Cleaner Production New Opportunities For Food Industry

In Egypt

Prof. Dr. Nabih Abdel Hamid Ibrahim

Farmer Dir. Of Food Tech. Res. Institute A.R.C.

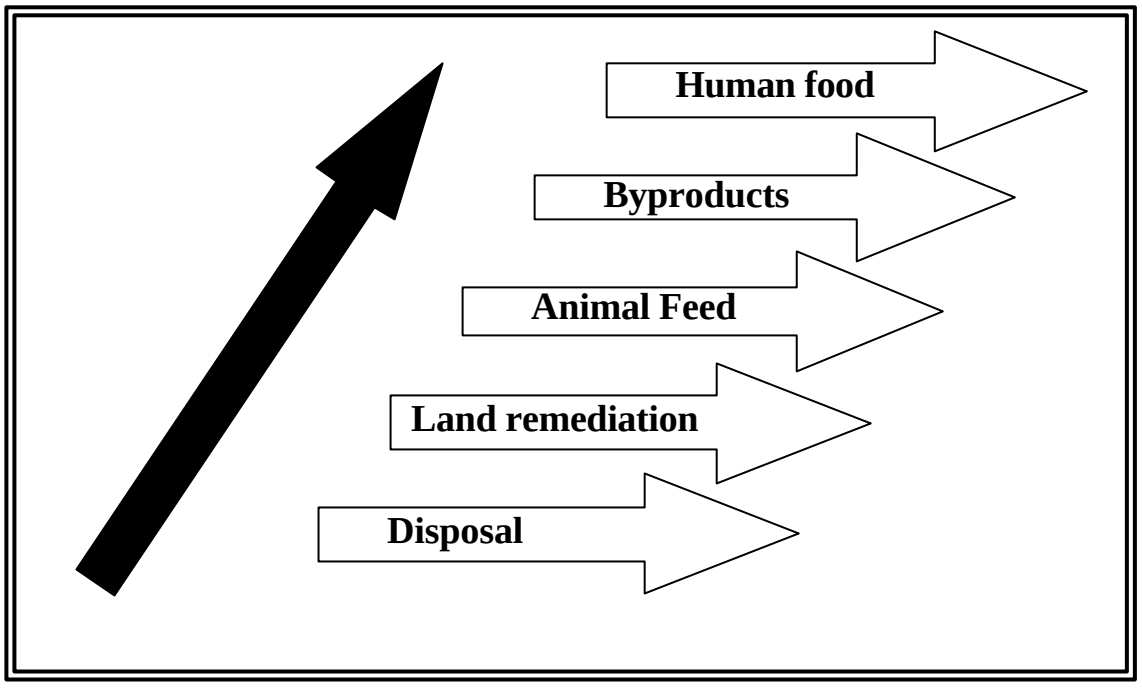
Co-ordinator of Food Safety Project in Egypt

Introduction

Food processing companies operate in competitive environments ranging from high value-added niches to the larger market for low margin/low value-added products.

Also, there are many opportunities for residuals recovery from the sector, for example as animal feed. The practicality of implementing these options will be governed by economics of scale, availability of appropriate technical skills, availability of capital and a range of other factors. However waste recovery should always be considered.

Figure



Shober (1988) points out that the hierarchy of value is important for the food processing company – as much of the incoming product should be transferred to human food rather than to other products.

The techniques of identifying Cleaner Production options, both within the food processing sector and within industry as a whole are broadly similar. These generic strategies may be applied over a range of situations and comprise: process modifications, product modification, good housekeeping, raw material substitution and selection and on site recycling. Within these general groups, interventions that will be common throughout the sector

include water reuse and recycling, potential for energy saving, potential for hazardous chemical replacements and potential for source reduction.

Strategic position

The business environment in which the company operates needs to be defined when trying to bring in and consider environmental issues – company profitability, product margins, market stability, barriers to entry etc. This includes carrying out a full analysis of the products, the market share, plans for growth, type of management, company structure, the reporting structure and as much supporting information as is available. However, such detailed information is unlikely to be available for a Cleaner Production assessment, but such information provides a picture of the business environment in which decisions are made.

There is a need to find out if environment is an issue in company management, if there is someone responsible for pollution and emission and the level of environmental skill, awareness and knowledge in the firm. The general business risks and liabilities associated with environmental issues are often overlooked.

The Need for Information

Does the company perceive a need for information and does it actively solicit data for environmental concerns? This can be understood by determining whether or not the company has environmental data already and if it collects information on environmental issues.

Other questions that need to be answered include:

- Does the company appreciate how its production processes in general and specifically interact with the environment and create residuals?
- Does the company need information to upgrade or to improve the efficiency of its wastewater treatment system, for example?
- Does it have access to adequate information on technologies and processes which have an environmental consequence?
- Finally, does it care about this information or does it need to care?

These questions will reveal how important Cleaner Production may or may not be to the firm and how low the starting point for change may be.

Process Considerations

The following points need to be considered:

- Does the company have flow diagrams, Piping and Instrumentation (PID) diagrams etc. available and are they adequate and up to date?
- Are there maintenance schedules, input/output schedules, monitoring and measurement?
- What is the present quality regime carried out for risk management or is Hazard Analysis and Critical Control Point (HACCP) system in place, or is there any certification to any standard or code of practices, for example ISO9000 series?

- What is the ability to carry out measurements of process parameters and interpret them? For example is there a process laboratory and what kind of test are required, what instruments are available and how are records kept?
- Is process instrumentation functional and maintained? Often suppliers provide appropriate instrumentation, for example temperature measurement and recording and with time it breaks down and is forgotten about.
- Is there a materials flow diagram showing movement of materials, inventory available and are good records of materials maintained? Many modern companies are making huge environmental and cost saving from advanced process control systems which have become quite affordable.

These are just some of the type of site specific questions which must be addressed in considering a Cleaner Production programme. Answers to these questions give some idea of the environmental status of participating firms and indicate the amount of effort which will have to be put into a full Cleaner Production programme. It must be said that having an adequate supply of this type of information is rare and it is expected that there will be a need to gather information in any Cleaner Production programme. However a rapid appreciation can be gained of the environmental and efficiency status of the company from such data.

Capacity Building and Organizational change

Organizational change, which is required for effective Cleaner Production needing the following steps:

COMMUNICATION to let employees know what the process is about.
ORIENTATION to put changes in context.
INDUCTION to train employees and get them involved.
MORALE building to work on improving participation.
SATISFICATION with the workplace and management activities.

All leading to:
ORGANIZATIONAL CHANGE which will integrate Cleaner Production.

Treatment Technologies

There are a large number of treatment technology options available for different subsectors and for different needs. For Cleaner Production to be successful it need to assess what is being used at the moment and take into account the geographic location, the site aspects, the energy inputs as well as alternatives to site treatment such as sewer disposal and future trends which may need consideration.

Wastewater treatment in the food processing industry can range from no treatment at all through screening and sedimentation to quite complex on- site biological systems which may be in package plants, home-made plants or ponds and lagoons. Each technology has its preferred treatment stream and

waste treatment information is generally readily available and treatment is not counted as a Cleaner Production option, it should be included as a pollution prevention issue for this sector, once all practical waste minimization options have been adopted. This will ensure that wastewater volume and load are minimized, so that capital maintenance and operation costs of a treatment plant are kept to a minimum. Any treatment plant can be considered during a full Cleaner Production assessment and the efficiency, reliability and costs of treatment, for example, can be assessed, and environmental improvements can be made.

Similarly there are many solid wastes which are often amenable to product recovery or reuse and recycle. There are often opportunities for by-product recovery where economics change regularly and should be reconsidered from time to time, eg. Flavor recovery.

Wastes and BOD.

There is still the perception, both within and outside the food processing industry, that food processing industry wastes are harmless to the environment. This misconception has arisen due to the wastes being essentially natural in origin (e.g. fruit skins, whey, etc.) rather than manufactured. This may be true if the wastes are appropriately treated before release to the environment or are appropriately disposed of, however this is often not the case.

However most wastes can be readily reused by simple biological systems or minimized by waste reduction measure. Thus the scope for intervention by the use of Cleaner Production, appropriate technology inputs or educational and economic inputs is high. Cost, capital availability and economics is the deciding factor in such technology uptake.

Wastes from the food processing industry are to a certain extent an inevitable part of the business. When these wastes, which are fairly wet and high in carbon, are left untreated, they become a breeding ground for micro-organisms, which are everywhere in the environment. As these proliferate, so the material starts to decay and smell. Harmful micro-organisms (pathogens) may also grow in the material. Wastes can also give a dirty, untidy appearance to a factory.

BOD (Biological Oxygen Demand) is an indicator of pollution load. It refers directly to the uptake of oxygen by any carbon (and some nitrogen) entering a water stream. It represents a direct measure of the pollution potential of a waste stream and is measured in mg/l (milligrams of oxygen per Liter of Solution). BOD is measured in laboratories by working out how much oxygen a water sample uses up over a five day period at a certain temperature.

Clean water in a stream may have a BOD of 15-20 mg/l; an average factory effluent has a BOD of 2-3000 mg/l and milk a BOD of > 100,000mg/l. Most living things need oxygen for survival so anything that removes or depletes oxygen in water means that fewer organisms can survive there. Fish and higher organisms for example, need quite high dissolved oxygen levels to survive.

Cleaner production options in food processing-An Overview of opportunities

The Egyptian food processing industries seem to carry significant environmental risks in that:

- They produce large quantities of wastes.
- The wastes become putrid and objectionable very quickly
- The wastes find their way into watersourses.
- The wastes are often not treated.
- The quantity of wastes is unknown and uncontrolled
- The wastes constitute a potential resource in some cases.
- The wastes can constitute a health hazard.
- The waste of energy reduces the viability of a company's operation.
- The waste of water represents a major resource issue to Egypt.

Therefore, in the food processing sector there are numerous options for intervention. The practicality of these options will depend on the business cycle, the business situation of the firm and numerous other factors. Generally these options will fall into a few categories:

- Good Housekeeping
- Energy Savings.
- Water Conservation, Reuse and Recycle
- Raw Materials and Input Changes.
- Chemical Substitution
- On site Recycle and Reuse
- Product Redesign
- Worker Training Programmes.

Good Housekeeping

There are many opportunities for good housekeeping options in almost all food processing operation. Every site and every operation is different, but some options are given below for the fruit\vegetable sectors. These option are easy to implement, require little capital and can be seen to make sense. As well as this they sometimes save considerable sums of money and improve staff morale.

Some example include:

- Install drip trays to stop food hitting the ground
- Prevent leaks and repair them.
- Store dry materials appropriately.
- Prevent vermin ingress.
- Minimise clean out waste by increasing batch size.
- Improve inventory management.
- Avoid shut-down losses.
- Avoid combining different waste streams.

Energy Savings

There are many options for energy saving in most food productions plants which range from stopping simple energy losses and leaks through to

complex computer control operation. Often a specialist is required to examine the energy balance of the site and to bring a novel perspective to the task. Energy, like water, is often taken for granted in production operations and not fully coasted into the products.

In Egypt, site visits demonstrated that energy wastage was significant – there was a large problem in controlling steam leaks, lack of condensate recovery, lack of boiler maintenance and there was significant energy losses from lines and tanks etc. However this is not unique to Egypt, but the scale of the energy inefficiencies may be greater, in other developing countries.

Water Conservation, Reuse and Recycle

The option for water reuse and recycle in a food plant are divers. However success will depend very heavily on the costs of purchasing raw water and treating wastewater, as well as the desire of the plant to become more environmentally efficient. This depended of course on water and wastewater costs as drivers for change and environmental improvement.
Today there is a world–wide shift toward encouraging in-plant water conservation, recycle and reuse.

Raw Materials and Input Changes

This is an area where substantial environmental and pollution benefits can be gained by choosing a more environmentally suitable feedstock. However, there can be substantial difficulty in changing raw materials as real choice is often outside the ability of the company to manage. This type of change involves long term strategic decisions, which may impact directly on the profitability of the firm. Huge successes have been gained in both environmental improvement and profitability improvement from the more effective management of the supply chain in general and inputs in particular.

Chemical Substitution

There is no straightforward methodology which can be used for identifying chemical substitution opportunities in a food processing factory. Sometimes there are obvious places where a simple substitution can be made (such as sulphuric caustic sada and freon), otherwise considerable research may be necessary to identify likely candidates. Obviously dangerous chemicals such as some sanitisers are priority listed, but there may be many others which go unnoticed without an environmental scan. Therefore it is recommended that a full Cleaner Production or Toxic use Reduction type assessment be carried out, with management `input, to investigate the ability of any company to reduce its environmental risks by this method.

On site Recycle and Reuse

There are many possibilities for this strategy in a food processing from development of new products to different qualities of products. Most companies are aware of many possibilities in the recycle area and attempt to recover as much of their reject, spoilt materials and other materials.

Off-site reuse/recycle is an obvious environmental benefit and it may bring about significant environmental and commercial improvements. The use of whey as an animal feed for example, may be viewed in this way.

Product Redesign

In the food processing industry, there is little written material on product modification for enhanced environmental management, however some customer preferences can be harnessed. For Example brown sugar may be considered environmentally preferable to white, similarly white vs. brown rice and wholemeal vs. white bread. Controlled atmosphere packaging is resulting in the ability to manage shelf life and repackage products and reposition them in the marketplace, as is cold chain management.

Better knowledge of how to sanitize, pasteurize and sterilize has caused big improvements in product shelf life and reduced spoilage, waste and improved customer safety. Thus there is scope for this kind of intervention in Cleaner Production programs resulting in better products and better profitability.

Worker Training Programmes

As an essential part of any Cleaner Production programme, at any level, for any firm, a worker training and awareness programme is essential. Although management commitment is equally essential, without staff involvement and their sense of need, then the gains made by Cleaner Production will be minimized. Without worker training, involvement, and a sense of ownership, the Cleaner Production programme will be relatively unsuccessful in the longer term.

There are many different types of worker training programme which depend heavily on the needs of the organization, its size and management structure. Where Cleaner Production awareness does not exist or is relatively low, a programme which introduces the general concepts would be most appropriate. Any such training should also assist factories to identify individuals and build up teams who would take the concept forward. Thus Cleaner Production can be used as a management tool for change as well as involving the workforce.

Fish Processing as Case Study

Upstream

Although most factories have no direct influence on how fish are either caught or grown, they may be exert some influence by not purchasing from wasteful producer. Wastage can be minimized “at source” by:

- Targeting appropriate spices.
- Using spices specific catch methods.
- Finding a use for by-catch.
- Harvesting appropriate sizes.
- Segregating catches.

- Controlling chemical and antibiotic use in marine farming operations – reduce when possible.
- Controlling farm-feeding operations and seek improvements.

Process Waste Reduction Measures

To reduce the amount of wastage generated during processing, the following actions could be taken:

- Recycle cooling water from autoclaves – for an initial investment of around LE8.000, annual saving in water and energy of LE12.000 were calculated, giving a payback period of 8 months.
- Installation of pressure regulators on steam lines. In one factory, for an initial investment of LE7.500, it was calculated that annual saving of LE36.000 could be made, giving a payback period of 3 months.

Other options which could be investigated include:

- Install water recovery/water reduction options.
- High pressure low sprays.
- Air thawing.
- Air chilling.
- Vacuum cleanup.
- Dry cleaning.
- Good clean process areas.
- Use mechanical conveying.
- Modern hygienic equipment for defleshing, etc.

Product Recovery

Two such opportunities which were identified during auditing included:

- Recovery of fish oil. Large volume of fish oil escaping to the effluent steam represents a loss of a valuable product as well as unnecessarily increasing the organic load of the wastewater. In one factory, it was estimated that for an initial investment of LE4.000, annual revenue could total LE200.000, giving a payback period of less than 1 month.
- Recycling of fish oil sludge. Rather than being disposed as a solid waste, this can be used as an animal feed. For an initial investment of LE5.000, an annual revenue of LE3.600 could be generated.

Other options which could be investigated include:

- Chitin and Chitosan recovery. For many years there has been continual interest in recovering these shellfish structural materials for use in products as diverse as immobilizing enzymes to ion exchange. Research is underway in many laboratories to find cost-effective and economical applications for these products, however there is still reluctance to invest in large recovery plants without knowledge of secure markets.
- Recovery of fishmeal. Most large seafood plants would have a drying plant for fishmeal recovery for feed or for fertilizer. There are also numerous derivatives of fermented or otherwise stabilized products for fertilizer application. Drying technologies are well known and the major

problems associated with the plants are adour production and control and fines recovery from what can be a difficult product. In some countries fish are caught principally for fishmeal production. Fish oils too comprise a valuable resource which are usually effectively recovered.

Hydrolysates and Sauces

Many countries have their specific native fermented fish sauces. These are methods of invoking the enzymes present in the seafood or encouraging consortia of micro-organisms to grow and break down the protein and tissues to produce a savoury brew which can be used as a sauce. Technology options are mostly concerned with controlling the organisms present, controlling the salt levels and preventing pathogenic organisms from growing. These hydrolysates can be very useful as they add palatability to food and to animal feed, they can increase digestibility and can add significant levels of nutrients. They are generally liquid and thus can be easily sprayed on to food in low, controlled doses.

Future Trends

Actions which are being adopted internationally include:

- HACCP for risk reduction.
- Improved retort management.
- Improved workplace management.
- Decreased by-catch production.
- Recycling and reusing water on site.
- Fish juice recovery.
- Mechanized flesh recovery.
- Flavour recovery from washwaters.