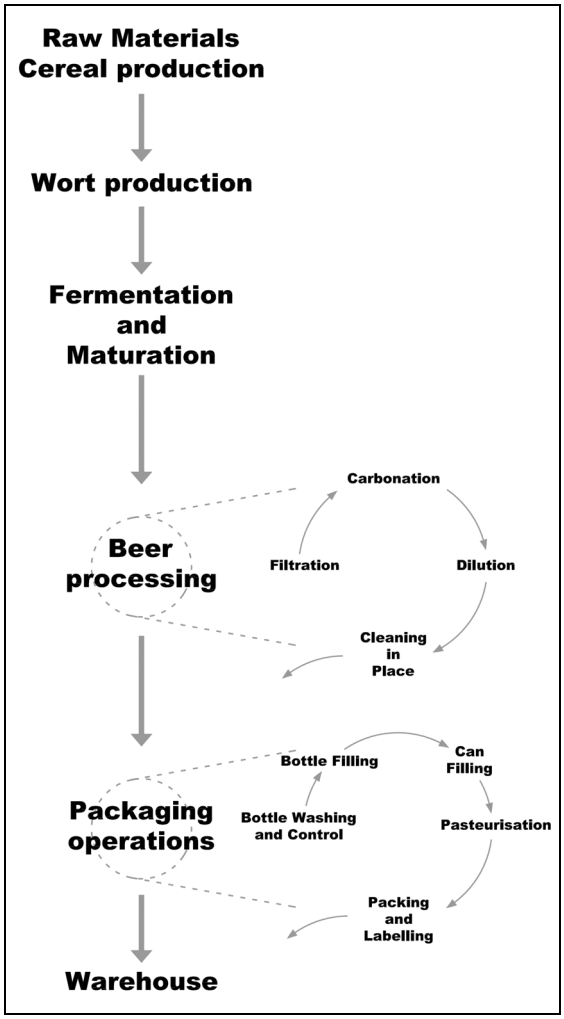
European Bank
for Reconstruction and Development

Sub-sectoral Environmental and Social Guidelines: Breweries

PROCESS DESCRIPTION

Beer (or lager, pilsner, ale, etc) is produced from malted barley, hops, yeast and water. Possible additional ingredients include caramel as colouring and various enzyme preparations. The key stages are shown in the figure below.



The stages comprise:

- Malting of barley, allowing controlled germination;
- Drying and wet or dry milling;
- Mashing with the addition of water and additional ingredients;
- Boiling with hops followed by clarification and cooling;
- Aeration;
- Fermentation and maturation, including carbonation by fermentation of residual sugars, removal of excess yeast and clarification;
- A sequence of cask, tank and bottle storage depending on the types of beer being produced;
- Post maturation treatment including filtration and pasteurisation;
- Packaging in to barrels, tanks, cans and glass and plastic bottles.

KEY ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Water supply and wastewater management

The quality of water used in brewing production is critical. It must be:

- Potable (clean and safe to drink);
- Free from contaminants (such as chlorine, sulphides, iron and nitrates);
- Of an appropriate hardness or softness (mineral content);

- Free of suspended solids (particles result in cloudy beer or wine). These can be removed;

- Sterilised or disinfected.

Wastewater from brewing presents a pollution risk due to:

- High levels of organic matter, which can pollute water courses,

- High acidity or alkalinity, depending on the type of cleaning detergents used.

Cost, quality and security of water supply are key factors in the production of beer. Large quantities of water are required both for the product and for plant cleaning.

Contamination of water supply or variable water quality may cause disruption to production processes and give rise to product quality problems. Groundwater from on-site wells is often used to produce beer. The volume and quality of the groundwater used are critical factors, as is the potential for groundwater contamination from both on-site and off-site sources such as pesticides/ fertilisers, detergents or objects dropped into the product. Abstracted water may require pre-treatment before it can be used in the production process.

Brewing often generates significant volumes of wastewater including waste product and cleaning water. While this effluent is unlikely to contain toxic materials, its high organic content may present a pollution risk if discharged untreated. The brewery may require a permit that sets limits on water quality discharged from an on-site waste water treatment plant or discharged to a municipal waste water treatment plant.

Water Consumption

Brewing uses large quantities of water throughout the process while a large proportion of water used in this sector is used in the product, additional large volumes are used in the cleaning and cooling processes. Water might be abstracted and in this case there might be licenses controlling the volumes of water to be abstracted in order to reduce the impacts on local communities. Wastewater can be treated and reused in the process to reduce water consumption.

Waste

Solid wastes include:

- Organic material, including yeast, from filtration and clarification processes;

- Removal of bicarbonate during pre-treatment of water;

- Sludges from wastewater treatment plants;

- Hazardous wastes include waste oil and solvents from maintenance and operation of equipment.

Significant quantities of organic waste may be generated from beer production, including for example, spent yeast and residues from process tanks, pipes and rejected beer. This waste may be used as animal feed or for soil conditioning.

Energy Consumption

Many of the stages in the brewing process are high energy users. Where equipment is being used for heating and cooling purposes it will increase the amount of energy (gas, electric, or diesel) use within the process. Energy usage has a direct correlation to the operating costs of the company.

Many countries are signatories to the Kyoto Protocol and have adopted targets for the reduction of CO_2 emissions. Where Governments have set up carbon emission reduction programmes industrial processes like brewing have been required to reduce their CO_2 emissions through the setting of targets. This can result in a need for substantial investment in new/clean technologies to achieve the emission targets set. These targets can be reflected in environmental permits.

Collision Risk

In a busy manufacturing environment it is common to have injuries where people are struck by moving or falling objects, such as, crates, boxes, equipment, conveyors (bottling machines, packaging machines and palletisers) and fork lift trucks, all of which can lead to injury.

Explosion Risk

Brewing includes processes that use grains resulting in dusts that can create explosive atmospheres. Filter systems should be installed to remove dusts from the work environment and anti static equipment should be employed in these areas. In addition, the fermenting vessels used in brewing can operate at high pressures. If this pressure is not correctly regulated there is a high risk of the vessel exploding and causing severe injury or death.

Slips and Trips

Liquid substances form the majority of the brewing process and therefore there is a high risk of slips, trips and falls where liquid spills have not been cleaned up or where cleaning is taking place.

Manual Handling and Repetitive Work

Lifting, repetitive work and posture injuries occur as a result of lifting and carrying heavy or awkward shaped items (especially crates and barrels). Repetitive tasks can lead to musculoskeletal injuries, for example, manual tasks within a bottling plant.

Occupational Dermatitis

Within the brewing industry hygiene is paramount and this results in a requirement for regular hand washing which can lead to occupational dermatitis (skin conditions).

OTHER ENVIRONMENTAL, HEALTH AND SAFETY RISK/LIABILITY ISSUES

Handling and storage of materials

Storage facilities may include silos, bulk storage tanks and drums, sacks and bags. These will store a range of products, secondary materials and raw materials used in the process.

Pollution risks to water courses arise from spillages of sugar syrups; colours;

flavourings; other additives; product; cleaning materials; and oils & fuels.

Emissions to Air

Particulates from raw material loading, unloading and transportation.

Odour from process operations can cause a local nuisance.

Refrigerants

Breweries will usually have facilities to chill the product at various stages in the process. The refrigerants used may be ozone depleting chemicals, such as Chlorofluorocarbons (CFC's) Hydro chlorofluorocarbons (HCFC's) the production of which, are being phased out under the Montreal Protocol. Releases of these types of refrigerant gases should be avoided. Ammonia is becoming a more commonly used alternative refrigerant, which has no such restriction. There are significant health and safety risks associated with the storage (and accidental release) of large volumes of ammonia.

Packaging

Within the brewing sector packaging is widely used for protection of the quality of the product, marketing and for transport purposes. Typically this is glass, aluminium, plastic, cardboard, PET, shrink wrap and film. In some cases the glass bottles and delivery crates are returnable, however, in many cases the material becomes part of the waste stream. Where possible companies should attempt to recover packaging or should ensure that the packaging used is easy to recycle.

Companies operating within the European Union (either as a manufacturer or as a supplier into European Union countries) will be subject to the European Union Packaging & Packaging Waste Directive (94/62/EC), which aims to reduce the amount of packaging that is being introduced into the waste streams.

Polychlorinated Biphenyls (PCBs)

PCBs are a group of substances which are good electrical insulators. Typically PCBs may be present as constituents of hydraulic oils or dielectric fluids in electrical switchgear and transformers. PCBs are hazardous and known carcinogens. Though the presence of PCBs is not likely to be a principal issue of concern in relation to the main brewery process it may be present in equipment and be an environmental and health and safety hazard. Particular attention should be given to factories constructed prior to the 1980s.

Permitting requirements

Large beverage manufacturing plants operating in the European Union may be required to hold an environmental permit under Integrated Pollution Prevention and Control (IPPC) regulations. Other smaller facilities and operations outside the EU may still require environmental permits but these permits may be less stringent and cover fewer processes.

The injury rate in the food and drink industry has been identified as one of the

highest injury rates across manufacturing sectors[1].

Moving equipment

Conveyors, fork lift trucks, pulley systems this provides risks of entrapment and collision.

Liquid on floors

Liquid substances form a large proportion of the brewing processes and therefore there is a high risk of slips, trips and falls where liquid has not been cleared up

Temperature

Refrigeration systems will result in very cold temperatures which can result in frost bites and contact burns.

Vats

Vats for mixing raw materials provide hazards in the form of working at height which could result in falls and drowning (immersion)

Working at Height

Storage warehouses will entail moving equipment and possibly working at height.

Asphyxiation

Uncontrolled release of CO_2 (produced during the fermentation process) in confined spaces can accumulate and present an asphyxiation risk if ventilation is poor.

Noise

High noise that can lead to hearing deficiencies can be experienced in the bottling plant.

Caustics, acids and carbon dioxides

Brewing uses caustics, acids and carbon dioxides. Inappropriate storage and use of these materials could result in chemical contact burns, inhalation of harmful/toxic fumes or ingestion of harmful substances.

Asbestos

Asbestos has been used on a large scale for many years as fire proofing and insulation material and may be encountered in a wide range of forms including asbestos cement boards, as fire retardant gaskets in pipe work and as fire retardant insulation around boilers and furnaces. Particular attention should be paid to facilities constructed prior to the 1980's.

Dust

Dust presents health and safety hazards in terms of inhalation leading to respiratory problems in personnel who work in dusty atmospheres without the correct ventilation and personal protective equipment.

Hygiene

Hygiene standards within process areas must be maintained to a high level to prevent product contamination.

[1] United Kingdom Health and Safety Executive 2006-2007

KEY SOCIAL, LABOUR, AND COMMUNITY RISK/LIABILITY ISSUES

- Brewing uses chemicals and substances which, if incorrectly used, could release into the surrounding environment resulting in inhalation of harmful fumes by the general public;
- Transport of raw materials and chemicals to site could result in a road traffic accident which involves the general public;
- Contamination of product could result in ill health in the general public and may result in product recall;
- Operations may cause noise which is a nuisance to neighbours.

FINANCIAL IMPLCATIONS

- If groundwater is used in production, the quality, volume and protection of the source are critical issues which can determine the viability of the business;
- Water supply and wastewater treatment may constitute a significant proportion of operating costs;
- Pre-treatment of water used for the production of beverages may require considerable capital investment in water pre-treatment or investment in alternative sources of water;
- Environmental improvement targets for wastewater discharges are set as part of a local, regional or national plan to improve and protect the quality of water courses. These targets may be very costly to achieve, and require significant capital expenditure and operating costs;
- Legislative requirements to recycle used packaging in countries to which product is exported may increase costs of packaging materials;
- Energy costs, particularly for generation of steam and hot water, may be significant;
- Capital expenditure might be required to maintain health, safety and hygiene standards;
- Injuries may lead to increased payroll costs to replaced skilled workers;
- Fines, penalties and third party claims may be incurred for non compliance with environment, hygiene and health & safety regulations.

IMPROVEMENTS

- Reduction of water consumption per litre of product in line with good industry standards;
- Pre-treatment of water is likely to be necessary, including sterilisation, filtration and softening;
- Wastewater treatment systems for process water, drainage water and cleaning water are essential in order to minimise the risks to water courses.
- Hard standing for vehicles, should be designed to prevent or contain oil or fuel leaks;

- List all hazardous materials held on site and prepare procedures for their handling and treatment in the event of spillage;
- Carry out handling of dust-generating materials in enclosed areas, with filter equipment where necessary;
- Install secondary containment of tanks (bunds, for example) to prevent spills reaching the wider environment;
- Regular inspection of secondary containment facilities and fitting of alarms, where not regularly inspected;
- Protect water courses from possible leakage from raw material or product storage facilities, tanks for storage of sludge and wastewater;
- Organic solid wastes can be sold as animal feed;
- Spent yeast/grain from the brewing process can be used as animal feed;
- Sludges must be disposed of to appropriately licensed waste facilities or licensed for spreading on agricultural land;
- Implement a packaging re-use scheme;
- Segregate and recycle wastes;
- Investigate options for heat recovery and insulation to reduce/supplement energy consumption;
- Investigate options for CO_2 and methane (from WWTP) recovery
- Ensure that equipment operating temperatures are not set above levels that are necessary to achieve the required performance of the equipment.

Health & Safety Improvements

- Separation of people from moving equipment:
  - Ensure that the process layout reduces opportunities for process activities to cross paths, walkways demarcation, signage.
  - Install correct machinery guarding to reduce risk of entrapment of employees;
  - Install walkways to separate people from vehicle movements to reduce risk of collision;
  - Restrict access or use clear signage in areas with potential electrical hazards.
- Prevent spillage and maintain walking areas to ensure they are clean and dry;
- Ensure correct clean up programmes are in place for liquids: restrict access to areas being cleaned down or where spillages have occurred;
- Install mechanical lifting aids where possible and rotate work tasks to reduce repetitive activities;
- Ensure workplace lighting is high in production areas;

- To reduce the risk of noise exposure, isolate noisy equipment, rotate tasks to minimise time spent in a noisy area over an eight hour period and provide personal protective equipment where people have to enter noisy areas;

- Restrict access to areas of high temperature;

    - Restrict times for people being in very cold or very hot areas;

    - Provide personal protective equipment to reduce risk of frost bite or contact burns;

- Restrict access to working at height or around the top of vats and in confined spaces through a permit to work system. Ensure correct fall arrest systems are in place, such as, (guarding and harnesses) and lifting equipment maintained.

- Regular cleaning and disinfection to maintain food safety and hygiene standards;

- Upgrade storage arrangements to ensure leaks do not occur;

- Personal protective equipment can be used by organisations to protect employees and visitors from identified Health & Safety hazards. Failing to use the correct personal protective equipment can result in injury or illness. Provide personal protective equipment to maintain hygiene standards and train personnel in the correct selection, maintenance and use of personal protective equipment;

- Install filter equipment to reduce the likelihood of explosion associated with dust build up;

- Regularly review and test fire protection equipment and procedures;

- Ensure that tanks are correctly maintained and operated to reduce the risk of explosion as a result of a build up in pressure.

GUIDE TO INITIAL DUE DILLIGENCE SITE VISITS

- Perform a complete tour of the works, accompanied by someone knowledgeable about all the activities at the site;

- Look for signs of poor housekeeping, such as spillages and piles of empty drums/containers;

- Establish the source and reliability of water supply and any potential constraints which may affect production. Are there any industrial facilities neighbouring the facility which may pollute the water used in the process;

- Find out whether drainage systems lead to wastewater treatment systems or discharge directly to surface waters;

- Note the extent of treatment systems for the different types of wastewater, including process water, surface water runoff and cleaning water;

- Note the colour and appearance of adjacent water courses;

- Note any strong odours outside the site;
- Note if areas of the factory appear to be noisy;
- Check whether people are wearing personal protective equipment;
- Check the signage around the site, does it convey what health & safety risks might exist in areas?
- Is fire fighting and first aid equipment available?
- Note the location and condition of oil and chemical storage areas. These should be located away from operational areas and have measures to contain spillages (for example, bunding);
- Explore any environmental requirements which may affect the cost or type of packaging used;
- Check that wages and working hours are consistent with the average for the sector and national standards;
- Is the facility next to any industries which may pollute ground water used in the process?
- Does the organisation have insurance in place to cover the recall of contaminated products? Have there been any recent product recall incidents?
- Have there been any recent incidents (within the last 3 years) on site such as fatalities, fires/explosions, spills?
- Is the facility subject to any audits by customers? What was the outcome of these audits?
- Does the business plan have line items for environment, health and safety improvements?
- Check that labour standards, contracting and remuneration are in line with national law and are consistent with the average for the sector.
- Check that hours worked, including overtime, are recorded and staff should receive written details of hours worked and payment received.
- Has the Company received inspections from the local labour inspectorate in the previous three years? Have these resulted in any penalties, fines, major recommendations or corrective action plans?
- Does the organisation have a grievance mechanism which allows employees to raise workplace concerns?
- Are employees free to form, or join, a worker's organisation of their choosing?

Take note/ask questions relating to any activities that address the improvements listed in the improvements section of this document.

Check what permits are required for the site (air, water, wastewater, noise) and compliance monitoring reports.

ACTION PLANS

Dependent on the individual business, select appropriate improvements from the list above to include in the action plan. As a minimum any business should be required to have the following in place:

- Operational procedures to manage environmental, health & safety risks;
- Monitoring programmes;
- Improvement objectives, targets and project plans;
- Training programme for personnel;
- Regular inspections, checks and audits with records to demonstrate achievement of the required level of performance against legal requirements and improvement action;
- Emergency plans for environment, health & safety accidents and site security;
- Management review/demonstrated involvement in environment, health & safety management.

REFERENCES AND ADDITIONAL SOURCES

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