Food processing and manufacturing – Environmental impact

This paper is meant as an introduction to the environmental impact of food processing and manufacturing. It describes the most common environmental impacts in relation to food processing, what part of the process or function they are related to, their source and the alternatives available.

Furthermore an introduction to environmental management and environmental impact in the overall food supply chain (life cycle analysis) is also given.

The paper is a generic document for the food processing industry but will in many places refer to processes and impact in relation to the milk processing industry.

Energy

Electricity is used for cooling of products, running of production equipment and general refrigeration purposes, including cooling or pumping of material.
Dairy processing equipment such as separators, bactofuges, homogenizers and membrane filtration plants are heavy energy users.

Traditionally electricity has been produced on combustion plants (burning coal or waste) – now it may also come from hydropower, solar or wind energy.

Heat and steam is used for heat treatment and drying of products (incl. pasteurisation, UHT and evaporation) as well as cleaning purposes where hot water is used. In many areas heat can be re-generated e.g. from condensate recovery.

Energy for heat manufacturing has come from oil (heavy or light fuel oil) or natural gas. Recently Solar Thermal Energy, wind energy and Biogas have been introduced as alternative energy sources.
In regions where hydropower is widely used, electricity may be used for generation for steam.

Water

Water is used for many purposes; as an ingredient, cooling/heating medium or for cleaning purposes.

Where water is in direct or indirect contact with the food product it must be of drinking water quality. Water used for cleaning of food contract surfaces must therefore be of adequate quality.

Water can also be used for technical purposes and must then meet other requirements such as hardness and conductivity.

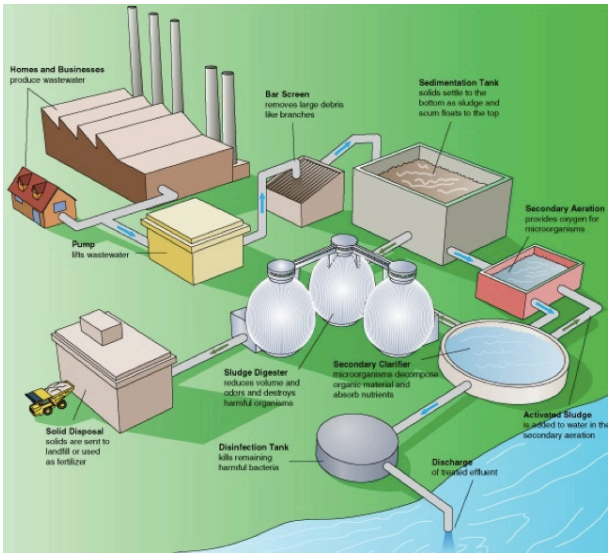
Depending on the production and set-up up to 90% of water at a food processing plant is used for cleaning.

Water may come from many sources such as borehole water, surface water /reservoirs or de-salination of seawater and often undergoes different types of treatment before being distributed as mains water.

Water can be reclaimed from many processes and re-used or recycled following one or more treatment steps, such as membrane filtration, heat treatment, UV and/or ozone treatment. Ethical as well as economical and environmental considerations should be given before choosing the relevant treatment.

Wastewater

Wastewater from food manufacturing plants consists of used water, product waste and chemicals. Cleaning cycles and discharge of cleaning water has a significant impact of pH levels and temperature of the wastewater, therefore it is often fed to a balancing tank before being discharged.



When raw materials and product waste goes down the drain it is monitored and reported as COD (Chemical Oxygen Demand). E.g. 4.2kg of raw milk is equivalent to 1kg of COD.

After balancing of pH and temperature wastewater can be sent directly for further treatment at a wastewater plant or it may undergo pre-treatment or full treatment on site. A wastewater permit or agreement will in all situations be required and will hold limits on flow, contamination level, pH, temperature and other relevant parameters.

To reduce the total volume of wastewater and COD it is recommended that product interfaces and pre-flush are collected and reclaimed. Cleaning liquids from CIP systems can also be reclaimed and re-used.

Sludge from balancing tank and wastewater treatment may be sent for biogas production.

Chemicals

Chemicals are used for cleaning purposes, maintenance, analyses and as ingredients/production aids.

When chemicals are in direct or indirect contact with food product they must be approved for such use by national authorities, e.g. chemicals used for boiler water.

For ***cleaning chemicals*** considerations must be given to how the chemicals may impact the process equipment and waste water as they may add to wear and tear of some materials and also impact the pH level or e.g. phosphoric level of the waste water (or sludge of waste water plant).

Where chemicals are used for ***maintenance*** special attention must be given to those, which may come into contact with food, these must be of food contact quality. Furthermore it is also important that oils/fats used for maintenance do not hold any allergens, e.g. peanut oil.

Used chemicals and leftovers from maintenance or laboratory may be classified as hazardous waste and must be stored and disposed of according to local requirements.

Waste

Waste from a food-manufacturing site can be classified into many categories such as solid waste, liquid waste, wastewater or hazardous waste.

However it is important to remember that most of these waste streams – when correctly segregated – can be reused or recycled, therefore a classification as: re-use, recycle, recovery to energy, landfill or deposit may be used.

Secondary packaging may be re-used or recycled. Water and product waste may also be re-used or recycled, alternatively sent for energy recovery e.g. biogas plants. Non-contaminated primary packaging may be recycled, contaminated packaging can be sent for energy recovery.

Chemical waste from maintenance and laboratory may together with certain types of electronic waste be sent for deposit – but may also be recycled or recovered depending on waste infrastructure and local legislation.

A zero landfill target should be available for all food manufacturing plants depending on the national infrastructure for waste handling.

Packaging

Safe and convenient packaging is needed for storage and distribution of foods and must protect the product throughout its shelf life. Increased complexity of the packaging (incl. printing and labelling) will often result in higher packaging waste due to more changeovers and thereby also increased risk of operational failures.

Packaging based on biodegradable materials can be considered when product characteristics and storage requirements allow this.

Noise

Noise from the manufacturing plant is often related to utilities located outside the factory environment or ventilation outlets.

In addition to this transport to and from the site may often be a source for noise pollution and special attendance should be given to transport during night where limits on noise levels may be down to 30dB(A) depending on whether the site is located in an industrial or residential area.

Land contamination

Land contamination is a result of storage of hazardous substances on non-impervious surfaces. Land or soil contamination is often related to oil storage facilities (for boiler or vehicles). Historical storage of electronic equipment, light tubes and chemicals may also have resulted in land contamination.

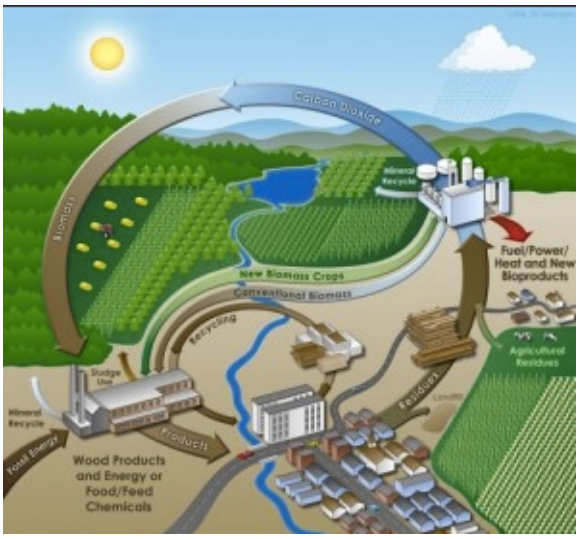
Depending on the nature of the site incl. e.g. water causes, the contaminated soil may have to be removed. Local authorities must always be informed if there is a risk of land contamination.

Odour

Where a maturation process is part of the food-processing odour may become a problem depending on the ventilation system. Furthermore opening of gates to maturation storage areas may also release odour to the external environment.

More often odour problems are related to storage and handling of waster or waste water treatment. Additional cleaning, changes in processes and installation of filters may reduce the problem.

Environmental management and requirements



Environmental management is about understanding and controlling the environmental impact of both product and production.

Specially for food manufacturing the environmental impact is closely related to processes required to secure quality and food safety, such as heat treatment, cleaning and chilled storage, it is therefore recommended that quality, food safety and environment is integrated in the same management system to avoid conflicting requirements.

The ISO14001 standard can be used to manage and secure continual improvement the environmental impact of a manufacturing site.

The essential of an environmental management system is first of all to identify the environmental impact of production and product, then identify legal and other requirements as well as agreeing on a policy, objectives and set targets for the facility.

Well established risk assessment tools from food safety and HACCP risk assessments can easily be adapted and used for environmental risk assessment, and similar to an PRP, OPRP and CCP plan for food safety the same methodology can be used for management and control of environmental impact.

Next step is to plan the production to ensure minimal environmental impact. Production planning and cleaning programs are areas in which carefully planning and implementation can have a significant impact on the environment.
The performance of activities must then be followed up and evaluated before modifications are made to secure continually improvements.

The most common legal requirements of food manufacturing sites are related to;

- Water abstraction license (e.g. limits on waster usage as m3/year, m3/day or l/s),
- Environmental permit (e.g. noise, CO2 emission, storage of chemicals and emergency planning),
- Wastewater discharge consent (e.g. volumes, pH, components)

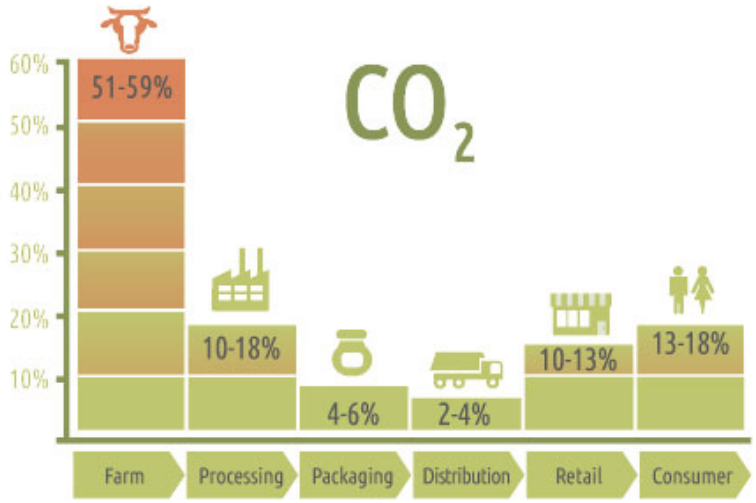
These requirements are related to the facility and based on best available technology (BAT), environmental sensitivity of the location and the area around and resource management.

The need for an environmental permit is related to the size and nature of the facility and based on thresholds in national legislation. The requirements of the different licence and permits will differ from sites located in an industrial zone to sites located close to a nature habitat.

Please notice that the next Best Available Techniques Reference Document (BREFs) for the Food, Drink and Milk Industries will be published in 2017. European manufacturing sites captured under the Industrial Emissions Directive the BAT requirements must be implemented within 4 years from publishing of the requirements.

Environmental impact and Life Cycle Assessment

The above-mentioned areas in which the environmental impacts are describer are directly related to processing and manufacturing of food. But to obtain the true understanding of the overall environmental impact of a given food, e.g. a litre of fresh milk, one needs to understand the impact of the entire supply chain, from farm to fork.



Source: WWF Study, http://tgh.co.za/our-work/case-studies/

The picture above shows that the majority of the environmental impact comes from the farm, related to feed production and feeding of the cow, and less than 20% from milk processing.

The environmental impact from the consumer relates to transport to and from the shop as well as disposal of product and packaging.

In this context the best way to reduce the environmental impact of one litre of milk is therefore to minimize product wastage in the entire supply chain and secure that the final product is of such quality that it can be enjoyed to the last drop by the consumer.

We thereby ensure that the effort and impact from the farm is conserved and not wasted in neither the supply chain, or at the consumer.