

S

Industrial Pollution Prevention Case Study: Food Sector

Waste Reduction by Improved Quality Control and HACCP Implementation

Edfina Company for Preserved Foods, Alexandria, Egypt

E

INTRODUCTION

Waste minimisation through improved quality control procedures was implemented at Edfina Company for Preserved Foods (Edfina), Alexandria. A number of interventions costing LE65,200 have yielded annual savings of LE382,622. Quality control training and the implementation of Hazard Analysis and Critical Control Point (HACCP) system will lead to improved product quality and further savings. Although it is difficult to quantify at this stage further savings of LE550,000 could be expected in the short term.

A

THE FACTORY

Edfina is a public sector company and its factory at Montazah, Alexandria is one of the largest producer of preserved foods in Egypt. Built in 1958 on 56,000 m² the

plans, to its current level of 600 employees. Production is seasonal and is around 12,100 tons per year comprising: 4,600 tons of fruit juice and syrup; 3,900 tons of jam; 1,700 tons of canned beans and vegetables; 1,050 tons of frozen foods; 500 tons of tomato paste; and 350 tons of honey and other products.

M

Project



Improved quality control can reduce wastage of raw materials and products

Process Description

Processing of the 5 main products can be summarised as follows:

- ❖ Fruit Juices - fresh fruits are received, sorted, washed and squeezed. Pulp is heated, screened and mixed with ingredients. The mixture is heated, screened, homogenised, either bottled or canned then pasteurised. Product is incubated before final packaging and storage.
- ❖ Jam - fresh fruits are sorted, washed, peeled then cut. The fruit is then mixed with sugar, steam cooked and concentrated under vacuum. Concentrate is packed in tin cans, or jam pots, sterilised and stored.
- ❖ Frozen Vegetables - fresh vegetables are received, weighed, sorted, trimmed, peeled and cut manually. Peeled vegetables are sorted, blanched, frozen, sieved, and packed in pouches.
- ❖ Canned Beans - green beans are received, weighed, sprayed with insecticide, sieved, sorted, dip and spray washed, and soaked. This is followed by steam cooking, rapid cooling and final sorting. Cooked beans are seasoned, canned and sterilised.

- ❖ **Tomato Paste** - raw tomatoes are received from suppliers, weighed, sorted and washed. Clean sorted tomatoes are pressed for juice and screened. Seasoning is added and juice is concentrated under vacuum and heat treated. Paste is automatically canned, sterilised, sealed, cooled and stored.

Process and Service Units

There are two canning facilities, a freezing unit, two can making plants, and a varnishing and printing facility on site. Service units include a water treatment facility, boiler station, quality control laboratories, freeze-storage and refrigerators in addition to cooling towers, garages and maintenance workshops.

Energy and Water Consumption

Annual consumption is typically:

- ❖ Electricity: : 5.95 million kWh
- ❖ Fuel : 2,419 tons
- ❖ Water : 700,000 m³

Wastewater

Around 520,000 m³/year of effluent are discharged untreated into the public sewerage system. Effluent quality is: BOD - 845 ppm; COD - 1,445 ppm; TSS - 2,225 ppm; Oil and Grease - 95 ppm; and TDS - 1,275 ppm. The factory is in the process of installing a wastewater treatment plant.

CLEANER PRODUCTION OPPORTUNITIES

Cleaner production opportunities were initially identified by means of an industrial audit of the factory. An assessment was made of the different factory processes which highlighted high product losses and recalls at around 400 tons per annum. Juice losses accounted for 204 tons (4.5%); jam losses, 58 tons (15%); tomato paste losses, 57 tons (11.5%); frozen vegetables losses, 45 tons (4.5%); and cooked bean losses, 23 tons (1.5%). Issues that need addressing included:

- ❖ Quality control capabilities needed strengthening through additional employee training programmes.
- ❖ Product reject rates were high and could be reduced by better on-line production controls.
- ❖ Considerable amounts of jam pots were wasted due to faulty packaging.
- ❖ Manual packaging and poor handling of the vegetable paste resulted in unnecessary losses.
- ❖ For frozen food production, vegetables are washed and cooled manually. Product rejects arise due to improper handling and post blanching contamination.
- ❖ Insects were posing a problem to product quality particularly in jam production.
- ❖ Considerable amounts of packaging waste were generated particularly tin and reject cans (1,500 ton/year) and glass bottles (22 ton/year).
- ❖ Large amounts of steam and water were being wasted due to condensate losses, leaking valves, insufficient thermal insulation and excessive use of water (see SEAM Case
- ❖ Pollution loads in discharge effluents were above permissible limits.

CLEANER PRODUCTION APPLICATIONS

To address the above issues a series of improvement measures were identified and implemented through the SEAM Project as outlined below. Priority was given to improvements that could entail significant savings at least cost.

Involving the Employees

An in-house team was established to identify opportunities for improvements that will minimise wastage in the

by the quality control manager, and included members from other key departments. The team enhanced the communication between all levels of management and workers and facilitated co-operation between the different departments.

Quality Control Training and Awareness Raising

A training needs assessment was undertaken with management, process engineers, production supervisors and line workers in order to tailor an appropriate employee training and awareness programme. Training over 8 weeks was provided for 23 employees, mainly from the production and quality control departments, in the following areas:

- ❖ Improved quality control for food industries.
- ❖ Good manufacturing practices in food processing.
- ❖ Hazard Analysis and Critical Control Point (HACCP) Systems.
- ❖ Cleaner Production principles and waste reduction techniques.
- ❖ On-line quality control monitoring and environmental measurements.
- ❖ Computer applications to improve monitoring, data analysis and reporting.

Training manuals were disseminated and on the job training was an integral part of the programme.

Monitoring to Improve Process Control

were upgraded with partitioning, new benches and air conditioning. Additional equipment purchased to improve on-line monitoring included:

- ❖ Portable refractometers, pH meters, thermometers and colour meters that provide quick and reliable on-line analysis of product quality.
- ❖ Turbidity meters to test process water quality.
- ❖ Computer, printer and software to improve monitoring of data and reporting of results.

LE33,230 was invested in the above equipment.



Improved food quality monitoring to reduce product losses

Consideration is also being given to obtaining:

- ❖ Equipment for testing coating thickness, can seams and vacuum seals, to reduce losses caused by canning defects.
- ❖ Environmental test kit and BOD incubator to monitor effluents and final discharges.

Cleaner Production Interventions

Improve Packaging of Fruit Jam

Packaging of jam in single-use foil pots was resulting in around 15% losses due to poor cutting and seal defects. During seasonal production as many as 12,000 pots (0.36 ton) were lost daily giving rise to annual losses of 43.2 tons. Improving the design of the trimming machine has overcome the problem and led to higher quality packaging. Operational costs are marginally lower.

The new machine reduced downtime by 80% thereby increasing production capacity by 6% or 36 tons per year. Net marginal value of the increased capacity is LE16,200.

Implementation costs: LE18,000

Annual savings: LE190,056

Net margins on increased production: LE16,200

Improve Packaging of Vegetable Pastes

packed manually resulting in handling and packaging losses of 17.5 tons per year. A semi-automatic packaging system made of a dispensing assemblage and a sealing device has been introduced to eliminate these losses. As a result packaging time has been reduced by 50% thereby saving labour costs and increasing productivity.

Implementation costs: LE13,950

Annual savings: LE57,750



Semi-automatic vegetable paste packing has eliminated handling losses

Modification to Vegetable Processing

The production of frozen vegetables involved a lot of manual handling resulting in product losses and increasing the risk of contamination. To minimise manual handling during cooling of the vegetables after blanching a special sprinkler and screening system was installed. This measure has reduced product rejects by 10 tons per year. In addition, cooling water requirements were reduced by 25% (10,920m³/year) and labour requirements reduced by 30%.

Implementation costs: LE10,750

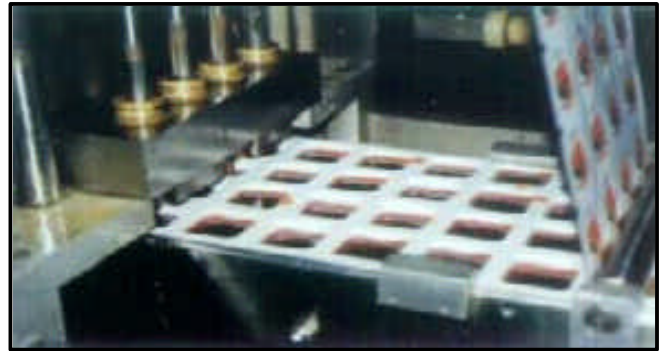
Annual savings: LE49,720.

Improve Pest Control

The current pest control program was upgraded by installing window screens and insectocuters to control flying insects. Frequent inspection and pest surveys were also initiated. These improvements were required to bring the factory into line with international hygiene specifications and have eliminated 29.3 tons per year in product losses.

Implementation costs: LE22,500

Annual savings: LE68,986



15% losses in jam packaging were eliminated by improving the trimming mechanism for foil pots

HAZARD ANALYSIS AND CRITICAL CONTROL POINT (HACCP)

HACCP was introduced for the fruit drinks bottling line. Steps for implementation were as follows:

- ❖ All necessary quality control procedures were verified for completeness and to determine if they are being implemented to required standards.
- ❖ A Hazard Analysis was conducted to identify hazards that may occur in the product cycle, from farm delivery to retail, and to assess the preventative measures for controlling them.
- ❖ Critical Control Points (CCPs) were determined to control the identified hazards. CCP signs were then posted on the factory floor.
- ❖ Critical Limits were established at each CCP.
- ❖ Appropriate monitoring system was established for each CCP to monitor its control.
- ❖ Corrective actions to be taken when monitoring indicates deviation or loss of control were established.
- ❖ Verification procedures were established to confirm that the HACCP system is working effectively.
- ❖ Documentation concerning all procedures and records were established.
- ❖ Integrating HACCP with ISO 9000 under one management system.

BENEFITS AND ACHIEVEMENTS

The main benefits of this project have been to reduce raw material wastage and product rejects through better quality control. Employee training, improved process monitoring and the preventative approach of HACCP have led to greater efficiencies and operational controls yielding benefits that are better quantified over time.

The application of HACCP will be essential in maintaining and

assured products from the United States and European buyers are already evident for the following:

- ❖ **Frozen vegetables**, for which Edfina have exported 2,000 tons to Europe and the United States, valued at LE7.6 million.
- ❖ **Fruit drinks**, for which Edfina presently exports 25 tons per year valued at LE73,000.

HACCP that was implemented for bottled fruit drink production is being replicated by the factory in other production lines.

Environmental improvements have included a reduction in water consumption, pollution loads and volume of effluent discharges.

ECONOMICS

A summary of the cost benefits that have been quantified for the four interventions is given below.

Intervention	Costs LE	Annual Savings	Payback Months
Improve packaging of fruit jam	18,000	206,256	1
Improve packaging of vegetable paste	13,950	57,750	<3
Modifications to vegetable processing	10,750	49,720	<3
Improve pest control	22,500	68,896	<4
TOTAL	65,200	382,622	2

In addition to the above costs LE33,230 was spent on on-line monitoring equipment and a further LE40,000 was spent on quality control training and HACCP implementation. Although the direct benefits of improved quality control practices are difficult to quantify it is expected that in the short term at least a further 2% of wasted raw materials and products will be recovered yielding savings in excess of LE550,000.

CONTACTS

More information on this project and the SEAM Project, are available from:

- ❖ **Edfina Company for Preserved Food**
Quality Control Department
Ras El-Souda, Alexandria, Egypt
Tel.: (20) 3 534 5446 Fax: (20) 3 534 9017
- ❖ **Egyptian Environmental Affairs Agency (EEAA),**
Technical Co-operation Office for the Environment (TCOE)
30 Misr Helwan Agricultural Road
5th floor, Maadi, Cairo, Egypt
Tel.: (20) 2 525 6452 Fax: (20) 2 525 6457
E-mail: EEAA2@idsc.gov.eg
- ❖ **SEAM Project/Entec UK Ltd.**
30 Misr Helwan Agricultural Road
4th floor, Maadi, Cairo, Egypt
Tel.: (20) 2 525 6452 Fax: (20) 2 349 9795
E-mail: entecegy@eis.com.eg

July 1999

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 audit¹. 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.

¹ Guidelines for Industrial Audits have been prepared by the SEAM Project.