# BAT Guidance Note
# on Best Available Techniques for the Dairy Processing Sector

(1st Edition)


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# 1. INTRODUCTION

## 1.1 GENERAL

This Guidance Note is one of a series issued by the Environmental Protection Agency (EPA), which provides guidance on the determination of Best Available Techniques (BAT) in relation to:

– applicants seeking Integrated Pollution Prevention and Control (IPPC) licenses under Part IV of the Environmental Protection Agency Acts 1992 to 2007,

– existing Integrated Pollution Prevention and Control (IPPC) Licensees, whose licence is to be reviewed under the Environmental Protection Agency Acts 1992 to 2007,

– applicants seeking Waste Licenses under Part V of the Waste Management Acts 1996 to 2008,

– existing Waste Licensees, whose licence is to be reviewed under the Waste Management Acts 1996 to 2008.

This Guidance Note shall not be construed as negating the installation/facility statutory obligations or requirements under any other enactments or regulations.

## 1.2 BAT GUIDANCE NOTE STRUCTURE

This Guidance Note has been structured as follows:

| Section | Details |
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| 1 | Introduction |
| 2 | Interpretation of BAT |
| 3 | Sector covered by this Guidance Note |
| 4 | Process Description, Risk to the Environment and Control Techniques |
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| 6 | BAT Associated Emission Levels |
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Where relevant, references are made to other detailed guidance, such as the Reference documents (BREF) published by the European Commission, Agency Guidance Note for *Noise in Relation to Scheduled Activities*, and the determination of BAT should be made giving regard to these.

The information contained in this Guidance Note is intended for use as a tool to assist in determining BAT for the specified activities.

# 2. INTERPRETATION OF BAT

## 2.1 STATUS OF THIS GUIDANCE NOTE

This Guidance Note will be periodically reviewed and updated as required to reflect any changes in legislation and in order to incorporate advances as they arise.

Techniques identified in these Guidance Notes are considered to be best practice at the time of writing. The EPA encourages the development and introduction of new and innovative technologies and techniques, which meet BAT criteria and look for continuous improvement in the overall environmental performance of the sector's activities as part of sustainable development.

## 2.2 INTERPRETATION OF BAT

The concept of BAT was introduced as a key principle in the IPPC Directive 96/61/EC. This Directive has been incorporated into Irish law by the Protection of the Environment Act 2003. To meet the requirements of this Directive, relevant Sections of the Environmental Protection Agency Act 1992 and the Waste Management Act 1996 have been amended to replace BATNEEC (Best Available Technology Not Entailing Excessive Costs) with BAT. Thus, for activities falling within the scope of the Directive and regulated by these Acts, BAT must be applied.

Best available techniques (BAT) is defined in Section 5 of Environmental Protection Agency Acts, 1992 to 2007, and Section 5(2) of the Waste Management Acts 1996 to 2008, as the "most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or, where that is not practicable, generally to reduce an emission and its impact on the environment as a whole", where:

**B** ***'best'*** in relation to techniques, means the most effective in achieving a high general level of protection of the environment as a whole

**A** ***'available techniques'*** means those techniques developed on a scale which allows implementation in the relevant class of activity under economically the technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying out the activity

**T** ***'techniques'*** includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.

The range of BAT associated emission level values specified in Section 6 indicate those that are achievable through the use of a combination of the process techniques and abatement technologies specified as BAT in Section 5. The licensee must demonstrate to the satisfaction of the Agency, during the licensing process, that the installation/facility will be operated in such a way that all the appropriate preventative measures are taken against pollution through the application of BAT and justify the application of other than the most stringent ELV in the range.

At the installation/facility level, the most appropriate techniques will depend on local factors. A local assessment of the costs and benefits of the available options may be needed to establish the best option. The choice may be justified on:

- the technical characteristics of the installation/facility
- its geographical location
- local environmental considerations
- the economic and technical viability of upgrading existing installation/facility.

The overall objective of ensuring a high level of protection for the environment as a whole will often involve making a judgment between different types of environmental impact, and these judgments will often be influenced by local considerations. On the other hand, the obligation to ensure a high level of environmental protection including the minimisation of long-distance or transboundary pollution implies that the most appropriate techniques cannot be set on the basis of purely local considerations.

The guidance issued in this Note in respect of the use of any technology, technique or standard does not preclude the use of any other similar technology, technique or standard that may achieve the required emission standards and is demonstrated to the Agency to satisfy the requirement of BAT.

## 2.3 BAT HIERARCHY

In the identification of BAT, emphasis is placed on pollution prevention techniques rather than end-of-pipe treatment.

The IPPC Directive 96/61/EC and the Environmental Protection Agency Acts 1992 to 2007 (Section 5(3)), require the determination of BAT to consider in particular the following, giving regard to the likely costs and advantages of measures and to the principles of precaution and prevention:

(i) the use of low-waste technology,

(ii) the use of less hazardous substances,

(iii) the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate,

(iv) comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale,

(v) technological advances and changes in scientific knowledge and understanding,

(vi) the nature, effects and volume of the emissions concerned,

(vii) the commissioning dates for new or existing activities,

(viii) the length of time needed to introduce the best available techniques,

(ix) the consumption and nature of raw materials (including water) used in the process and their energy efficiency,

(x) the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it,

(xi) the need to prevent accidents and to minimise the consequences for the environment, and

(xii) the information published by the Commission of the European Communities pursuant to any exchange of information between Member States and the industries concerned on best available techniques, associated monitoring, and developments in them, or by international organisations, and such other matters as may be prescribed.

# 3. SECTOR COVERED BY THIS GUIDANCE NOTE

This Guidance Note covers the following activities under the First Schedule of the Environmental Protection Agency Acts 1992 to 2007:

7.2.1 The treatment and processing of milk, the quantity of milk received being greater than 200 tonnes per day (average value on a yearly basis).

7.2.2 The manufacture of dairy products where the processing capacity exceeds 50 million gallons of milk equivalent per year, not included in paragraph 7.2.1.

# 4. PROCESS DESCRIPTION, RISK TO THE ENVIRONMENT AND CONTROL TECHNIQUES

(Note: any reference to BREF in this document means the reference document on *Best Available Techniques in the Food, Drink and Milk Industry* (January 2006), published by the European Commission.)

## 4.1 DESCRIPTION OF PROCESS

This section lists the unit operations involved in the treatment and processing of milk and the manufacture of dairy products. A full description of each operation is given in the BREF and the relevant BREF section number is referenced here.

### 4.1.1 Unit Processes Applicable to all Dairy Production Processes

The unit operations listed are applicable to all processes described below.

- Materials handling, unpacking, storage (see BREF Sections 2.1.1 and 2.1.1.1)
- Mixing, blending, homogenisation (see BREF Section 2.1.2.2)
- Centrifugation (see BREF Section 2.1.3.4)
- Filtration (see BREF Section 2.1.3.5)
- Pasteurisation, sterilisation, UH (see BREF Section 2.1.5.8)
- Packing, filling (see BREF Section 2.1.8.1)
- Cleaning / sanitisation (see BREF Section 2.1.9.1)
- Energy generation / consumption (see BREF Section 2.1.9.2)
- Water treatment (incoming process water) (see BREF Section 2.1.9.3)
- Vacuum generation (see BREF Section 2.1.9.4)
- Refrigeration (see BREF Section 2.1.9.5)
- Compressed air generation (see BREF Section 2.1.9.6).

### 4.1.2 Butter Production (incl. Spreads Production)

See BREF Section 2.2.5.3 in addition to references listed below.

- Neutralisation (removal of fatty acids) (see BREF Section 2.1.3.8)
- Cooling, chilling, cold stabilisation (see BREF Section 2.1.7.1).

### 4.1.3 Casein Production

- Coagulation (see BREF Section 2.1.4.5).

### 4.1.4 Cheese Production

See BREF Section 2.2.5.4 in addition to references listed below.

- Cutting, slicing, chopping, mincing, pulping, pressing (see BREF Section 2.1.2.1)
- Forming, moulding, extruding (see BREF Section 2.1.2.4)
- Coagulation (see BREF 2.1.4.5)
- Brining, curing (see BREF Section 2.1.4.7)
- Smoking (see BREF Section 2.1.4.8)
- Melting (see BREF Section 2.1.5.1)
- Cooling, chilling, cold stabilisation (see BREF Section 2.1.7.1).

### 4.1.5 Cream Production

See BREF Section 2.2.5.1 in addition to references listed below.

- Drying (liquid to solid) (see BREF Section 2.1.6.2).

### 4.1.6 Ice Cream Production

See BREF Section 2.3.5.6 in addition to references listed below.

- Coating, spraying, enrobing, agglomerisation, encapsulation (see BREF Section 2.1.4.13)
- Freezing (see BREF Section 2.1.7.2).

### 4.1.7 Lactose Production

- Grinding, milling, crushing (see BREF Section 2.1.2.3)
- Crystallisation (see BREF Section 2.1.3.7).

### 4.1.8 Milk Production (incl. Condensed & Powdered Milk)

See BREF Sections 2.2.5.1 & 2.2.5.2 in addition to references listed below.

- Grinding, milling, crushing (see BREF Section 2.1.2.3)
- Dissolving (see BREF Section 2.1.4.2)
- Evaporation (liquid to liquid) (see BREF Section 2.1.6.1)
- Drying (liquid to solid) (see BREF Section 2.1.6.2)
- Cooling, chilling, cold stabilisation (see BREF Section 2.1.7.1).

### 4.1.9 Whey Production

- Deionisation (see BREF Section 2.1.3.2)
- Membrane separation (see BREF Section 2.1.3.6)
- Drying (liquid to solid) (see BREF Section 2.1.6.2).

### 4.1.10 Yoghurt Production

See BREF Section 2.2.5.5 in addition to references listed below.

- Fermentation (see BREF Section 2.1.4.4)
- Cooling, chilling, cold stabilisation (see BREF Section 2.1.7.1).

## 4.2 Risk to the Environment

Environmental issues for the dairy industry are:

- Water consumption
- High volume of wastewater produced
- High energy consumption
- Air emissions from drying operations
- Solid waste production.

In addition, odours from wastewater treatment plant operations and noise from equipment may also be issues. A description of relevant general environmental issues is given below and specific environmental issues associated with unit processes as described in 4.1 are listed in Table 1 in Appendix 2.

### 4.2.1 Water Consumption

See BREF Sections 3.1.1.1 & 3.3.5.1.1.

The dairy industry uses large quantities of water and consequently also generates large quantities of wastewater in maintaining the required level of hygiene and cleanliness in the installation. In the industry, water is used as process water, cooling water, transportation water, auxiliary water, sanitary water, etc. Overall a large proportion of the water used is of drinking water quality.

Since water is such an important material for the milk and dairy production industry, much attention is, or should be, paid to the supply of the water and to its quality. Taking into account that water supply is not an unlimited source; it is also necessary to reduce water consumption as far as possible. However, food safety is paramount and takes precedence over all conservation issues.

The following types of water are used in the industry:

- Process water
- Cooling water and
- Boiler feed-water.

*Process water*
Process water can be defined as water, which can come into contact with the food product either directly or indirectly, or water used for technical purposes and which in some way can affect the quality of the food products.

*Cooling water*
Cooling water is the water used for the removal of heat from process streams and products.

*Boiler feed-water*
It is important that boiler feed-water does not cause scaling in the boiler or corrosion of the steam system. This means that boiler feed-water has a very low hardness and is de-aerated where feasible.

### 4.2.2 Wastewater Emission

See BREF Sections 3.1.1.2 & 3.3.5.1.2.

Generation of wastewater is the main environmental issue in the dairy sector. The largest source of wastewater is wash-water used in operations such as equipment washing; line purging at product changeover; start-up, shutdown and changeover of high temperature short time (HTST) pasteurisation units and product washing. Although cleaning in place (CIP) operations contribute to saving water, energy and chemicals, they still generate large volumes of wastewater, which may have a high or low pH.

Other sources of wastewater are membrane plants and the condensate from the large evaporators used in the production of milk concentrate (the first stage in the production of milk powder) and dried whey. The condensate is generally clean, but vacuum leaks on the condensers can lead to contamination of the product. The condensate may also be re-used in other processes, such as pre-heating incoming milk or as cleaning water provided it has been treated properly (e.g. reverse osmosis followed by disinfection).

Dairy industry wastewater is notable for being variable in composition. The wastewater typically has a high BOD, especially that from the cream, butter, cheese and whey processes. High COD levels and the high concentrations of suspended solids may also be an issue in wastewater from this industry as well as the presence of other pollutants such as phosphorus, nitrogen and chloride. The wide pH range and temperature of the wastewater may also be a consideration. The concentration of pollutants is largely dependant on the water management of a plant (e.g. water re-use, segregation, good housekeeping) (see BREF Section 3.3.5.1.2).

### 4.2.3 Emissions to Air

See BREF Sections 3.1.2 & 3.3.5.2.

Air emissions consist of waste gas streams and odour emissions. Only ducted emissions can be treated and therefore their environmental impact minimised. Fugitive emissions cannot be treated therefore to minimise their environmental impact, they must be managed effectively to prevent or minimise their release. The main air pollutants from dairy processes (not including the pollutants released in associated activities such as energy production) are:

- Particulate matter
- Ammonia and halogen containing refrigerants.

The sources of waste gas streams include:

Ducted sources

- Process emissions
- Waste gases from purge vents or preheating equipment
- Effluent of vents from storage and handling
- Flue gases from energy-providing units
- Waste gases from emission control equipment
- Discharges of safety relief devices
- Exhaust of general ventilation system
- Exhaust of vents from captured diffuse and/or fugitive sources.

Non-ducted sources

- Working losses and breathing losses from storage equipment and during handling operations (e.g. filling of drums, trucks or containers)
- Secondary emissions, resulting from the handling or disposal of waste
- Odour losses during storage, filling and emptying of bulk tanks and silos
- Stripping of odorous compounds from waste water treatment plants (WWTP)
- Storage tank vents
- Fumigation
- Leakages from flanges, pumps, seals, valve glands, etc.
- Building losses
- Settling ponds
- Cooling towers and cooling ponds.

Other pollutants include halogenated compounds used in cooling systems, usually HCFCs although they are currently being phased out. Emissions of carbon dioxide, sulphur dioxide and nitrogen oxides, which derive from energy production in boiler plants, may also be significant. For more information, see BAT Guidance Note on Energy. Odour emissions are usually related to effluent treatment operations or leaks of ammonia used in cooling systems.

### 4.2.4 Energy

See BREF Sections 3.1.4 & 3.3.5.4.

The dairy industry consumes a significant amount of energy. The majority of the energy consumed is used to generate steam and hot water for heating operations and cleaning, while a lesser amount is used to drive power machinery, refrigeration, ventilation, and lighting. The most energy consuming operations are the evaporation and drying of milk.

### 4.2.5 Noise

See BREF Section 3.3.5.6.

For dairy plants, noise emissions are generated by traffic from milk tankers and distribution lorries, evaporators, spray dryers, cooling condensers, ventilation systems, fans, refrigeration units, compressors, pipelines for steam and solids transport.

### 4.2.6 Waste Production

See BREF Sections 3.1.3 & 3.3.5.3.

Packaging waste, other solid or liquid wastes such as nonconforming products, sludge from separation (milk clarification, filtration), solid wastes from fat traps, solid wastes flotation and biological wastewater treatment plants and other wastes attributable to general industrial operations (e.g. lubricants, batteries, paint, fluorescent lamps, laboratory chemicals, etc.) are the most likely wastes generated from dairy processing.

## 4.3 CONTROL TECHNIQUES

The existing or possible measures for eliminating, reducing and controlling emissions that are considered to be most relevant for determining BAT in the dairy industry are described in this section; more detailed descriptions are given in the BREF document and these are referenced below.

- generic process-integrated measures such as prevention, control, minimisation, re-use and re-cycling procedures (see BREF Sections 4.1, 4.2 & 4.3)
- generic end-of-pipe techniques applied to waste water treatment, air pollution and odour control (see BREF Sections 4.4.3 & 4.5)
- control techniques for specific processes within the dairy industry (see BREF Sections 4.5.7.5 & 4.7.5).

### 4.3.1 Generic Preventative Techniques

See BREF Section 4.1.

### 4.3.2 Environmental Management System

See BREF Section 4.1.1.

An Environmental Management System (EMS) is a tool that operators can use to address design, construction, maintenance, operation and decommissioning issues in a systematic, demonstrable way. An EMS includes the organisational structure, responsibilities, practices, procedures, processes and resources for developing, implementing, maintaining, reviewing and monitoring the environmental policy. Environmental Management Systems are most effective and efficient where they form an inherent part of the overall management and operation of an installation.

An environmental management system (EMS) for an IPPC installation contains the following components:

(a) Defining of an environmental policy
(b) Planning and establishing objectives and targets
(c) Implementing and operating procedures
(d) Checking and corrective action
(e) Management review
(f) Preparing a regular environmental statement
(g) Validating by certification body or external EMS verifier
(h) Considering design for end-of-life plant decommissioning
(i) Development of cleaner technologies

(j) Benchmarking.

### 4.3.3 Raw Material Use & Selection of Materials

Often it is difficult to substitute ingredients in dairy product manufacturing, as the ingredients are often specific with few alternatives. However, substitution or reduction of the use of some non-ingredient materials, especially chemicals, can where possible minimise environmental impacts. These substances include for example cleaning and sanitising agents, refrigerants, and packaging materials.

*Selection of Material (see BREF Section 4.1.9)*

In practice, the option of using different raw materials is often limited as the materials are specified in recipes and there are often few or no alternatives. However, some sectors try to use raw materials resulting in fewer by-products or wastes.

*Materials used in Cleaning and Sanitation (see BREF Section 4.3)*

Chemicals are important in the cleaning and sanitation of the plant to prevent biological contamination of the product. However, large quantities of these materials are discharged in the wastewater and therefore they may have a significant impact on the environment, if not adequately treated.

The use of automated CIP reduces the consumption of chemicals compared to manual cleaning. These systems are designed to recirculate chemicals for the duration of their useful life to minimise the waste of chemicals. Consumption of chemicals can be further reduced if the CIP incorporates:

- Recirculation of cleaning chemicals, where feasible
- Automatic dosage of chemicals, where feasible
- Monitoring by means of conductivity transmitters the concentration of chemicals
- Use of optimised cleaning sequences
- Self-neutralisation in the neutralisation tank.

For sanitation purposes, to prevent bacterial growth, several types of treatments (see BREF Section 4.3.8.1) can be applied, e.g.:

- Oxidising biocides
- Non-oxidising biocides
- UV light

*Selection of Chelating Agents (see BREF Section 4.3.8.2)*

Chelating agents are used to clean scale deposits and to prevent calcium and magnesium scales. EDTA is the chelating agent used in the largest quantities. However, the use of EDTA is being reduced because of its environmental risks to water and the problems it causes to municipal sewage treatment plants. Information on alternatives and reducing use of EDTA, including a case study, is given in BREF Section 4.3.8.2.5.

*Selection of Refrigerants (see BREF Section 4.1.9.3)*

Refrigerants are widely used in cooling, refrigeration and freezing operations. The use of halogenated substances, especially CFCs, has mostly been eliminated. In some countries however, HCFCs are still in use. These compounds have been substituted by other refrigerants such as ammonia, glycol or iced water but the leaking of ammonia or glycol can still cause health and safety problems within the installation. To prevent the formation of leaks, pipelines should be protected against external damages and a system of frequent inspection and maintenance should be implemented.

*Packaging (see BREF Section 4.2.12)*

The type of packaging used is determined by food safety and hygiene regulations and transportation considerations. Packaging includes a number of raw materials, for example, glass bottles, big bags, corrugated and non-corrugated cartons, plastic bags, shrink-wrap, stretch-wrap, pallets and slip sheets, drums and other containers and filler materials (e.g. polystyrene).

Packaging raw materials may be selected which cause the least environmental impact. To keep waste to a minimum, the weight and volume of each material, together with its recycled content, need to be considered, as does the potential for re-use, recycling and disposal of the packaging. Often one material can replace the need for another; for example, recyclable shrink-wrap could replace the need for cardboard trays and shrink-wrap.

### 4.3.4 Waste Minimisation

See BREF Section 4.1.6.

Waste minimisation is one of the main objectives of the IPPC Directive. Article 3 of this Directive states waste generation should be avoided in accordance with Council Directive 75/442/EEC of 15 July 1975 on waste and that where waste is produced it is recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment. Some examples of techniques that can be applied to enable re-use or recycling of materials or utilities and other forms of recovery are given below; no priority ranking is intended, and the appropriate selection in a particular case will depend on the specifics of the process concerned and on site constraints.

- Implement a waste minimisation program (see BREF Section 4.1.6.6)
- Optimise the process (see BREF Section 4.1.6.2.3) by:
    - Implementing good housekeeping practices
    - Improving operating practices
- Improve process control by installing control and measurement devices (see BREF Section 4.1.6.7)
- Reported examples of waste minimisation for the dairy industry (see BREF Sections 4.7.5.13.1 & 4.7.5.14.2).

### 4.3.5 Water Management

See BREF Sections 4.5 & 4.1.6

Water management includes the efficient use of this natural resource and preventing or reducing the production of water pollution.

Water pollution control can be achieved by:

- Reducing the volume of wastewater generated
- Reducing the strength of the wastewater generated
- Eliminating or decreasing the concentration of certain pollutants
- Recycling or re-use water
- Wastewater treatment
- Or a combination of these measures.

Further water management techniques such as the following may be implemented (see BREF Section 4.1.6)

- Provide water in sufficient amounts and good quality
- Implement a water management system
- Apply a methodology for reducing water consumption
- Eliminate the use of water wherever possible
    - Utilise closed circuit cooling systems instead of once-through cooling, this eliminates most of the water waste in cooling

- Optimise existing processes to reduce water usage
- Implement good housekeeping by monitoring for water leaks and faults and repairing them promptly. Also monitor water consumption on high-use equipment
- Implement an efficient program of maintenance of utility systems.

Further techniques to improve the management of the water are outlined in BREF section 4.7.5.

### 4.3.6 Cleaning

See BREF Section 4.3.

Cleaning is used in all processes in the milk sectors. Since it is the most water consuming operation in most processes it is included separately from the Water Management Section.

To save water and minimise water pollution from cleaning, the following techniques can be applied:

- Adopt Cleaning-in-place (CIP) rather than manual cleaning where possible (see BREF Section 4.3.9):
    - Optimise the CIP sequences, i.e. cleaning and rinsing times
    - Optimise the CIP programme for the size of plant/vessel and type of soiling
    - Calibrate CIP programme
    - Recover CIP solutions
- Adopt dry clean-up techniques. This can be achieved (see BREF Section 4.3.1) by:
    - Equipment design
    - Good housekeeping
- Management of manual cleaning:
    - Install trigger nozzles on hoses to reduce flow rates
    - Utilise spray guns instead of open-ended hoses for cleaning
    - Cleaning chemicals usage
- Reduce the use of EDTA as a chelating agent (see BREF Section 4.3.8.2.3)
- Apply automatic dosing of chemicals at the correct concentrations
- Sanitisation
- Recycling the water and recovering the cleaning chemicals:
    - Re-use secondary water, such as reverse osmosis water and product condensate, for cleaning less sensitive areas where feasible
    - Re-use warm cooling water for cleaning, where feasible
    - Apply recycling process controls based on conductivity rather than time
    - Re-use water from the final rinse for pre-rinsing
    - Pre-rinse to enable remaining product to be recovered for re-use or disposal
- Use high-pressure jet cleaning (see BREF Section 4.3.7)
- Use foam and gel cleaning (see BREF Sections 4.3.7.3 & 4.3.7.4).

In addition to the water pollution control measures described above, the following are additional methods to reduce environmental impact:

- Apply good design, installation and maintenance practice to reduce or eliminate spillages
- Remove as much residual material as possible from vessels and equipment before they are washed
- Ensure that drains are equipped with catchpots
- Ensure that the catchpots are in place during cleaning
- Optimise the water pressure at jets, nozzles and orifices

- Utilise an automatic water supply shut off on trigger operated spray guns or hoses.

### 4.3.7 Energy Efficiency

See BREF Sections 4.2.13 & 4.1.6.

- Implement an energy management system (see BREF Section 4.1.6)
- Implement good housekeeping by monitoring and managing the steam, compressed air, air conditioning and refrigeration systems (see BREF Section 4.2.15)
- Optimise the process (see BREF Section 4.1.6.2.2)
- Use appropriate technology to investigate energy savings through process integration (see BREF Section 4.1.6.4.1)
- Implement heat recovery where applicable (see BREF Sections 4.2.13.5 & 4.2.13.4).
- Consider using CHP technology (see BREF Section 4.2.13.1)
- Ensure proper insulation of pipes and equipment (see BREF Section 4.2.13.3)
- Leak audits on compressed air and steam trap surveys
- Install frequency converters on pumps and motors, where feasible (see BREF Section 4.2.13.9).

A large part of the energy consumption of a plant is related to its utilities. Important utilities are compressed air, steam, refrigeration, air conditioning and electricity supply. Some techniques to reduce environmental impact for utilities are as follows:

For steam systems (see BREF Section 4.2.17):

- Maximise condensate return
- Avoid losses of flash steam from condensate return
- Isolate unused piping
- Improve steam trapping
- Repair steam leaks.

For compressed air generation (see BREF Section 4.2.16):

- Apply good housekeeping
- Treatment of compressed air: regularly inspect and maintain the treatment, check the dryer temperature, etc. where appropriate
- Check the use of compressed air and the need for it
- Establish if there is any compressed air leakage and repair leaks immediately.

For air conditioning and refrigeration (see BREF Section 4.2.15):

- For refrigeration plants: keep the condensers clean, make sure that the air entering the condensers is as cold as possible, check for leaks of refrigerant, check oil levels
- For cooled rooms: keep the doors closed as much as possible, check that evaporators defrost properly, do not keep the store colder than necessary, etc. (see BREF Section 4.2.15.1).

### 4.3.8 Minimising Air Emissions

See BREF Section 4.4.

A reduction in pollutant emissions can be achieved by:

- Using low-emission substances and products (substance-related primary measures)
- Using low-emission systems and production processes (process-related primary measures).

Measures to prevent, or reduce pollutant emissions are listed below (see BREF Section 4.4):

- Apply a control strategy (see BREF Section 4.4.1)
- Collect waste gases at source, wherever this is possible at reasonable cost
- Choose integrated process techniques with maximum possible product yield and minimum emissions into the environment as a whole
- Optimise the process, e.g. through extensive utilisation of input materials and recovery of co-products
- Avoid process cycles that could result in elevated emissions of hazardous substances by means of technical or operational measures
- Reduce energy consumption and the emissions of greenhouse gases, e.g. through energy-optimised planning, construction, and the operation of systems, in-plant energy utilisation, use of heat insulation measures
- Prevent or minimise the use of substances that deplete the ozone layer
- Design and operate procedures that involve switching off or bypassing the waste gas treatment systems so as to ensure low emissions and instigate special monitoring by recording relevant process parameters
- Plans must be in place for measures to immediately reduce emissions as far as possible, in the event of a failure of the emission reduction systems
- Design and operate procedures that involve switching off or bypassing the waste gas treatment systems
- Separate solid and liquid substances from exhaust air. The following basic methods can be applied:
    - Dynamic separation
    - Wet separation
    - Electrostatic precipitation
    - Filtration

Even after undertaking these prevention and control measures to minimise air emissions, there may still be a need to apply end-of-pipe techniques.

### 4.3.9 Odour Management & Minimisation

The following techniques can be used in the management and minimisation of odours

- Develop and Odour Control Strategy (see BREF Section 4.4.1.1).

## 4.4 GENERIC END-OF-PIPE TREATMENT TECHNIQUES

This section describes end-of-pipe techniques for the treatment of pollutant emissions. The reduction of pollution at source should be applied instead of, or before, treatment of pollutants. However, even after extensive minimisation/prevention of waste and implementation of primary control measures, some discharges from sites are inevitable and therefore the use of end-of-pipe techniques may be needed.

### 4.4.1 Wastewater Treatment

See BREF Section 4.5.

It is important to stress that elimination, i.e. the reduction of water pollution at source, should be applied instead of, or before, treatment of the wastewater produced.

When applying techniques for the treatment of wastewaters, the following unit processes should be considered prior to treatment:

- Segregate wastewater with some or all of the following criteria; high solids content, very high BOD, high salinity
- Install screens to remove gross solids where necessary

- Ensure that flow and load balancing are in place in wastewater discharge systems.
- Ensure adequate mixing and aeration in order to prevent stratification within the balance tank and to maintain a positive dissolved oxygen level
- Dissolved air flotation for the removal of fats, oils and greases, and suspended solids
- For waste water streams with a BOD concentration greater than 1000 - 1500 mg/l BOD, consider the use of anaerobic treatment processes
- For lower strength wastewater streams, aerobic treatment is the preferred option, e.g. high rate trickling filters. Secondary settlement may be required following a high rate filter and before it is discharged direct to sewer
- Conventional activated sludge systems for lower strength dairy waste water streams
- Other activated sludge variants (pure oxygen, Sequencing Batch Reactors (SBR), Membrane Bioreactors (MBR)) can also be applicable, where economics allow
- Hybrid aerobic reactors, such as the submerged biological aerated filter may be used.

Wastewater treatment techniques are divided into three sections; primary, secondary and tertiary. Data on the quality of the effluent after proper primary and secondary treatment is given in BREF Table 4.44.

Primary treatment includes typically physical unit operations as follows:

- Bar racks and screens (see BREF Section 4.5.2.1)
- Separators for oil, fats and light hydrocarbons (see BREF Section 4.5.2.2)
- Flow and Load equalisation (see BREF Section 4.5.2.3)
- Neutralisation (see BREF Section 4.5.2.4)
- Diversion tank (see BREF Section 4.5.2.7)
- Floatation (see BREF Section 4.5.2.6)
- Sedimentation (see BREF Section 4.5.2.5)
- Centrifuges (see BREF Section 4.5.2.8)
- Wetlands systems.

Between primary and secondary treatment, chemical treatment such as precipitation, flocculation, coagulation and acidification, may be applied to further remove suspended solids in the wastewater.

Secondary treatment, which is typically biological treatment, follows and it can be either aerobic, anaerobic or a combination of these. Aerobic treatments include:

- Activated sludge (see BREF Section 4.5.3.1.1)
- Sequencing batch reactor (see BREF Section 4.5.3.1.3)
- Lagoons (see BREF Section 4.5.3.1.4)
- Biotowers (see BREF Section 4.5.3.1.6)
- Biological aerated flooded filters (See BREF Section 4.5.3.1.8)
- Submerged biological aerated filters (see BREF Section 4.5.3.1.8)
- Membrane bioreactor (see BREF Section 4.5.3.3.1)
- Losse media systems
- Wetlands systems.

Anaerobic treatments include:

- Anaerobic contact processes (see BREF Section 4.5.3.2.2)
- Anaerobic filter (see BREF Section 4.5.3.2.3)
- Upflow anaerobic sludge blanket (see BREF Section 4.5.3.2.6)
- Expanded and fluidised bed reactors (see BREF Section 4.5.3.2.7).

Finally, there are a number of treatments following primary and secondary treatment, known as tertiary treatment. These include:

- Activated sludge configuration for nitrogen removal (see BREF Section 4.5.4.1)
- Ammonia stripping (see BREF Section 4.5.4.2)
- Removal of phosphorus (see BREF Section 4.5.4.3)
- Removal of priority substances (see BREF Section 4.5.4.4)
- Filtration for effluent polishing (see BREF Section 4.5.4.5)
- Membrane techniques (see BREF Section 4.5.4.6)
- Wetland systems
- Biofiltration
- Sterilisation and disinfection techniques (see BREF Section 4.5.4.8):
    - Use of oxidising biocides (see BREF Section 4.5.4.8.1)
    - Ozone (see BREF Section 4.5.4.8.1)
    - UV radiation (see BREF Section 4.5.4.8.2)
- Wetlands systems
- Biofiltration.

### 4.4.2 Techniques for Treating and Recovering Solid Output

See BREF Section 4.5.6.

Examples of methods to treat, recover and dispose of solid emissions prior to leaving an installation are given below; the disposal of solid outputs is not covered by the BREF document.

The treatment and disposal of wastewater treatment sludge may include:

- Conditioning
- Sludge thickening
- Sludge dewatering
- Stabilisation
- Drying
- Landspreading
- Composting
- Anaerobic digestion
- Wetlands Systems.

### 4.4.3 Techniques for the Treatment of Air Emissions

See BREF Section 4.4.3.

Having minimised in-process air emissions, further control of waste gases and odour by applying end-of-pipe techniques may be needed.

To reduce the environmental impact:

- Control odour and gaseous substances from exhaust air (see BREF Section 4.4.3.4)
- Use a tubular dust filter (see BREF Section 4.4.3.7.1)
- Use bag filters that are capable of reducing dust emissions (see BREF Section 4.4.3.7.2)
- Apply early warning fire alarm to reduce the risks of explosion in spray drying plants (see BREF Section 5.2.5.1).

### 4.4.4 Odour

See BREF Section 4.4.3.4.

The most appropriate abatement technique for a given application depends upon many factors such as the physical characteristics of the waste gases to be treated, the flow rate, the components present in the exhaust and/or the odour intensity, the degree of contamination present, such as particulate and condensable material, and the degree of treatment required. All of these factors need to be taken into consideration when deriving the optimum treatment techniques. The variation in treatment efficiency and capital and operating costs between the various options can be potentially very high.

There are a number of potential options for the treatment of gaseous and odorous exhaust emissions including the following operations:

- Water and chemical scrubbing
- Adsorption onto activated carbon or other porous substrate
- Incineration, including both thermal and catalytic oxidation
- Biological oxidation.

There are also some additional odour control techniques, such as physical dispersion, which can minimise the environmental impact of an odorous emission. This treatment involves implementing improvements to the dispersion potential of the emission, e.g. extending the height of the discharge stack or increasing the discharge velocity.

### 4.4.5 Noise Abatement

See BREF Sections 4.1.3 & 4.1.4.

- Implement noise management system
- Carry out routine monitoring and maintenance to reduce noise emissions:
    - Use silencers on ventilation system (absorb, encapsulate)
    - Use elastic linkages in between fans and ducts
    - Install pipes with better sound insulation properties (e.g. cast iron instead of plastic)
    - Insulate mechanical vapour compressors and thermal vapour compressors
    - Increase wall thickness of pipes, where feasible
    - Enclose pipes in jackets
    - Insulate parts of industrial buildings
    - Install machines on a basement with rubber
    - Keep doors and windows closed
- Design an appropriate supply height for pumps and/or operate the pumps via frequency converters
- Insulate to reduce noise emissions, including insulation of items of equipment
- See also EPA Guidance Note for *Noise in Relation to Scheduled Activities.*

### 4.4.6 Management of Accidental Release

See BREF Section 4.6.

One of the most significant potential environmental impacts is the accidental release of material into the environment due to an abnormal event. For example, the accidental release of the contents of a tank containing raw material or products (e.g. milk, ammonia) can have a significant detrimental impact on a local watercourse or water supply. Techniques to minimise the effect of accidental releases are:

- Identify potential incidents/accidental releases (abnormal operation) that could have an adverse impact on the environment (see BREF Section 4.6.1)
- Identify potential accidental releases to determine their risk to the environment (see BREF Section 4.6.2)
- Develop control measures to prevent, eliminate or reduce the risks associated with identified potential incidents (see BREF Section 4.6.4)
- Develop an emergency plan (see BREF Section 4.6.5)
- Investigate all accidents and near misses (see BREF Section 4.6.6).

## 4.5 CONTROL TECHNIQUES FOR SPECIFIC PROCESSES WITHIN THE DAIRY INDUSTRY

### 4.5.1 Condensed Milk and Powder Production

The following techniques can be applied to the production of condensed milk and powder (see BREF Section 2.2.5.2):

- Abatement technologies for the reduction of emissions to air should be utilised where necessary and bag filters considered for the reduction of dust emissions
- Improve fire and explosion protection in spray drying plants where explosive dust/air mixtures can occur
- Avoid the use of dampers on air ducts
- Remove powder residues in dry form.

### 4.5.2 Butter Manufacture

The following techniques can be applied to the production of butter (see BREF Section 2.2.5.3):

- Remove completely butter and cream remnants in the buttermaking machine at the end of production, i.e. before cleaning to ensure they do not get into the waste water
- Remove butter in pipework at the end of production before cleaning.

### 4.5.3 Manufacture of Cheese

The following techniques can be applied to the production of cheese (see BREF Section 2.2.5.4):

- Ensure that systems are completely drained of whey and curd by applying efficient plant design and operation
- Preheat the entering cheese milk by using warm whey
- Heat exchangers may be used in batch processing
- Check the air-conditioning of ripening rooms for any possibilities of heat regeneration in order to save energy
- Drain the top or platform of the salting vats to avoid brine spillage to the drain.

### 4.5.4 Manufacture of Yogurt

The following techniques can be applied to the production of yogurt (see BREF Section 2.2.5.5):

- Take into account the possibility of an increase in $BOD_5$ values and settleable solids if fruit containers are cleaned in place
- Use raw material in returnable packaging or in silo tankers instead of non-returnable packaging
- Ensure that the systems are completely drained by efficient plant design and operation
- Use heat loss from other operations for pre-warming of yoghurt milk to reduce energy consumption.

# 5. BEST AVAILABLE TECHNIQUES FOR THE DAIRY PROCESSING SECTOR

## 5.1 INTRODUCTION

This Guidance Note identifies BAT but obviously does so in the absence of site-specific information. Accordingly, it represents the requirements expected of any new activity covered by the Note, and ultimately the requirements expected of existing facilities, but exclude additional requirements, which may form part of the granting of a licence for a specific site.

The technical feasibility of the measures listed below has been demonstrated by various sources. Used singly, or in combination, the measures represent BAT solutions when implemented in the appropriate circumstances. These circumstances depend on the nature of the process, plant scale, fuels used, etc.

## 5.2 BAT – GENERIC PREVENTATIVE MEASURES

### 5.2.1 Generic Measures

See BREF Section 5.1.

- Implement an environmental management system (see BREF Section 5.1.1).

### 5.2.2 Raw Materials Use & Selection of Materials

See BREF Sections 5.1.2 & 5.1.3.

- Substitute or reduce the use of materials, especially chemicals, to minimise the environmental impact.

With regard to materials used as refrigerants or packaging, generally it can be said that BAT is to:

- Eliminate the use of halogenated substances as refrigerants, with special regard to CFCs
- Select packaging materials, which cause the least environmental impact
- To keep waste to a minimum:
    - Select packaging materials that are designed for re-use, where feasible
    - Consider the weight and volume of each material, together with its recycled content, also the potential for re-use, recycling and where appropriate disposal of the packaging.

### 5.2.3 Waste Minimisation

See BREF Section 5.1.4.

BAT is to:

- Adopt a waste minimisation programme (see BREF Section 4.1.6)
- Apply good housekeeping practices (see BREF Section 4.1.7)
- Improve operating practices (see BREF Sections 4.1.6.2.3 & 5.1.4.1.8)
- Optimise the process control of inputs, conditions, handling, storage and effluent generation. See BREF Section 4.1.8 and also BREF on General Principles of Monitoring[1] gives information on BAT for monitoring

[1] European IPPC Bureau, 2002. *BREF Document on the General Principles of Monitoring*

- Apply BAT for storage and handling of materials as described in the BAT Reference Document on Best Available Techniques on Emissions from Storage[2]. Some techniques for storage and handling are also listed in the Food, Drink and Milk Industry (see BREF Section 4.1.7).

### 5.2.4 Water Management

See BREF Section 4.1.6.

BAT for water management are given in this section. There is a cross-over with the BAT for other issues, e.g. waste minimisation, cleaning.

BAT is to:

- Provide water in a sufficient amount and suitable quality (see BREF Section 4.1.6)
- Apply a water management system
- Apply a methodology for reducing water consumption.

In addition, for reducing water consumption and water pollution, BAT is to:

- Eliminate the use of water, where possible
- Apply good housekeeping
- Optimise the process
- Recycle/re-use water within a unit process or group of processes without treatment or with treatment
- Implement an efficient program of maintenance of utility systems.

Additionally, BAT (see BREF Sections 4.7.5, 5.2.5 & 5.1.4.11) is to:

- Implement adequate process control and maintenance systems to eliminate leaks, overflows and other associated losses to wastewater and to maximise solids recovery
- Treat spills as solid waste rather than washing down drains, where feasible
- Fit drains with screens and/or traps to prevent solid material from entering effluent drains
- Utilise a CIP system to minimise chemical usage and water consumption
- Re-use cooling water, condensates from drying and evaporation operations, permeates from membrane separation processes and final rinse water with and without treatment, where feasible.

### 5.2.5 Cleaning

See BREF Section 5.1.3.

Cleaning and sanitising are used in all processes in the milk sectors. Since it is the most water consuming operation in most processes it is included separately from the Water Management Section (see BREF Section 5.2.4).

To save water and minimise water pollution from cleaning, BAT is to:

- Use dry cleaning (see also waste minimisation and sector specific examples)
- Apply good housekeeping practices.

In manual cleaning, BAT is to:

  - Use high pressure (low volume) water for cleaning floors and open equipment
  - Use low-pressure foam cleaning
  - Install trigger nozzles on hoses to reduce flow rates, where feasible
  - Utilise spray guns instead of open-ended hoses for cleaning, where feasible.

[2] European IPPC Bureau, 2001. *BREF Document on Emissions from Storage*

In automated cleaning, BAT is to:

- Optimise the CIP sequences, i.e. cleaning and rinsing times
- Optimise the CIP programme for the size of plant/vessel and type of soiling
- Calibrate CIP programme
- Recover CIP solutions
- Re-use secondary water, such as reverse osmosis water and product condensate, for cleaning less sensitive areas, where feasible
- Re-use warm cooling water for cleaning where feasible (see BREF Section 4.7.5.17)
- Apply recycling process controls based on conductivity rather than time
- Re-use water from the final rinse for pre-rinsing
- Pre-rinse to enable remaining product to be recovered for re-use or disposal
- Apply automatic dosing of chemicals at the correct concentrations
- Apply high-pressure jet cleaning, foam and gel cleaning for open equipment, walls and floors
- Apply automated CIP rather than manual cleaning, where feasible
- Reduce the use of EDTA as a chelating agent (see BREF Section 4.3.8)
- Avoid use of organo-halogen based oxidising biocides, except when unavoidable for technical reasons (see BREF Section 4.3.8.1).

In addition to the water pollution control measures described above, BAT is to:

- Modify process lines and operations that cause excessive spillage of material onto the floor to eliminate or reduce the problem, wherever practicable
- Remove as much residual material as possible from vessels and equipment before they are washed
- Ensure that drains are equipped with catchpots
- Ensure that the catchpots are in place during cleaning
- Optimise the water pressure at jets, nozzles and orifices
- Utilise an automatic water supply shut off on trigger operated spray guns or hoses.

### 5.2.6 Energy Efficiency

See BREF Section 5.1.4.10.

BAT to improve energy efficiency is to:

- Apply efficient energy management (see BREF Section 4.1.6)
- Optimise the manufacturing process (see BREF Section 4.1.6)
- Minimise heat/energy losses as far as practicable
- Evaluate the use combined heat and power generation (see BREF Section 4.2.13.1.1)
- Recover energy, where feasible, by:
    - Recovering heat from cooling systems where feasible (see BREF Section 4.2.13.15)
    - Using (low grade) heat from another process where feasible
    - Using counter-current heat-exchange where feasible.

A large part of the energy consumption of a plant is related to its utilities. Important utilities are compressed air, steam, refrigeration, air conditioning and electricity supply.

For steam systems, BAT is to:

- Maximise condensate return
- Avoid losses of flash steam from condensate return
- Improve steam trapping
- Repair steam leaks.

For compressed air generation, BAT is to:

- Apply good housekeeping
- Treatment of compressed air: check the use of compressed air and the need for it
- Establish if there is any compressed air leakage and if so, repair immediately.

For refrigeration plants, BAT is to:

- Keep the condensers clean
- Make sure that the air entering the condensers is as cold as possible
- Check for leaks of refrigerant
- Check oil level, etc.

For cooled rooms, BAT is to:

- Keep doors and windows closed as much as possible
- Fit fast-closing and effectively insulating doors between areas with different temperatures where feasible
- Refrigerate at night, where feasible
- Check that evaporators defrost properly
- Avoid keeping the store colder than necessary.

In addition, BAT (see BREF Section 5.2.5) is to:

- In powdered milk manufacturing, run evaporators to get the highest possible concentration prior to drying (where appropriate) because the energy consumption needed for water evaporation in the evaporator is lower than it is in the drying plant
- Optimise process engineering to reduce energy for heating and refrigeration (heat regeneration, raw milk partial stream refrigeration)
- Use mechanical vapour recompression or thermal recompression where feasible. Mechanical recompression is more efficient in terms of energy. Note, however, it is necessary to check on a case-by-case basis whether an evaporator with thermal recompression is economically advantageous under the specific circumstances.

For cheese ripening, BAT is to:

- Use higher temperatures to shorten ripening times where feasible. Humidifying and cleaning of circulated air is then needed.

For milk processing, BAT is to:

- Use a partial homogenisation of milk.

In deep-freezing operations, BAT is to:

- Use automatic defrosting of cooling evaporators.

### 5.2.7 Minimising Air Emissions

See BREF Section 5.1.5.

Generally for controlling emissions to air, BAT is to:

- Use of low-emission substances and products (substance-related primary measures)
- Use of low-emission systems and production processes (process-related primary measures).

Specifically, BAT is to:

- Apply a control strategy (this applies in the case of odour minimisation also) (see BREF Section 4.4.1)
- Select process techniques with maximum possible product yield and minimum emissions into the environment

- Optimise the process as well as the start-up and shutdown and other special operating situations
- Reduce the quantity of waste gas
- Avoid process cycles that could result in elevated emissions of hazardous substances by means of technical or operational measures
- Reduce energy consumption and emissions of greenhouse gases
- Prevent or minimise emissions of substances that deplete the ozone layer.

## 5.3 BAT – Generic Measures for Treatment, Abatement and Disposal

### 5.3.1 Wastewater Treatment

See BREF Sections 5.1 & 5.1.6.

For all facilities, BAT is to minimise the quantity and load of wastewater generated using the measures outlined in BREF Section 4.1.6, then treat wastewater as follows:

- For new installations, BAT is to segregate wastewater streams, i.e. trade effluents, sanitary waters, cooling water, storm-water, according to their contaminant type and load

- BAT is to treat effluents including applying:
  - Primary treatment (see BREF Section 4.5.2), e.g. using:
    - Flow and load equalisation (see BREF Section 4.5.2.3)
    - pH correction/neutralisation (see BREF Section 4.5.2.4)
    - Screening (see BREF Section 4.5.2.1)
    - Sedimentation (see BREF Section 4.5.2.5)
    - Flotation (see BREF Section 4.5.2.6)
    - Centrifugation (see BREF Section 4.5.2.8)
  - Secondary treatment (see BREF Section 4.5.3), used alone or in combination, e.g.:
    - Aerobic suspended growth processes, such as activated sludge, aeration lagoons, sequencing batch reactors (see BREF Sections 4.5.3.1.1 & 4.5.3.1.1)
    - The above processes with extended aeration (to reduce sludge production)
    - Fixed film aerobic processes, such as a biotower, a biofilter (see BREF Section 4.5.3.1.6)
    - Aerobic treatment with nitrification (to reduce ammonia) (see BREF Section 4.5.4.1)
    - Anaerobic processes (see BREF Section 4.5.3.2).

Further treatment may be needed either for re-use of the water or to meet special discharge requirements to protect the receiving water (see BREF Section 4.5.4). In this case, BAT is to:

- Remove nitrogen biologically (see BREF Section 4.5.4.1)
- Remove phosphorous by precipitation/sedimentation (see BREF Section 4.5.2.9)
- Remove nitrogen and phosphorous biologically (see BREF Section 4.5.4.3)
- Use filtration for effluent polishing (see BREF Section 4.5.4.5)
- Remove priority pollutants (see BREF Section 4.5.4.4)
- Apply separation techniques using membranes (see BREF Section 4.5.4.6)
- Consider wetland systems and biofiltration
- Disinfect the treated effluent (see BREF Section 4.5.4.8)

- Wetlands systems
- Biofiltration.

### 5.3.2 Solid Waste Treatment

See BREF section 5.1.6.

The BAT for the disposal options of wastewater sludge are not given in the BREF document. However, selection of BAT takes into account the final use or disposal processes (e.g. use as a fertiliser or soil conditioner, use as a sealing material, incineration, co-incineration, wet oxidation, pyrolysis, gasification, vitrification).

Prior to final use or disposal of wastewater sludges, BAT is to use the following techniques alone or in combination (see BREF Section 4.5.6):

- Thickening (see BREF Section 4.5.6.1.3)
- Dewatering (see BREF Section 4.5.6.1.4)
- Stabilisation, i.e. chemical, thermal stabilisation, aerobic or anaerobic digestion (see BREF Section 4.5.6.1.2)
- Drying (see BREF Section 4.5.6.1.5).

### 5.3.3 Treatment of Air Emissions

See BREF Sections 5.1 & 5.1.5

Having minimised in-process air emissions further control of waste gases and odour by applying end-of-pipe techniques may be needed.

In this respect, BAT is to:

- Separate solid and liquid substances from exhaust air (see BREF Sections 4.4.3.5 & 4.4.3.6)
- Control odour and gaseous substances from exhaust air (see BREF Section 4.4.3.13)
- Use abatement technologies to reduce particulate emissions to air (see BREF Section 4.4.3.7 & 4.4.3.8)
- Apply early warning fire alarm to reduce the risks of explosion in spray drying plants.

In the case of treatment and abatement of gaseous substances from exhaust air including odour emissions BAT is to use:

- Absorption (see BREF Section 4.4.3.8), or
- Adsorption (see BREF Section 4.4.3.9), or
- Chemical degradation, such as thermal treatment (see BREF Section 4.4.3.11)
- For odour, non-thermal plasma treatment (see BREF Section 4.4.3.12)
- Biological degradation, such as soil beds, biofilters and bioscrubbers (see BREF Section 4.4.3.10)
- Or a combination of these techniques.

The selection of abatement techniques for a given application depends on a large number of factors, this information is given in BREF Section 4.4.3.4.

### 5.3.4 Noise Abatement

See BREF Section 5.1.

For noise reduction, where feasible, BAT (see BREF Sections 4.1.3 & 4.1.4) is to:

- Use silencers on ventilation system (absorb, encapsulate)
- Use elastic linkages in between fans and ducts
- Install pipes with better sound insulation properties (e.g. cast iron instead of plastic)

- Insulate mechanical vapour compressors and thermal vapour compressors
- Increase wall thickness of pipes, where feasible
- Enclose pipes in jackets
- Insulate parts of industrial buildings
- Install machines on a rubber base
- Keep doors and windows closed
- Design an appropriate supply height for pumps and/or operate the pumps via frequency converters.

### 5.3.5 Accidental releases

See BREF Sections 5.1 & 4.1.7.

The management of accidental releases may be part of an environmental management system.
In general, regarding avoiding or minimising the risk of accidents, BAT (see BREF Section 4.6) is to:

- Identify potential sources of incidents/accidental releases (abnormal operation) that could have an adverse impact on the environment (see BREF Section 4.6.1)
- Identify potential accidental releases to determine their risk to the environment (see BREF Section 4.6.2)
- Develop control measures to prevent, eliminate or reduce the risks associated with identified potential incidents (see BREF Section 4.6.4)
- Develop an emergency plan (see BREF Section 4.6.5).

Further information on a number of waste gas and wastewater treatment techniques can be found in the BREF document on *Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector*, EIPPCB, February 2003.

# 6. BAT ASSOCIATED EMISSION LEVELS

## 6.1 EMISSION LEVELS FOR DISCHARGES TO AIR

The BAT-associated emission levels for emissions to air are as follows:

***Table 6.1 BAT-Associated Emission Levels for Emissions to Air***

| Constituent Group or Parameter | Emission Level ($mg/m^3$) | Mass Threshold (g/hour) Note 1 |
|---|---|---|
| Total Organic Carbon (as C) | 50 | 500 |
| Total Particulate | 5 - 50 | >200 |
| | 150 | <200 |
| Ammonia | 30 | 150 |
| Amines | 5 | - |
| Hydrogen Sulphide (as S) | 3 | 15 |
| Mercaptans | 5 | - |
| Hydrogen Chloride | 30 | 15 |
| Other | -- | Note 2 |

Note 1: The Mass Flow Threshold is calculated in g/hr or kg/hr and is determined to be the maximum emission, which can occur over any one-hour period of plant operation. Where the Mass Flow in the raw gas exceeds the mass flow threshold given in the Table, abatement will be required to reduce the emission to below the appropriate emission level or mass flow threshold.

Note 2: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

### ODOUR EMISSIONS

Activities at the installation shall be carried out in a manner such that emissions of odours do not result in significant impairment of, and/or significant interference with amenities or the environment beyond the installation boundary. Reference shall be made to the Environmental Protection Agency's publication *Odour impacts and odour emission control measures for intensive agriculture (2001).*

## 6.2 Emission Levels for Discharges to Water

The following table sets out emission level values that are achievable using BAT for wastewater treatment. However establishing emission limit values within a licence for direct discharges to surface water from wastewater treatment plant and stormwater discharges must ensure that the quality of the receiving water is not impaired or that the current Environmental Quality Standards (EQS) are not exceeded.

All discharges to sewer are subject to approval from the Water Services Authority.

Compliance with the Water Framework Directive (2000/60/EC) is required where relevant, in particular Article 16.

***Table 6.2: BAT-Associated Emission Levels for Discharges to Water****

| Constituent Group or Parameter | Emission Level | Notes |
|---|---|---|
| pH | 6 - 9 | |
| Number of Toxicity Units (TU) | 5 | 1 |
| $BOD_5$ | >90% removal[3], or 20 - 40mg/l | |
| COD | >75% removal[3], or 125 - 250mg/l | |
| Suspended Solids | 50mg/l | |
| Total Ammonia (as N) | 10mg/l | |
| Total Nitrogen (as N) | >80% removal[3], or 5 - 25mg/l | 2,4 |
| Total Phosphorus (as P) | >80% removal[3], or 2 - 5mg/l | 4 |
| Oils, Fat and Grease | 10 - 15mg/l | |
| Mineral Oil (from interceptor) | 20mg/l | |
| Mineral Oil (from biological Treatment) | 1.0mg/l | |
| Other | -- | 5 |

* All values refer to daily averages based on a 24-hour flow proportional composite sample, except where stated to the contrary and for pH, which refers to continuous values. Levels apply to effluent prior to dilution by uncontaminated streams, e.g. storm water, cooling water, etc.

* Temperature measured downstream of a point of thermal discharge must not exceed the unaffected temperature by more than 1.5°C in salmonid waters and 3°C in cyprinid waters (Freshwater Fish Directive 79/659/EEC).

Note 1: The number of toxic units (TU) = 100/x hour $EC/LC_{50}$ in percentage vol/vol so that higher TU values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

Note 2: Total Nitrogen means the sum of Kjeldahl Nitrogen, Nitrate N and Nitrite N.

Note 3: Reduction in relation to influent load.

Note 4: Limits will depend on the sensitivity of the receiving waterbody.

Note 5: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

## 6.3 Emissions to Land

In the assessment of the impact of landspreading of organic waste, reference shall be made to the relevant Environmental Protection Agency's guidance and any guidance from the Department of Agriculture and Teagasc.

# 7. COMPLIANCE MONITORING

The methods proposed for monitoring the emissions from the sector are set out below. Licence requirements may vary from those stated below due to site-specific considerations, sensitivity of receiving media, and scale of the operations.

## 7.1 MONITORING OF EMISSIONS TO AIR

- Annual monitoring of boiler stack emissions for $SO_x$, $NO_x$, CO and particulates, as required by the licence, taking account of the nature, magnitude and variability of the emission and the reliability of the controls.
- Monitoring of boiler combustion efficiency in accordance with the manufacturer's instructions at a frequency determined by the Agency.
- Annual monitoring of driers, filter exhausts and powder transfer or conditioning units for particulates – $PM_{10}$.
- Periodic monitoring for other parameters as determined by the Agency.
- Olfactory (sniff) assessment for odours should be carried out daily or as directed by the Agency at a minimum at four boundary locations and at the nearest odour sensitive locations to be agreed with the Agency.

## 7.2 MONITORING OF AQUEOUS EMISSIONS

- For uncontaminated cooling waters, continuous monitoring of temperature and flow
- Continuous monitoring of flow discharge from wastewater treatment plant and any other parameters deemed necessary by the Agency.
- Daily monitoring of flow, volume, pH, temperature and any other relevant parameters deemed necessary by the Agency, taking account of the nature, magnitude and variability of the emissions and the reliability of the control technique.
- Establish existing conditions prior to start-up of key emission constituents and salient flora and fauna.
- Monitoring of influent and effluent for the waste water treatment plant to establish % BOD reduction and early warning of any difficulties in waste water treatment, or unusual loads.
- The potential for the treated effluent to have tainting and toxic effects should be assessed and if necessary measured by established laboratory techniques.
- Periodic biodegradability checks where appropriate on effluents to municipal waste treatment plants, both prior to start-up and thereafter.

## 7.3 MONITORING OF EMISSIONS TO GROUNDWATER

There should be no direct emissions to groundwater, including during extraction and treatment of groundwater.

## 7.4 MONITORING OF SOLID WASTE

- The recording in a register of the types, quantities, date and manner of disposal/recovery of all wastes.
- Leachate testing of sludges and other material as appropriate being sent for landfilling.
- Annual waste minimisation report showing efforts made to reduce specific consumption together with material balance and fate of all waste materials.

# Appendix 1

## PRINCIPAL REFERENCES


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# Appendix 2

## Table 1: Environmental Risks associated with Unit Processes

| Unit Operation | Environmental Risk | | | | | BREF Reference |
|---|---|---|---|---|---|---|
| | Water | Air Emissions | Solid Output | Energy | Noise | |
| **Materials handling, unpacking, storage** | • Leakage of SS[3] and soluble compounds from water transport<br>• Cleaning | Leakage while filling or conveying (particulates, gases, odours) | From vessels or material handling equipment | Minor risk from electrical consumption | Short period noise from vehicle discharge | 3.2.2 |
| **Cutting, slicing, chopping, mincing, pulping, pressing** | WW mainly from cleaning, may contain product remnants | | By-products from processing | Electrical energy | High-speed, power-operated equipment – not usually issue | 3.2.6 |
| **Mixing, blending, homogenisation** | WW mainly from cleaning equipment may contain SS and soluble compounds | • Solids and volatile materials emissions<br>• Odours in processing treating VOCs<br>• Particulates | Product loss | Electrical energy | Homogenisatio n may be noise issue | 3.2.7 |
| **Grinding, milling, crushing** | | Particulates | Product loss | Grinding uses lots of energy | | 3.2.8 |
| **Forming, moulding, extruding** | Cleaning – contains BOD and solid matter | Extrusion may cause emission of VOCs and odour | Product loss | Extruders use lots of energy | | 3.2.9 |
| **Deionisation** | WW containing chemicals, minerals, product residue, with variable pH | | Ion exchange resins | | | 3.2.11 |
| **Centrifugation** | WW from process & cleaning contains BOD & SS | | Separator sludges (may be reused) as an animal feed or fertiliser | Electrical energy for pumping operations | Centrifuges can produce high levels of noise | 3.2.12 |

[3] SS means Suspended Solids, WW means Wastewater

| Unit Operation | Environmental Risk | | | | | BREF Reference |
|---|---|---|---|---|---|---|
| | Water | Air Emissions | Solid Output | Energy | Noise | |
| **Filtration** | Liquid waste stream containing dissolved organic matter and SS | Vacuum filtration may cause particulate emissions | Filter cake | Pumping requires lots of energy | | 3.2.13 |
| **Membrane separation** | WW from process & cleaning contains BOD & SS | | | Electrical energy required | | 3.2.14 |
| **Crystallisation** | WW after crystal removal | | Spent absorbers | Energy needed for pumps, drives & cooling system | | 3.2.15 |
| **Neutralisation (removal of fatty acids)** | • Requires cooling water<br>• WW very acidic, contains salts, sodium phosphate, sodium-sulphate or chloride, may also have high BOD | Soap-stock acidulation may cause odour | Treatment of wastewater produces lots of sludge containing phosphate or sulphates | Steam | | 3.2.16 |
| **Dissolving** | Cleaning<br>WW may contain product residue, BOD, SS and fat | Dust emissions - minor | | Steam and electricity | | 3.2.22 |
| **Fermentation** | Cooling water<br>Cleaning<br>WW has high COD – may be recovered as animal feed | $CO_2$ | Spent yeasts | Electrical energy to circulate cooling water | | 3.2.24 |
| **Coagulation** | High quality water needed for curd washing<br>Cleaning – contains BOD and SS | | | Steam for heat treatment<br>Electricity for cooling | | 3.2.25 |
| **Brining, curing** | WW has high salt content and high BOD, may contain protein<br>Cleaning – WW contain BOD, DS and solid material | | | | | 3.2.27 |

| Unit Operation | Environmental Risk | | | | | BREF Reference |
|---|---|---|---|---|---|---|
| | Water | Air Emissions | Solid Output | Energy | Noise | |
| **Smoking** | Cleaning | Strong odours<br>Smoke contains VOCs | Ashes | Smoke generation, heating and drying | | 3.2.28 |
| **Coating, spraying, enrobing, agglomerisation, encapsulation** | Cleaning – may contain BOD and solid material | | | | | 3.2.32 |
| **Melting** | Cleaning<br>WW contains fat, BOD and solid matter | Odour during dry melting | Solid phase left after melting in some processes | Steam | | 3.2.33 |
| **Pasteurisation, sterilisation, UHT** | Water for cooling<br>WW contains BOD and solid matter | | | Steam or hot water<br>Energy for refrigeration | | 3.2.40 |
| **Evaporation (liquid to liquid)** | Condensate<br>Cleaning –<br>WW contains contains BOD, dissolve inorganic and SS | Incondensable gases may be vented to air | | Steam | Equipment may be very noisy | 3.2.41 |
| **Drying (liquid to solid)** | Cleaning – WW contains soluble organic matter, SS and fine dust | Gas/vapour emitted to air – may contain dust VOCs<br>Odour<br>Exhaust may contain $CO_2$, CO, SO, NOx | Product losses | For evaporation of water | Noise may occur from dryers | 3.2.42 |
| **Cooling, chilling, cold stabilisation** | Cooling water | May be emissions of $N_2$ of $CO_2$<br>Leaking refrigerant | | Electrical energy for pumps and fans | Fans and cooling towers | 3.2.44 |
| **Freezing** | WW containing brine for immersion freezing | Emissions of $N_2$ or $CO_2$ | | Electrical energy for fans, air circulation and freezing system | Operation of fans | 3.2.45 |

| Unit Operation | Environmental Risk | | | | | BREF Reference |
|---|---|---|---|---|---|---|
| | Water | Air Emissions | Solid Output | Energy | Noise | |
| **Packing, filling** | Accidental releases<br>Washing of glass containers<br>WW contains BOD, solid matter | | Packaging material, damaged products | Energy for filling, capping, packing equipment | | 3.2.47 |
| **Cleaning/sanitisation** | Main use of water – needs to be appropriate water quality<br>WW contains BOD, COD, SS, products remnants, residues of cleaning agents | | Product residues | Heat used for cleaning | | 3.2.49 |
| **Energy generation/ consumption** | Boiler water may contain chemicals, silica or other soluble minerals | $CO_2$ and water<br>May be $SO_2$, CO, NOx, particulates, VOCs | Ashes, scale, soot | | Boiler safety valves | 3.2.50 |
| **Water treatment (incoming process water)** | WW contains effluent from regeneration and retentates from other processes | | Mineral sludges and spent resins | | | 3.2.51 |
| **Vacuum generation** | Water used in vacuum pumps – may be recycled<br>Spray condensers - large volume used to condense steam<br>WW contains BOD | Emission may be volatile material and odour<br>Non-condensable material | | Reasonably high for large operations | Fans associated with cooling towers | 3.2.52 |
| **Refrigeration** | Used as cooling medium<br>Prevent accidental release of ammonia | Release of ammonia into atmosphere | | Electricity for refrigeration equipment | Compressors of refrigeration equipment | 3.2.53 |

# Appendix 3

## GLOSSARY OF TERMS AND ABBREVIATIONS

| | |
|---|---|
| BAT | Best Available Technique |
| BOD | Biochemical Oxygen Demand |
| BREF | Reference document on Best Available Techniques in the Food, Drink and Milk Industry, published by the European Commission, January 2006 |
| °C | Degree Celsius |
| CO | Carbon monoxide |
| COD | Chemical Oxygen Demand |
| $CO_2$ | Carbon dioxide |
| ELV | Emission Limit Value |
| kg | Kilogramme |
| K | Degree Kelvin (0 °C = 273.15 K) |
| $m^3$ | Cubic metre |
| mg | Milligramme |
| MJ | Megajoule (1 MJ = 1000 kJ = $10^6$ joule) |
| $N_2$ | Nitrogen |
| $Nm^3$ | Normal cubic metre (101.3 kPa, 273 K) |
| $NH_3$ | Ammonia |
| $NH_4$ | Ammonium |
| NO | Nitrogen monoxide |
| $NO_2$ | Nitrogen dioxide |
| $NO_x$ | Nitrogen oxides |
| $O_2$ | Oxygen |
| $SO_2$ | Sulphur dioxide |
| $SO_x$ | Sulphur oxides |
| SRM | Specified Risk Material |
| t | Tonne (metric) |
| TSE | Transmissible Spongiform Encephalopathy |
| VOC | Volatile Organic Compounds |
| WWTP | Waste Water Treatment Plants |