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# Industrial Pollution Prevention

## Case Study: Food Sector

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### Reduction of Milk Losses at: Misr Company for Dairy and Food, Mansoura, Egypt

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#### INTRODUCTION

A range of pollution prevention opportunities have been identified and are currently being implemented by Misr Company for Dairy and Food in Mansoura, Egypt. To date, this has involved a total investment of LE113,250 and resulting in annual savings of LE 309,250.

A summary of how these improvements were identified and the underlying problems solved, follows.

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#### THE FACTORY

This factory is one of nine owned by the public sector company Misr for Dairy and Food and is one of the largest producers of dairy products in Egypt. The Mansoura factory was built in 1965 and has a workforce of around 420.

The factory annually processes an average of 7,200 tons of milk, producing mainly pasteurised milk, white cheese, blue cheese and mish. Yoghurt, sour cream, ghee and processed cheese are also produced.

#### Process Description

##### Outline of Main Processes

The main process units present in the factory are outlined below:

**Milk Receiving, Preparation and Storage** - raw milk is delivered from collection centres to the factory's reception area where it is tested and graded. If it is of a suitable quality it is then accepted and refrigerated prior to use.

**Milk Pasteurisation** - the received milk is pasteurised by being rapidly heated and cooled. It is then either sent for packaging or for further processing.

**White Cheese Manufacturing** - white cheese is produced from the milk concentrate produced by the ultra-filtration of pasteurised milk, which is then curded, packaged and sold.

**Ghee Manufacturing** - initially, cream is separated from the raw milk and blended with artificial ghee and salt and then cooked. This mixture is then incubated for a day and then packed. Morta is generated as a by-product of this process (0.05%), which is also packed and sold.

**Roquefort Cheese Manufacturing** - the pasteurised milk is placed in basins, where it is curded, incubated, and refrigerated, followed by punching. It is stored for one month to allow the blue colour to develop and then packed and stored for dispatch. 20% of the milk used in this process is lost as whey.

**Processed Cheese Manufacturing** - Quark and Roquefort cheese are minced and cooked with skimmed milk, whey protein and some additives such as salts and emulsifiers, followed by cooling and packing.

**Yoghurt and Sour Cream Manufacturing** - milk and fixing agents are mixed to produce yoghurt, which is then automatically packed in small cartons, incubated and refrigerated for dispatch.

**Mish (Salty Cheese Mix) Manufacturing** - this is produced using dairy products rejects. These are mixed, ground and filtered to separate the solids from the whey. Preservatives are added and the product is packaged.

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## Service Units

Factory service units include tin can manufacturing, refrigeration and storage, a boiler station, a quality control laboratory, a warehouse and maintenance workshops.

## Water Consumption

The factory uses about 37,080 m<sup>3</sup>/year of water from the Mansoura City potable water supply;

- ❖ *Processing* - 2,880 m<sup>3</sup>/year.
- ❖ *Equipment and floor washing* - 20,160 m<sup>3</sup>/year.
- ❖ *Boiler feed and cooling water* - 6,840 m<sup>3</sup>/year.
- ❖ *Domestic use* - 7,200 m<sup>3</sup>/year.

## Wastewater Characteristics

- ❖ *Volume*: 30,240 m<sup>3</sup>/year of industrial wastewater from different factory streams,
- ❖ *BOD*: 13,160ppm,
- ❖ *COD*: 18,800ppm,
- ❖ *TSS*: 10,640ppm.

There is no industrial wastewater treatment facility and the wastewater is disposed into the city sewerage system.

Summary of Cost Benefits				
Factory Unit	Action	Capital and Operation Costs (LE)	Yearly Savings (LE)	Payback Period (month)
All	Improve Housekeeping and Solid Waste Removal	13,000	120,000	1
Milk Packaging and Storage	Rationalise Milk Packaging and Increase Milk Refrigeration Efficiency	26,500	39,600	8
White Cheese	Reuse Whey	0	2,000	Immediate
Boiler House	Upgrade Boiler and Restore Softening Unit	2,000	18,750	< 1
Garage	Collect Used Oil	500	2,500	< 3
Milk Receiving and Pasteurisation	Milk Tank Level Controls	10,250	126,000	7
	Food Quality Valves	64,000		
<b>Total</b>		<b>116,250</b>	<b>308,850</b>	<b>&lt; 5</b>

## POLLUTION PREVENTION OPPORTUNITIES

Pollution prevention opportunities were identified by means of an industrial audit. This identified various improvement opportunities; a description of the most important being:

1. Different solid wastes stored haphazardly in open areas and roads, constituting a fire risk and impairing the general appearance of the premises.
2. Considerable amounts of milk were wasted due to overflow during the filling of storage and service tanks.
3. Milk leakages in the milk packaging and refrigeration units.

4. Oils used in the car and truck maintenance facilities was drained to factory sewers, encouraging drain blockage and consequent development of foul odours.
5. Excessive consumption of mazot in the boiler house, due to poorly tuned boilers. This also resulted in excessive air emissions (mainly smoke and carbon monoxide) being discharged from the boiler stacks.

## CLEANER PRODUCTION APPLICATIONS

During the audit stage, particular attention was paid to those improvements which could be carried out at low or no cost to the factory. These were given a high priority as they are easy to implement and often entail significant savings.

The measures which have already been implemented by the factory or under implementation through the Cleaner Production Demonstration Projects of the SEAM Project are briefly outlined below.

### *Improve Housekeeping*

In-plant housekeeping of factory units and buildings was improved, factory drainage, sewers, and manholes were maintained and upgraded to eliminate blockage and overflow problems. In-plant roadways were paved and signposts added to allow for better traffic flow of factory vehicles. Unattended areas were planted with trees and greened. Overall, the factory has improved its image and cleanliness.

*Implementation Cost: LE 10,000*

### *Used Garage Oil: Collection for Resale*

Pollution loads from the garage and workshops constitute the highest level of suspended solids (9,148ppm), and the only source of mineral oil and grease (1,245ppm) generated in the

factory. Oil, grease and lubricants are now collected instead of being disposed to the sewer, with the following benefits:

- ❖ Approximately 0.75 tons of oil are accumulated monthly and sold at LE275 per ton.
- ❖ reducing the strength of wastewater,
- ❖ improving the cleanliness of the garage and workshops,
- ❖ the prevention of serious blockage of sewers and overflow (as oil and grease tend to solidify milk products if mixed in sewers).

*Implementation Cost: LE 500*

*Annual Savings: LE 2,500*

### ***Solid Waste: Collection and Sale***

Solid wastes generated by the factory were initially segregated and then either disposed or sold:

- ❖ Garbage and packaging wastes are trucked out daily and disposed a
- ❖ Solid wastes such as scrap iron and metal objects are sold in auctions or to special scrap dealers.

This action has achieved an efficient removal of wastes from the site, and improved the cleanliness of the factory premi from the sale of solid wastes.

*Implementation Cost:* LE 3,000

*Savings:* LE 120,000

### **Water and Energy Conservation**

#### ***Boiler Tune-Up and Upgrade***

The ratio of air to mazot was optimised to increase the efficiency of the boilers, hence reducing mazot consumption and gas emissions. Benefits of this measure include:

- ❖ Mazot consumption has been reduced by 60 tons/year, saving LE 10,740.
- ❖ Solar consumption has been reduced by 12 tons/year, saving LE 4,980.
- ❖ Electricity consumption has been reduced by 12,775 kWh/year, saving LE 2,500.

#### ***Restoration of Softening Unit***

The softening unit was restored to prevent the scaling of the boiler by chemical treatment of the feedwater.

As a result of implementing this improvement, tuning and upgrading the boilers, steam generation from 1m<sup>3</sup> of water has increased from 1 ton to 1.16 tons, corresponding to a 16% increase in boiler efficiency.

*Implementation Cost:* LE 2,000

*Annual Savings:* LE 18,750

### **Reuse and Recycling**

#### ***Increase Refrigeration Efficiency and Rationalise Milk Packaging***

Raw milk storage units and the refrigeration room of the packaged milk products were upgraded to prevent spoilage and loss. This was achieved through investment in a refrigeration system which permitted temperature to be fully controlled. The benefits from this intervention include:

- ❖ increased production capacity.
- ❖ improved process efficiency.
- ❖ improved quality control.
- ❖ reduced reject rates of the final product.

The packaging unit was relocated from a restricted area to be adjacent to the refrigeration facility thus preventing handling losses. This has reduced milk losses by

3.3tons/month, corresponding tp monthly savings of LE3,330.

*Implementation Cost:* LE 26,500

*Annual Savings:* LE 39,600

#### ***Whey Reuse in White Cheese Manufacturing***

4.4m<sup>3</sup> of permeate with a high lactose concentration (4.5%) is generated as a by-product from ultra-filtration in this process. Originally, this was disposed directly to the sewer. The factory now reuse 50% of this in the cheese packaging stage, in place of fresh water.

This has resulted in a 50% drop in the organic load generated from the white cheese unit from 5,800ppm to about 3,000ppm. Almost 2,200m<sup>3</sup> of water are saved on an annual basis.

*Implementation Cost:* none

*Annual Savings:* LE 2,000

#### ***Installation of New Equipment***

Total losses from the factory in both raw milk and products was shown to be 0.80 tons/day. The receiving and pasteurisation processes were the greatest sources of wastage, with milk losses of up to 0.7 tons/day, valued at LE252,000 per year.

***The Problem:*** Raw milk coming into the factory is transferred directly from the delivery vehicles into the storage tanks. As the were no level gauges or controls on the tanks, overfilling and spillage frequently occurred.

***The Solution: Installation of Level Controls*** - milk storage tanks were equipped with level sensors and stopcocks to prevent overflow particularly during the receiving stage. This type of sensor was selected rather than infra-red sensors, as foaming of the milk as it is transferred can result in inaccurate readings and subsequent overflow.

*Implementation Cost:* LE 10,250

***The Problem:*** Leakages of milk from valves throughout the system were common, resulting in milk loss and an increased organic load of the final effluent.

***The Solution: Installation of Control Valves*** - the installation of food quality, stainless steel control valves were installed throughout the factory where required, including the milk receiving, storage and pasteurisation areas. Forty valves were required.

*Implementation Cost:* LE 64,000

The implementation of the above improvements has resulted in daily savings of 350 kilograms of milk. A total of 126 tons of milk are recovered annually resulting in savings of LE126,000 per year. Additional benefits include:

- ❖ reduced pollution loads,
- ❖ the elimination of floor spills,
- ❖ improved hygiene and safety.

## ECONOMICS

Throughout industry, pollution prevention and environmental protection measures can offer real financial benefits in terms of:

- ❖ reduced raw materials consumption;
- ❖ waste minimisation and
- ❖ reuse or recycling of in-plant materials.

Implementing these measures will also result in reduced environmental pollution and movement towards discharge consent limits.

The total capital and operation costs invested in the cleaner production measures at the Mansoura factory amounts to LE 116,250. This has produced total savings of over LE 308,850, with an average payback period of around 4 months.

## BENEFITS AND ACHIEVEMENTS

- ❖ **Recovery solutions and better quality control** of milk products and by-products has recovered 166 tons of milk/year (2.3%), which was previously wasted.
- ❖ **Water consumption** has dropped by 6%.
- ❖ **Mazout consumption** has decreased by 10%.
- ❖ **Solar consumption** has decreased by 5%.
- ❖ **Electricity consumption** has been reduced by 9%.

## CONTACTS

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## The SEAM Project

Support for Environmental Assessment and Management (SEAM), is a multi-disciplinary

Department for International Development (DFID). This project is being implemented by the Egyptian Environmental Affairs Agency (EEAA) through the Technical Co-operation Office for the Environment (TCOE) and Entec, a UK engineering and environmental consultancy.

## SEAM: Pollution Prevention

This is being implemented under the National Industrial Pollution Prevention Programme (NIPPP). NIPPP focuses on the introduction and promotion of low-cost improvement measures, which can be easily and quickly implemented by factories. It also emphasises the importance of economic benefits of any such intervention, particularly those with short pay-back periods.

## Methodology - A Description

Pollution prevention opportunities can be identified through an industrial audit<sup>1</sup>. This

and processes, focusing on reducing waste, improving efficiency and alleviating pollution. This aims to identify and prevent losses from occurring in the first place, rather than resorting immediately to a treatment facility.

The SEAM Project has carried out audits in 32 factories in the food, textile and oil and soap sectors, which identified a wide range of low-cost pollution prevention opportunities, including water and energy conservation, the importance of good housekeeping, in-process modification and hazardous materials substitution. The SEAM Project is presently implementing 23 of these opportunities as demonstration projects.

## Benefits of Pollution Prevention

It can **REDUCE** :

- production costs;
- losses of valuable raw materials;
- on site treatment costs;
- energy and water costs;
- the volume of solid and liquid wastes generated;
- the risk of spills and accidents.

. . . and **IMPROVE** :

- overall operating efficiency;
- generation of income through reuse and recycling of wastes;
- this approach can be easily replicated in sister factories to achieve similar savings;
- safety of employees;
- legislative compliance;
- company image.

<sup>1</sup> Guidelines for Industrial Audits have been prepared by the SEAM Project.