751.5	23890.4	1073.1
Activities of membership organizations							
Recreational, culture & sporting act.	831	2701	5735.5	19927.2	7263.1	12664.2	2393.5
Other service activities	3386	5458	3447.4	23970.7	11068.9	12901.7	1277.0
Industrial Activities	**11351**	**49990**	**138282.9**	**1474364.3**	**807763.0**	**666601.3**	**22360.7**
Construction Activities	**460**	**3908**	**16934.5**	**160475.1**	**24744.5**	**135730.5**	**897.1**
Internal Trade Activities	**43912**	**83312**	**90118.4**	**761570.6**	**183950.0**	**577620.6**	**12294.7**
Services Activities	**15645**	**53754**	**187410.5**	**486678.1**	**154793.5**	**331884.5**	**21778.6**
Transport, storage & communications Activities	**598**	**6239**	**62789.8**	**314504.1**	**69351.5**	**245152.6**	**31287.7**
Total	**71966**	**197203**	**495536.1**	**3197592.2**	**1240602.5**	**1956989.5**	**88618.8**

Annex 2: Palestinian Standards for Industrial Effluent Wastewater (PSI, 1998)

المادة	الحد الأعلى المسموح به (ملغم / لتر)[3]			
	إعادة الاستعمال [4] لأغراض الري	التغذية الطبيعية للمياه الجوفية	الصرف إلى	
			البحر	سيول ، انهار ، وديان ، تجمعات مائية
الأكسجين الممتص كيماويا	–	150	200	150
الأكسجين المذاب	1	1	5	1
المواد الذائبة الكلية	2000	1500	–	3000
المواد العالقة الصلبة الكلية	100	–	–	50
الزيوت والشحوم	5	–	10	15
الفينول	0.002	0.002	1	0.002
المنظفات الصناعية	–	15	–	25
النترات	50	12	–	12
الامونيا	5	5	12	5
النيتروجين الكلي	50	–	125	–
الفوسفات – فسفور	–	–	–	15
الكلورايد	300	500	–	500
الفلورايد	–	1.5	–	105
الصوديم	–	400	–	–
المغنيسيوم	–	–	–	–
الكالسيوم	–	–	–	–
نسبة ادمصاص الصوديم	9	–	–	–
البايكروبونات	500	–	–	–
الكبريتات	400	500	–	500
الالمنيوم	5	0.3	–	5
البورون	–	1	–	1
النحاس	0.2	2	0.1	2
الحديد	5	1	2	1
المنغنيز	0.2	0.2	0.2	0.2

3: mg/l depend on monthly average
4: Depend on Plants, production quantity,i method,soil,climate

Palestinian Standards for Industrial Effluent Wastewater (PSI, 1998)

Physical Requirements

الخواص	الحد الأعلى المسموح به			
	إعادة الاستعمال [4] لأغراض الري	التغذية الطبيعية للمياه الجوفيه	الصرف إلى	
			البحر	سيول ، انهار ، وديان ، تجمعات مائية
الرقم الهيدروجين	8.4-6.5	9.0-6.5	9.0-5.5	9.0-6.5
اللون	-	15	75	15
التغير في درجة الحرارة	-	-	4^{+}-	4^{+}-

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108 **Annex 3: The Questionnaire**

استمارة مصانع الالبان

أولا: معلومات عامة

اسم المصنع:
المحافظة:
العنوان:
التلفون:
تاريخ إنشاء المصنع:
راس المال:
عدد أيام العمل السنوية:
عدد العاملين:
الطاقة التصميمية:
الطاقة الفعلية:

ثانيا: المواد الخام والمواد المضافه

الرقم	اسم المادة	الاستهلاك السنوي (طن)	القيمة ب $
	الحليب السائل		
	الحليب الباودر		
	سوربات البوتاسيوم		
	البادئة		
	المنفحه(انزيم الرنين)		
	الملح		
	اطعمه		
	ملونات		

ثالثا: مواد التعبئة والتغليف

الرقم	اسم المادة	الاستهلاك السنوي (طن)	القيمة ب $

رابعا: مواد التنظيف

الرقم	اسم المادة	الاستهلاك السنوي (طن)	القيمة ب $
	هيكسونا		
	كوستك صودا		
	نيتريك اسيد		
	غير ذلك		

خامسا: الآلات والمعدات

الرقم	الالة	سنة الصنع	الطاقة الإنتاجية طن/السنة
	جهاز البسترة		
	المجنس		
	الفراز		
	خزانات التبريد		
	حوض التجبن		
	ماكنات التعبأة والتغليف		
	غير ذلك		

سادسا: الادوات والمواد المستخدمة في المختبرات

الرقم	المادة	كمياتها السنوية (كغم)	القيمة ب$
	جهاز قياس الحموضه(السحاحه)		
	جهاز قياس نسبة الدهن		
	pH meter		
	حاضنة		
	فرن		
	جهاز تعقيم ادوات المختبر		
	الاوساط الزرعيه (الميديا)		

	غير ذلك		

سابعا: فحوصات استلام الحليب

الرقم	الفحوصات	مكان الفحص	عددها بالسنة
	فحص الحموضه الكليه		
	فحص ال pH		
	فحص نسبه الدهن		
	غير ذلك		

ثامنا: فحوصات المختبر

الرقم	الفحوصات	مكان الفحص	عددها بالسنة
	العدد الكلي للبكتريا		
	الاعفان والخمائر		
	كوليفورم		
	المضادات الحيويه		
	غير ذلك		

تاسعا: المنتجات

الرقم	اسم المنتج	الكمية طن/السنة	القيمة ب $
	الحليب المبستر		
	الحليب المعقم		
	اللبن الرايب		
	اللبنه		
	مشروب اللبن (اللبن أب)		
	القشطه الحامضيه (الشمينت)		
	حليب مطعم بالفاكهة		
	اللبن بطعم الفاكهة		
	البودينج		
	الجبنه البيضاء بأنواعها		
	جبنة القريش		

عاشرا: المياه

الرقم	المياه المستخدمة	الكميةم 3 /السنة	القيمة ب $
	المياه المستخدمة في الإنتاج		
	المياه المستخدمة للتنظيف		
	المياه المستخدمة للاستعمال الشخصي		
	مجموع المياه المستخدمة الكلية		

حادي عشرً: المخلفات

1- المخلفات الصلبة

الرقم	اسم المادة	العملية الناتجة عنها	كيفية التعامل معها	الكميةطن/السنة	القيمة ب$
	الدهون				
	الشرش				
	مواد راجعة				
	مواد تعبئة وتغليف				

2- المخلفات السائلة

الرقم	اسم المادة	العملية الناتجة عنها	الكمية طن/السنة	قيمتها ب $	طريقة التعامل معها
	الحليب	حليب خام راجع اثناء التصنيع التخزين راجع من السوق			
	الالبان	اثناء التصنيع التخزين راجع من السوق			
	المياه العادمة	التصنيع التنظيف الاستعمال الشخصي			

ثاني عشر: الطاقة

الرقم	نوع الطاقة	الكمية / السنة	القيمة ب $
	كهرباء		
	سولار		
	اخرى (حدد)		

ثالث عشر: التخزين

1- هل يتم اتباع نظام للتخزين؟ وان وجد ماهو؟

2- كم قيمة ب $ للمواد التالفة اثناء التخزين؟

3- كم تبلغ كمية المواد التالفة اثناء التخزين؟

4- ماهي اكثر المواد التي تتلف اثناء التخزين؟

رابع عشر: السياسات البيئية

1- هل توجد سياسة بيئة للمنشاة ؟

2- هل تم تدريب العاملين في المصنع على نظم الادارة البيئية .

3- هل يتم قياس تسرب المياه في المنشاة ؟ إذا كان الجواب نعم، كم الكمية في السنة ؟

خامس عشر: السياسات البيئية

1- هل يتم إتباع نظام للصيانة في المنشاة ؟إذا كان الجواب نعم ما هو؟

2- كم قيمة الصيانة السنوية؟

3- كم مره تم توقف الإنتاج خلال السنة لحدوث عطل فني بالماكينات؟

4- ماهي التكلفة الناتجة عن توقف الإنتاج ؟

5- متى تتم عملية تنظيف خطوط الانتاج؟

6- ما هي الطريقة المتبعة بالتنظيف ؟

7- هل يتم إعادة استخدام مياه التنظيف ؟

8- هل يوجد مطعم في المصنع ؟

Annex 4: The Result

109 Table A-1: Case summaries

		Capital	Production System	Number of Working Days	Number of Working	Designed Capacity in Year	Real Capacity in Year	Consumption of Raw Milk in m3
Jerusalem	1	$300,000	Automatic	300	60	20160	3900	4560
	Total Sum	$300,000	1	300	60	20160	3900	4560
Ramallah	1	$2,000,000	Automatic	180	11	5760	900	600
	2	$400,000	Automatic	290	9	2320	580	500
	Total Sum	$2,400,000	2	470	20	8080	1480	1100
Nablus	1	$5,000,000	Automatic	365	75	21900	5475	5000
	Total Sum	$5,000,000	1	365	75	21900	5475	5000
Hebron	1	$714,000	Automatic	290	150	34800	3480	3500
	2	$360,000	Automatic	295	21	4425	2065	1500
	3	$1,500,000	Automatic	278	260	27800	16680	12000
	Total Sum	$2,574,000	3	863	431	67025	22225	17000
Qalqilia	1	$50,000	Traditional	300	5	1200	120	120
	2	$30,000	Traditional	300	2	0	60	60
	3	$15,000	Traditional	300	2	0	90	90
	Total Sum	$95,000	6	900	9	1200	270	270
Tulkarem	1	$200,000	Automatic	300	2	3000	1500	70
	2	$650,000	Automatic	240	18	2400	1440	250
	Total Sum	$850,000	2	540	20	5400	2940	320
Salfeet	1	$114,286	Traditional	220	7	2200	330	330
	Total Sum	$114,286	2	220	7	2200	330	330
Jaricho	1	$200,000	Automatic	312	10	3120	936	950
	Total Sum	$200,000	1	312	10	3120	936	950
Total	Sum	$11,533,286	18	3970	632	129085	37556	29530

Table A-2: Laboratory Tests Summary

	Tests	Tests	Tests	Tests	Tests	Tests	Tests	Tests
1	290	290	290	290	290	290	290	0
2	295	295	295	150	150	290	290	0
3	0	0	0	0	0	0	0	0
4	0	180	180	48	48	48	6	0
5	0	280	300	700	500	900	0	500
6	0	0	60	40	40	40	0	0
7	6000	3000	1500	3000	3900	3900	900	600
8	27800	20000	20000	8340	8340	8340	2788	150
9	0	300	0	10	0	0	0	0
10	0	0	0	0	0	0	0	0
11	365	365	365	365	365	365	365	365
12	0	0	0	0	0	0	0	0
13	220	220	50	50	100	100	50	0
14	0	0	0	0	0	0	0	0
Total N	14	14	14	14	14	14	14	14
Sum	34970	24930	23040	12993	13733	14273	4689	1615

110 Table A-3: Waste Production

The Industry		Quantity of Fat in Tons	Quantity of Whey in Tons	Return Quantity in Tons	Packaging Waste Quantity in Tons	Waste Milk Quantity in Tons	Waste Dairy Quantity in Tons	Wastewater Quantity in m3
1		0	0	2	0	175	175.00	17000
2		0	1000	2	0	0	.00	40
3		0	0	0	0	0	.00	200
4		0	0	0	0	0	7.50	600
5		0	0	0	0	0	1.50	1500
6		0	0	0	0	0	.00	160
7		0	0	40	0	12	.50	9000
8		0	3800	100	40	100	200.00	27350
9		0	0	0	0	3	.10	160
10		0	0	0	0	0	.00	150
11		50	50	0	0	0	.00	41000
12		0	0	0	0	0	.00	960
13		0	80	0	2200	0	6.00	1125
14		0	300	0	0	8	4.00	11500
Total	N	14	14	14	14	14	14	14
	Sum	50	5230	144	2241	298	394.60	110745

Table A-4: Question Analysis

	Storing System is Available	Storing System	Percentage of Storing Waste Material	Environmental Policy	Training of Worker	Leakage Measure	Quantity of Leakage	Maintenance System is Applicable	Maintenance Cost in Dollar	Production off	Production off Cost	Production Line Cleaning	Cleaning System	Water Reuse
1	yes	fifo	90000	yes	yes	no	0	yes	30000	0	0	290	CIP	no
2	yes	fifo	0	no	no	no	0	no	4000	1	1000	590	CIP	no
3	no	.00	0	no	no	no	0	no	2200	0	0	300	manual	no
4	yes	.00	8	no	no	no	0	yes	12000	0	0	180	CIP	no
5	no	.00	3000	yes	no	no	0	yes	2000	0	0	540	manual	no
6	no	.00	0	no	no	no	0	no	0	0	0	300	manual	no
7	yes	GMB	0	no	no	no	0	yes	40000	1	0	600	CIP	no
8	yes	fifo	0	yes	yes	no	0	yes	150000	2	0	260	CIP	no
9	no	.00	0	no	no	no	0	yes	1000	2	0	300	manual	no
10	no	.00	0	no	no	no	0	no	0	0	2	0	manual	no
11	yes	fifo	20000	yes	no	yes	2	yes	10000	5	50000	365	CIP	no
12	no	.00	0	no	no	no	0	no	0	0	0	300	manual	no
13	no	.00	0	no	no	no	0	no	5000	3	4500	440	manual	no
14	no	.00	0	no	no	no	0	no	20000	5	0	213	CIP	no
Total N	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Sum	22	9.00	113008	24	26	27	2	21	276200	19	55502	4678	21	28