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Industrial Pollution Prevention

Case Study: Oil & Soap Sector

Oil and Fats Recovery at Tanta Oil and Soap Company, Tanta, Egypt

INTRODUCTION

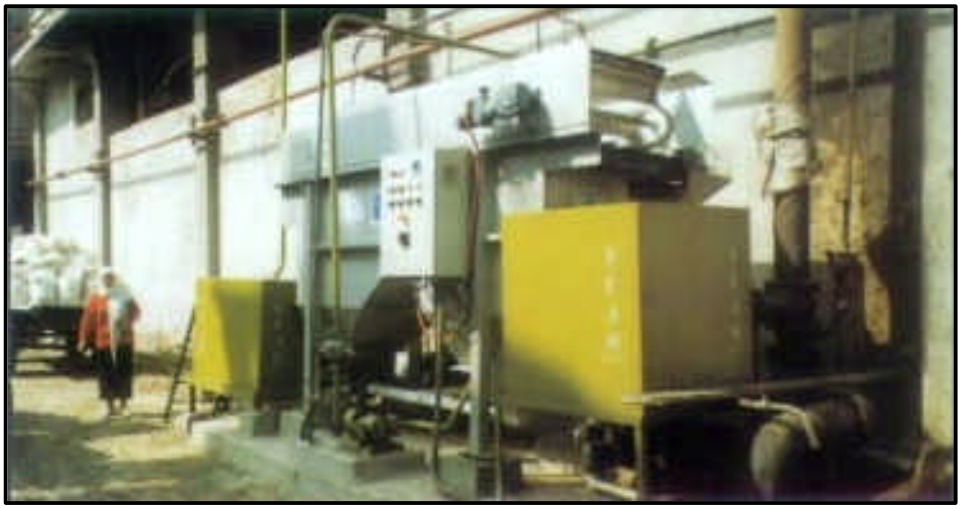
A range of waste minimisation opportunities has been identified and are currently being implemented by Tanta Oil and Soap Company in Tanta, Egypt. To date, this has involved a total investment of LE621,247 resulting in annual savings of LE637,020 and a saving in capital investment of the wastewater treatment plant of LE500,000.

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

THE FACTORY

This factory is located in Tanta city, covering an area of 35 feddans (147,000 m^2) and is one of three that are owned by Tanta Oil and Soap Company. The plant was established in 1934.

Tanta factory produces an average of 18,000 ton/year of edible oil extracted from cottonseeds, sunflower seeds and soy bean, 12,000 ton/year of ghee using palm and other oil seeds. The factory also produces 9,000 ton/year of glycerine and 48,000 ton/year of animal fodder.



Gravity Oil Separator in the Fatty Acids Unit

PROCESS DESCRIPTION

Production processes in the factory are described in the following:

Seed Receipt and Preparation. Following receipt, the seeds are sent for mechanical preparation. This consists of mechanical screening and magnetic separation to remove any impurities which may be present, followed by crushing, flaking, and cooking.

Oil Extraction. The prepared seeds are mixed with hexane in a continuous counter current system, to produce a hexane-oil mixture (miscella) and seed cake. The seed cake is separated from the miscella, dried, cooled, pressed and used in producing animal feed. The hexane is recovered from the miscella under vacuum (using direct and indirect steam) and reused in the system. The remaining crude oil is then cooled and sent for refining.

Oil Refining and Packaging. Crude oil and ghee is processed using the following steps:

- Degumming (for sunflower seeds or soybean) and neutralisation - gums are removed in a batch process, using phosphoric acid. Neutralisation is done by adding caustic soda to remove free fatty acids from crude oil to produce semi-refined oil.
- Bleaching - colour is removed from the oil using Fullers Earth followed by filtration.
- Deodorisation - unpleasant odours and tastes are removed from the oil by high temperature vacuum distillation.
- Packaging - the refined, bleached, and deodorised (RBD) oil is bottled in automatic filling lines.

Soap and Glycerine Production. Fats are saponified in a batch process, by mixing with caustic soda and heating with direct and indirect steam. After saponification, soap is separated from the lye solution to be dried, blended with additives, homogenised, cut, and packed. Glycerine is separated from the lye solution and distilled.

Service Units

Service units include boilers, cooling towers, pumping stations, power transformer, stand-by diesel power generators and storage and maintenance facilities.

Energy Consumption

The two main sources of energy are mazout and electricity:

- Mazout and solar are used in the boilers to generate steam. Average annual consumption is 15,000 tons of mazout and 600 tons of solar.
- Annual electricity consumption is around 10.5 million kWh.

Water Consumption

The factory consumes an average of 16,800 m^3/day of water of which 1,800 m^3/day is process water, and 15,000 m^3/day cooling and vacuum water. This water is taken entirely from ground water boreholes within factory premises. Approximately 35m^3 of drinking water is taken from the public network each day.

Wastewater Generation

The factory generates about 16,000 m^3/day of industrial wastewater from different factory streams, including process effluents, boiler blow down, cooling water, vacuum water, and steam condensate. The wastewater is discharged to Akhnaway drain near the factory.

POLLUTION PREVENTION OPPORTUNITIES

Pollution prevention opportunities were initially identified through an industrial audit of the factory, carried out by the SEAM Project. The following improvement opportunities were identified as being of particular importance:

1. Upgrade loading and unloading procedures for oil, ghee and fats to minimise spillage.
2. Improve housekeeping in the Fatty Acids Splitting Unit.
3. Oil recovery from processing units effluents, especially oil refining and packaging units.
4. Improve handling of animal fodder ingredients to prevent losses.
5. Water consumption control, by installing water meters for monitoring water consumption at various units, and installation of self closing taps to reduce water consumption in service units.
6. Segregation of cooling water and process water and usage of cooling tower to recycle cooling water.
7. Reduce oil losses in spent bleaching earth, by upgrading bleaching filters.

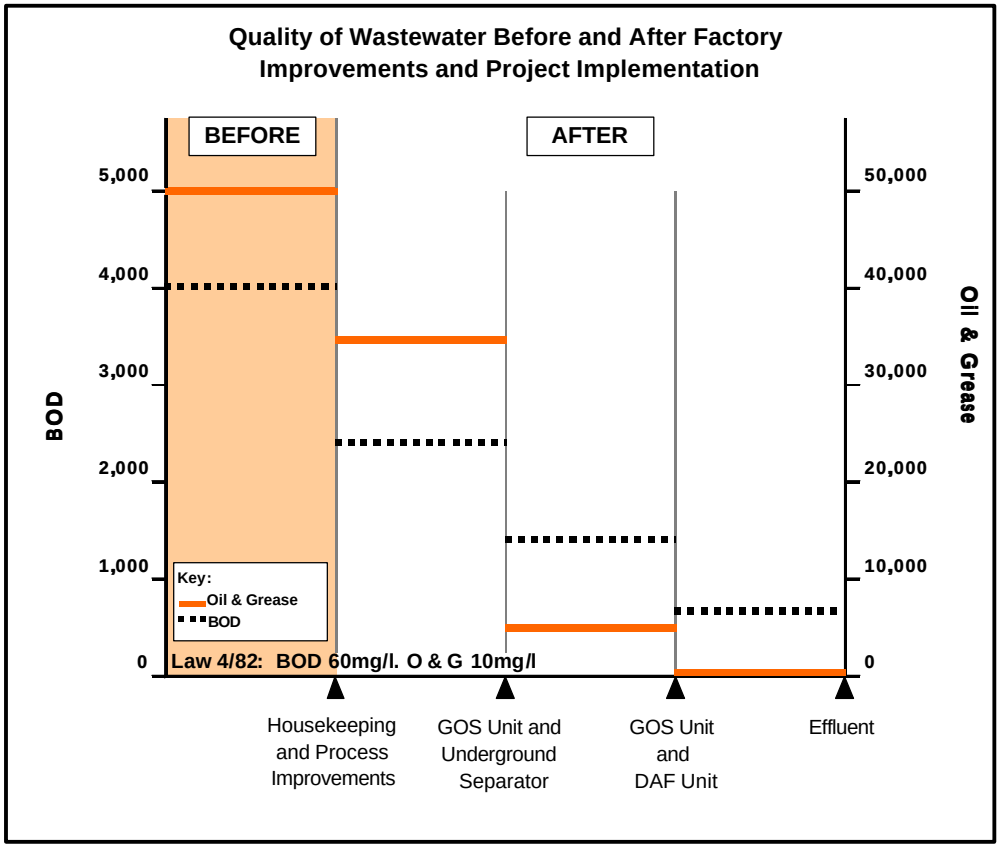
CLEANER PRODUCTION APPLICATIONS

Implementation of the identified opportunities are briefly outlined as follows:

Preventive Maintenance and Housekeeping

Upgrade Loading and Unloading Procedures

During the loading and unloading of oil, ghee and fatty matter from batch reactors and separators, significant levels of leakage and spillages were occurring. These losses were entirely eliminated as a



result of issuing improved procedural instructions and by improving the supervision of transfer operations.

Implementation cost: nil
Annual savings: LE206,280

Product Recovery

Recovery of Oil, Ghee and Fatty Matter

Large volumes of oil and ghee are now being recovered by the installation of 3 Gravity Oil Separators (GOS) manufactured by the factory. The GOS are installed on the oil washing line, immediately after the water is discharged from the batch reactors of oil and ghee refining. Recovered oil and ghee was discharged and lost to the refinery effluent before the installation of the GOS.

Fatty matter is recovered from 2 sources: the mucilage produced during neutralisation and fatty matter from refinery effluents in oil separators. The existing underground separators were found to be inefficient and were replaced with 3 new units. These units were installed to process effluents from the continuous refining unit, the fatty acids splitting unit and the effluent from the deodorisation unit

Implementation cost: LE273,647
Annual savings: LE203,220

Summary of Oils Recovered by the GOS Units

Type of oil	Oil losses before improvements (% of raw oil)	Oil losses after improvements (% of raw oil)	Average oil consumption (ton/month)	Annual savings (LE)
Crude cotton	11.98	11.20	530	88,220
Other oils	2.09	1.86	2,300	115,000
Total	**---**	**---**	**2,830**	**203,220**

Recovery of Fodder Ingredients

The animal fodder production unit was generating heavy dust emissions, caused during the loading and unloading of the raw materials. These emissions were stopped and the ingredients recovered by installing a cyclone vacuum system, which collects the suspended matter and transfers it directly to the raw material intake system.

Implementation cost: LE127,600
Annual savings: LE107,520

Water Conservation

Huge volumes of water were being wasted, as cooling water was not being reused in a closed circuit system.

This was addressed by segregating the cooling water, vacuum water, and process waters from one another, in parallel with rehabilitating two existing cooling towers.

Rehabilitation work consisted of the installation of new pipe lines, filling materials, valves, and connections. Some civil work was also required.

Implementation cost: LE220,000
Annual savings: LE120,000

Wastewater Treatment

Recovery of oil and fatty matter originally lost to the effluent, has significantly reduced the organic load of the final effluent. This has reduced the investment required for the end-of-pipe industrial wastewater treatment plant (IWWTP) by around LE500,000.

A dissolved air floatation (DAF) unit has been installed to reduce oil content of the effluent, and prepare it for a consequent biological treatment that is to be installed to ensure that the final effluent is in legislative compliance. LE259,926 was expended on the DAF unit and at the time of writing a further LE432,530 had been spent by the factory on civil works for the new biological treatment plant.

ECONOMICS

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

- Reduced raw materials consumption.
- Waste minimisation.
- Reuse or recycling of in-plant materials.
- Reduced capacity of the IWWTP.

Implementing these measures will also reduce environmental pollution and permit adherence to discharge consent limits.

The total capital and operation costs invested in the cleaner production measures at Tanta Oil and Soap factory amounts to LE621,247. This has produced total savings of around LE637,020 with an average payback period of around 1 year.

BENEFITS AND ACHIEVEMENTS

- Water consumption has been reduced by 23%.
- IWWTP capital investment costs have been reduced by about LE500,000.
- Annual recovery of oil, ghee, fats and animal feed totalling LE517,020.
- Working conditions improved in the animal feed and fatty acids production unit.
- Oil and grease concentrations in the final effluent reduced by 99%.
- BOD loads in the final effluent reduced by 85%.

Cost Benefit Summary of Implemented Improvement Measures

Factory unit	Action	Capital cost (LE)	Annual savings (LE)	Payback period (years)
All	Better process control and minimisation of wasted fats	---	206,280	Immediate
Refinery and fatty acids	Recovery of oil, ghee and fatty matter from wastewater	273,647	203,220	1.3
Fodder plant	Recovery of fodder ingredients	127,600	107,520	1.2
All	Segregation and recycling of cooling water	220,000	120,000	1.8
	TOTAL	**621,247**	**637,020**	**1**
Capital Investment savings achieved through pollution load reduction		0	500,000	---

Dissolved Air Flotation Unit installed in Tanta Factory

Ghee recovered from the Gravity Oil Separator

CONTACTS

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

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The SEAM Project

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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[1]. This systematically reviews the factorys operations 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.