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Integrated Pollution Prevention and Control

Reference Document on Best Available Techniques in the Slaughterhouses and Animal By-products Industries

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EXECUTIVE SUMMARY

Introduction

This BREF (Best available techniques REFerence document) on the Slaughterhouses and Animal by-products industries reflects an information exchange carried out according to Article 16(2) of Council Directive 96/61/EC. This "Executive summary", describes the main findings, the principal BAT conclusions and the associated emission levels. It should be read together with the "Preface", which explains this BREF's objectives; how it is intended to be used and legal terms. It can be read and understood as a stand-alone document but, as a summary, it does not present all the complexities of the full BREF text. The main text in its entirety should be used as a reference in the determination of BAT-based conditions for IPPC permits.

Scope

This BREF covers the industrial activities specified in Annex I, paragraphs 6.4.(a) and 6.5. of the Directive, i.e.

6.4.(a) Slaughterhouses with a carcase production capacity greater than 50 tonnes per day

and

6.5. Installations for the disposal or recycling of animal carcases and animal waste with a treatment capacity exceeding 10 tonnes per day

Some processes are in this document because they are associated activities of 6.4.(a) even though on first examination they would more obviously be 6.5. activities, but they fall below that threshold.

For large animals, such as cattle, sheep and pigs, the "slaughter" activity is considered to end with the making of standard cuts and for poultry, with the production of a clean whole saleable carcase. In recent years there has been a change in the terminology used to describe outputs from slaughterhouses. The term "by-product" is being used increasingly and it is widely used in this document. The word "waste" is only used when referring to disposal activities.

Animal by-products activities covered include the treatments for entire bodies or parts of animals and those for products of animal origin. These activities include the treatments of animal by-products both intended for and not intended for human consumption. A wide range of by-products activities are covered. These include fat melting; rendering; fish-meal and fish-oil production; bone processing; blood processing associated with slaughterhouses and to the degree where the blood becomes a material for use in the preparation of another product. The incineration of carcases, parts thereof and animal meal and the burning of tallow, are covered principally as routes for disposal. Land spreading; land injection; biogas production; composting; the preservation of hides and skins for tannery use, in slaughterhouses and gelatine manufacture are also covered. Landfill is not covered, except when mentioned as a route for disposal.

General information (Chapter 1)

<u>Slaughterhouses</u>
The slaughtering industry throughout the EU is diverse with many different national characteristics. Some of these are due to different local end products, e.g. typical Italian cured products. Others depend on what market the products are destined for, e.g. longer shelf-lives may be required for meat destined for export than that to be sent to the local market. These

characteristics reportedly affect some of the choices made about what techniques are used in some slaughterhouses.

Trends in the industries can influence environmental issues by, e.g. changing the amounts of water consumed or the amount of waste produced. There appears to be a trend towards fewer slaughterhouses with increasing average throughputs. It is reported that this trend towards larger units has not resulted in lower consumption levels, but that it is easier and cheaper to solve environmental problems at large plants. The increasing concern about food safety can result in more waste being produced as parts of animals are discarded, such as following the BSE crisis and in increased cleaning and sterilisation, which incur associated consumption of water, energy and chemicals. There are other trends based on environmental driving forces, such as odour prevention. The cooling of blood and other by-products, not only those parts destined for use, but also those destined for disposal is becoming more common. Refrigeration requires a considerable amount of energy, but does provide other advantages, such as better products and less air and water pollution.

Animal by-products installations

In the past, animal by-products provided a valuable source of slaughterhouse income, however, due to BSE, in recent years their value reduced substantially and much of the material which was previously used, is now disposed of as waste at a cost to the slaughterhouse operator.

The animal by-products industry handles all of the raw materials that are not directly destined for human consumption and some that are destined for eventual human consumption. The use and disposal routes permitted are governed by the *Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption.*

The continuing ban on the use of processed animal proteins in feed for animals farmed for food has lead to the diversification of the animal by-products industry into incineration and to research into alternative ways of disposing of by–products and in particular TSE materials and SRM. The rendering industry still processes most of the animal by-products not intended for human consumption although some are stored frozen, for future incineration.

Key environmental issues in slaughterhouses

The most significant environmental issues associated with slaughterhouse operations are typically water consumption, emissions of high organic strength liquids to water and the energy consumption associated with refrigeration and heating water. Blood has the highest COD strength of any liquid effluent arising from both large animal and poultry slaughterhouses and its collection, storage and handling is a key issue for assessment and control. At most slaughterhouses, the refrigeration plant is the biggest consumer of electricity. It can constitute 45 - 90 % of the total site load during the working day and almost 100 % during non-production periods. Food and veterinary legislation requires potable water to be used in slaughterhouses, so there are virtually no opportunities for re-use of water. This has water consumption and contamination consequences and also energy consequences when the water is heated. The emission of odours from e.g. blood storage and handling and WWTPs, can be the most problematic day to day environmental issue. Noise from e.g. animal noises during unloading and marshalling and from compressors can also lead to local problems.

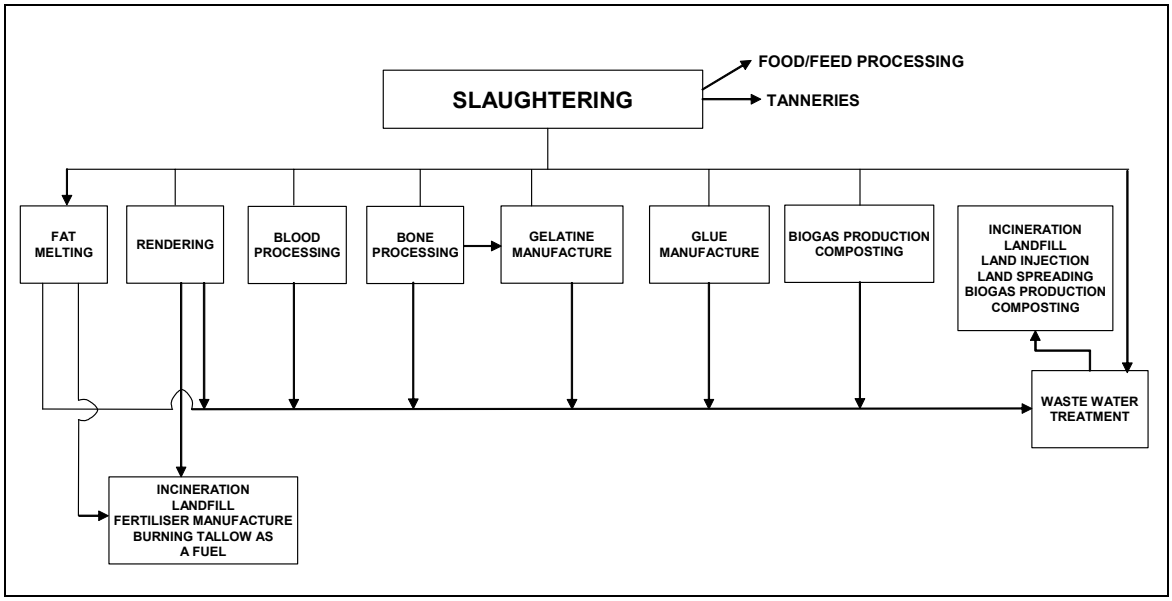
Key environmental issues in animal by-products installations

All animal by-products installations can potentially emit high organic strength liquids to water and cause significant local odour problems. If animal by-products are not treated quickly after slaughter and before decomposition causes odour and/or quality problems and downstream waste water problems, they may be refrigerated to minimise decomposition. This consumes energy. Odour is a key environmental issue during rendering and fish-meal and fish-oil production, even if fresh by-products are treated. Energy consumption is also a key issue for those installations undertaking drying activities, i.e. fat melting, rendering, fish-meal and fish-oil production, blood processing, gelatine manufacture and glue manufacture. Emissions of the

gaseous products of combustion to air, is an issue for incinerators. Infectivity associated with the destruction of TSE risk material is an issue for rendering plants and for incinerators. Infectivity associated with the destruction of pathogens has to be considered for composting and where the by-product or waste produced by a treatment can be landfilled, land spread or land injected. Infestation by insects, rodents and birds can be an issue during animal by-products storage and use. Water consumption is significant for gelatine manufacture.

Applied processes and techniques (Chapter 2)

The relationships between slaughterhouses and their downstream activities are illustrated in a very simplified and general form in the figure below.



Relationships between slaughterhouses and their downstream activities (summary)

Individual unit operations in slaughterhouses are described first. This section is divided between the slaughter of large animals and the slaughter of poultry. The processes at individual types of animal by-products installations are then described. Some waste water treatment processes that are applied in the industries are then described, firstly for slaughterhouses and then for animal by-products installations.

Current consumption and emission levels (Chapter 3)

The average live weights of animals and carcase weights vary considerably between Member States. Consumption and emission data has, to a large extent, been reported either "per tonne of carcase produced" or "per tonne of by-product treated". This reflects the terminology of the Directive and makes it easier to compare information from different sources. It also enables the relationships between the actual processes and consumption and emission levels to be examined, at the same time as avoiding misleading information based on, e.g. low concentrations, which may be achieved by the overconsumption of water.

Detailing the consumption and emission levels serves several purposes. Firstly, the ranges of levels for given processes and unit operations illustrate potential opportunities for improvement in environmental performance by those operating at the higher levels in the range. Secondly, the availability of data from unit operations also demonstrates that it is practicable to measure consumption and emission levels at that level and thus to monitor improvements. Thirdly, the

information can also be used to identify priority unit operations which can be improved. Also, the availability of data at unit operation level makes it possible to compare techniques and determine BAT for those parts of processes where consumption and emission levels are significant and alternatives are available.

The data reported in the BREF illustrate a wide range of performances in the industries. For example, for pig slaughterhouses a total water consumption range of 1600 – 8300 litres per tonne of carcase produced is reported in Table 3.2. Water consumption levels, either in ranges or single values, were also provided for the following unit operations: loading and vehicle washing; lairage; slaughter; bleeding; skin removal, scalding; hair and toenail removal; singeing; rind treatment; chilling; intestine washing and cleaning. Intestine washing was reported to use between 442 – 680 litres per tonne of carcase produced and to emit a BOD range of 0.98 - 3.25 kg per tonne of carcase and was therefore identified as a unit operation making a significant contribution to the pollution caused by the whole activity. Any contact between water and carcases or animal by-products leads to water contamination, which is one of the key environmental issues for slaughterhouses. The issue of reducing water consumption and water contamination, during intestine washing is addressed later in this document. Techniques are described and BAT is identified is identified in Section 5.2.1.

Some of the data provided for slaughterhouses show the breakdown of how water and energy are consumed for different operations in an installation, as percentage values. This method of presenting data can be useful for identifying overall priorities, but it is less useful for monitoring improvements in a single operation because others may also change. For example, if less water is used for scalding then the percentage used in cleaning may rise even if the actual consumption does not. Nevertheless, this information has been useful, for confirming that cleaning as a major consumer of water and that refrigeration as a major consumer of energy, in slaughterhouses. The issue of minimising the consumption of water, and therefore the associated reduced contamination of waste water and the energy consumed to heat the water, has been addressed in this document. Unfortunately very little information has been received about reducing the energy consumed by chilling and refrigeration.

Drying operations at animal by-products installations generally use most of the energy consumed. Information about consumption levels supports this. This issue has been addressed to some extent in the BREF and BAT has been identified for rendering.

Most of the information provided about odour is qualitative and the measurements received have been presented using several units, which has made quantitative comparison between the problems and potential solutions impossible. Nevertheless, odour associated with the storage and processing of animal by-products is addressed from both the preventive and abatement perspectives and BAT have been identified.

Most of the consumption and emission data provided for slaughterhouses and animal by-products installations relates to waste water, although unfortunately most of the data submissions were not accompanied by descriptions of the processes and throughput data or the waste water treatments applied. Nevertheless, sufficient information was received for the technical working group (TWG) to conclude that BAT is to subject the effluent from slaughterhouses and animal by-products installations to a biological treatment process. BAT associated levels based on the expert judgment of the TWG are given in chapter 5 and are shown in the table below.

For incineration, data on air emissions and ash analysis is reported both in this chapter and in the chapter 4. The TWG has agreed to BAT associated levels and these are reported in chapter 5 and are shown in the table below.

For some animal by-products activities, little or no consumption and emission level data was provided, however, qualitative information is included in the document.

The collection of data at the unit operation level, using comparable monitoring techniques and accompanied with detailed descriptions of the technique and the operating conditions, would be very useful for the revision of the BREF.

Techniques to consider in the determination of BAT (Chapter 4)

Chapter 4 contains the detailed information used by the TWG to determine BAT for the slaughterhouses and animal by-products industries.

About 250 techniques are described. They are described under the standard headings Description, Achieved environmental benefits, Cross-media effects, Operational data, Applicability, Economics, Driving force for implementation, Example plants and Reference literature. The TWG has aimed to include enough information to assess the applicability of the techniques in general or specific cases. The standard structure assists the comparison of techniques both qualitatively and quantitatively. The information in this chapter is essential to the determination of BAT.

Those techniques which the TWG has judged to be BAT, are also cross-referenced from chapter 5. Permit writers and installation operators are thus directed to the discussion of the technique associated with the BAT conclusions, which can assist them when they are determining the BAT-based conditions of IPPC permits.

This chapter includes both "process-integrated" and "end-of-pipe" techniques, thus covering both pollution prevention and pollution control measures, respectively. Some of the techniques are very technical and others are good operating practices, including management techniques.

The chapter is structured so that techniques which are generally applicable to all slaughterhouses and animal by-products installations are described first. These include general training, maintenance and operational good practice, considered as general techniques as they can be applied to virtually all activities. Others are more technical, but apply to the provision and use of utilities and services that are also applied in most industrial activities, such as providing lighting, or cleaning the installation. There are some techniques in this section which are more directly related to slaughterhouses and animal by-products installations, including several dealing with the storage of animal by-products and in particular the prevention of odour. Techniques associated with preventing the accidental release of large volumes of liquids and especially blood, are also included. General waste water treatment techniques are also included in this section.

Techniques which apply to all slaughterhouses are then described. These deal with issues such as the cleaning of lorries delivering live animals; minimisation of water consumption and contamination on slaughter-lines; blood collection and the minimisation of water and energy use in knife sterilisation.

The next 2 main sections contain techniques dealing with the slaughter of large animals and poultry, respectively. These include viscera and hide treatments undertaken at large animal slaughterhouses. The techniques address potential consumption and emission issues at the unit operation level, i.e. they are inherently "process-integrated" pollution prevention and control techniques. Some are technical and some are operational. Many of them address the key environmental issue of minimisation of water consumption and the associated contamination of waste water. In many cases there are energy considerations too, due to water being heated. They also address the minimisation of waste, e.g. associated with the trimming of hides.

The final section on slaughterhouses includes techniques for cleaning, waste water treatment and waste treatment. Throughout the chapter there is an ongoing theme about preventing waste water contamination and the segregation of by-products to maximise their usability and minimise cross contamination and waste.

When the animal by-products industries are addressed there is an emphasis on minimising waste and odour problems. Where the individual processes are addressed one by one, techniques particular to the process in question are addressed, although in many cases the same environmental issues are discussed. For example, several of the techniques address energy saving for drying processes. Many of the techniques deal with "end-of-pipe" odour abatement and waste water treatment.

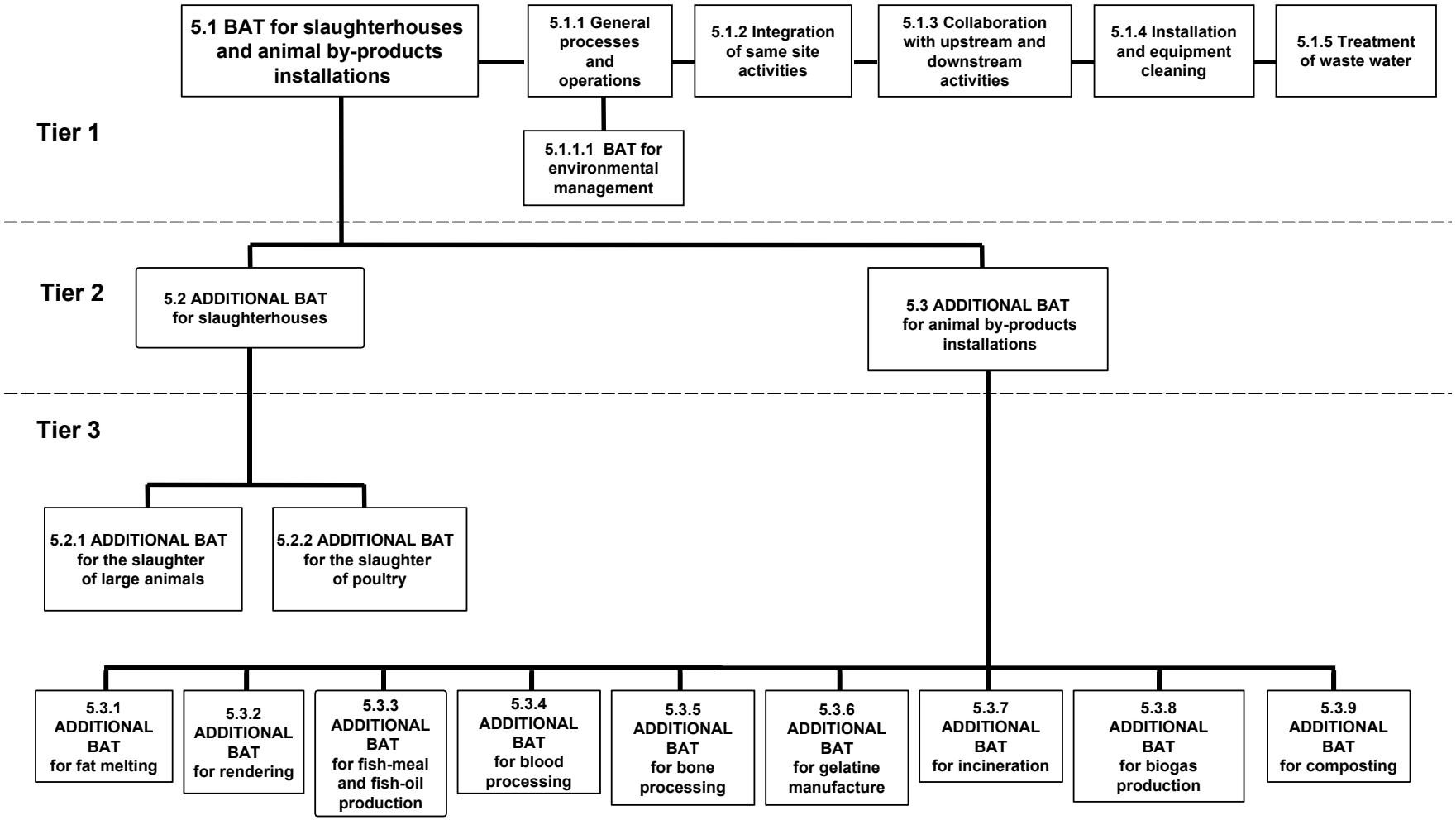
The section on the incineration of animal by-products addresses those issues specific to the incineration of animal by-products, starting from their delivery to the site. Techniques which have no special relevance to animal by-products are not covered because they come within the scope of the "Waste Incineration" BREF. Issues such as flue gas treatment come within the scope of the "Waste Incineration" BREF whereas the main issues addressed by the techniques in this BREF are either directly or indirectly related to prevention of odour arising from animal by-products and the destruction of TSE risk material.

Finally, 3 integrated same-site activities are described and the environmental advantages of, e.g. reduced energy consumption by re-using heat and odour destruction by on-site incinerators are described.

Best available techniques (Chapter 5)

The way the BAT conclusions are presented in chapter 5 is shown in the figure below. In the figure, the BAT conclusions are presented in tiers. The top tier shows the Sections listing BAT for all slaughterhouses and animal by-products installations; the second is divided between additional BAT for slaughterhouses and BAT for animal by-products installations and the third is divided further showing the Sections listing additional BAT for individual types of slaughterhouse and animal by-products installation.

The conclusions represent what the TWG considered to be BAT in a general sense for the slaughterhouses and animal by-products industries based upon the information in chapter 4 and taking account of the Article 2(11) definition of "best available techniques" and the considerations listed in Annex IV to the Directive. This chapter does not set emission limit values but suggests emission levels that are associated with the use of BAT.



How the BAT conclusions are presented for slaughterhouses and animal by-products installations

BAT addressing the main environmental issues for slaughterhouses and animal by-products installations have been identified, to the extent that the information provided during the information exchange has allowed. The assessment of techniques is dependent on the information provided and assessed by the TWG. For many techniques there is only limited technical and economic data available. For some key environmental issues very little information was provided.

For slaughterhouses, the key environmental issues are generally water consumption; the emission of high organic strength liquids to water and the energy consumption associated with refrigeration and heating water. For animal by-products installations, the main issues are related to the energy consumption associated with drying animal by-products; the emission of high strength organic liquids to water; infectivity, especially related to the controlling, the handling and the destruction of TSE material and odour.

Measures to minimise consumption and emission levels are very much influenced by planning each process technically and operationally at each unit operation level. Some BAT therefore, relate to this.

Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption specifies requirements for the handling, storage, transport and processing of animal by-products and describes the disposal routes allowed for TSE risk material. Care has been taken to ensure that the BAT conclusions do not conflict with the requirements of this Regulation. Likewise care has been taken to ensure consistency with other legislation relating to, e.g. public health, food safety, animal welfare and health and safety at work. A great deal of the discussion about the BAT conclusions examined the potential impact of the use of techniques on these issues.

The following paragraphs summarise the key BAT conclusions relating to the most relevant environmental issues. During the discussion of the information exchanged by the TWG, many issues were raised and discussed. Only some of them are highlighted in this summary and it should not be read instead of the "Best available techniques" chapter, which should not be read in isolation from the rest of the BREF.

<u>General management and operation</u>
BAT options related to general management and operational techniques contribute to the overall minimisation of consumption and emission levels, by providing systems of work which encourage good practice and raise awareness. The BAT identified focus on issues such as using an environmental management system; providing training; using a planned maintenance programme; implementing energy, refrigeration, light and noise management systems; managing and minimising the quantities of water and detergents consumed and, in slaughterhouses, managing and monitoring the use of hot water.

<u>Water consumption and the emission of high organic strength liquids in waste water</u>
It is recognised that minimising water consumption and contamination has wide reaching environmental benefits, beyond just that. Increasing the volume of water used automatically affects the volume of waste water which has to be treated at either an on-site or a municipal waste water treatment plant. The treatment of waste water consumes energy and sometimes chemicals and it can lead to odour problems. Every time water makes contact with a carcase or any animal by-product, whether during production or cleaning, contaminants such as fats or blood are entrained and these increase the burden on the waste water treatment plant. In many cases the water used is hot, so energy will have been used to heat it. Also the fats can melt in hot water and then become more difficult to separate from the water.

The availability of water varies depending on factors such as climate, hydrogeology, other demands for its use and price. Whether consumption is considered to be a key environmental issue at site level may, therefore, vary. The Water Framework Directive requires that water

pricing policies provide adequate incentives for users to use water resources efficiently. The BREF identifies BAT to minimise water consumption.

Some examples of the type of BAT conclusions reached are included in the following list, although this is only a summary and there are more in the BAT chapter. BAT is to remove all running water hoses and repair dripping taps and toilets; fit and use drains with screens and/or traps to prevent solid material from entering the waste water; dry clean vehicles and installations before cleaning with a high-pressure hoses fitted with hand-operated triggers; use a squeegee for the initial cleaning of the blood collection trough; where the equipment is suitable, operate a cleaning-in-place system; avoid carcase washing and where this is not possible to minimise it, combined with clean slaughter techniques; re-use cold water within pig de-hairing machines; re-use cooling water from pig singeing kilns; empty stomachs and small intestines dry; remove carcase washing equipment from poultry slaughter-lines except after de-feathering and evisceration and use recycled water, e.g. from the scalding tank, for the carriage of feathers.

Some of the techniques apply to all slaughterhouses and animal by-products installations and others are applicable in e.g. only in large animal or only in poultry slaughterhouses. Many, but not all, of the techniques applicable to animal by-products installations are waste water treatment techniques to clean water which has been contaminated by the process, e.g. during rendering; fish-meal and fish-oil manufacture or gelatine manufacture. Waste water treatment techniques are listed.

Energy

Power generation has major global implications, due to the emissions of greenhouse gases from large combustion plants, so minimising energy consumption, including the use of hot water is a key issue to be addressed. Hygiene standards have always been paramount in slaughterhouses and to a great extent in animal by-products installations producing food or pharmaceutical grade products. The Regulation *(EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption* has increased the emphasis on hygiene, at all animal by-products installations, to protect the food and feed chain and to control the risk to public health. Some examples of the types of relevant BAT which have been identified include: dry clean installations and transport by-products dry, followed by pressure cleaning using hoses fitted with hand-operated triggers and where the use of hot water is necessary, using thermostatically controlled steam and water valves; insulating and covering knife sterilisers and insulating scalding tanks and the steam scalding of pigs and poultry.

In animal by-products installations carrying out fat melting, rendering, fish-meal and fish-oil production, blood processing, bone processing, gelatine manufacturing or glue making the majority of the energy consumed is generally associated with the drying process. For example 2/3 of the energy consumed in a rendering plant may be directly due to drying. Some examples of the types of BAT techniques identified include: rationalising and insulating steam and water pipework; removing water from blood, by steam coagulation, prior to rendering; for raw material throughputs less than 50000 t/yr, to use a single effect evaporator and for raw material throughputs greater than, or equal to 50000 t/yr, to use a multiple-effect evaporator, to remove water from liquid mixtures and to concentrate plasma, prior to spray drying, using reverse osmosis, vacuum evaporation or by steam coagulation.

In slaughterhouses, in particular, refrigeration is a very large consumer of energy. It may also be significant where animal by-products are kept in refrigerated storage prior to treatment at animal by-products installations. Although this was identified as a key environmental issue, very little information was provided to assist with the determination of BAT. Some general BAT have been identified, including: implementing refrigeration management systems; operating controls over refrigeration plant running times; fitting and operating chill room door closing switches and recuperating heat from refrigeration plants.

Infectivity

Infectivity was identified as a key environmental issue, principally due to the concerns arising from the BSE crises regarding both animal health, especially with respect to the feed and food chain and human health after the links between TSE in animals and CJD, in humans were discovered. Control of the handling and treatment of confirmed TSE infected materials, those suspected of being infected and those arising from animals killed in the context of TSE eradication measures is regulated by *Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption.*

The BREF contains BAT conclusions both directly and indirectly associated with the prevention of the spread of TSE and the destruction of TSE risk materials. These are particularly related to rendering and incineration. For example, BAT is to do the following: continuously collect by-products dry and segregated from each other, along the length of the slaughter-line and throughout animal by-products treatment; optimise bleeding and the collection of blood; use sealed, storage, handling and charging facilities for animal by-products; enclose any buildings used for delivery storage, handling and processing of animal by-products; clean and disinfect delivery vehicles and equipment, after each delivery/use; reduce in size animal carcases and parts of animal carcases, before incineration; restrict feedstock to exactly that tested during trials; operate continuous incineration; operate an ash burnout chamber, where adequate combustion is not otherwise achievable, e.g. immediately downstream from rotary kilns; operate a monitoring regime for emissions, including a protocol for monitoring burnout, including biohazard from TSE prions, in ash; to achieve emission levels as low as reasonably practicable below those shown in the table below. This table includes BAT associated levels for total carbon and total protein, in ash.

Odour

Although odour is widely considered to be an issue of local nuisance, it can in reality be the most troublesome day to day environmental problem for slaughterhouses and animal by-products installations and so it has to be controlled. Typically it will be caused by the decomposition of animal by-products and this has other related environmental consequences, e.g. it reduces the usability of the animal by-products and hence increases waste. Also, the substances causing odour can cause problems during waste water treatment.

Odour has been considered in detail by the TWG and BAT has been identified to minimise odour and to destroy it when prevention has not been possible. The main conclusion was that animal by-products should be used or disposed of as soon as possible after the animal is slaughtered. Preservation techniques to prevent decomposition and to minimise the formation of malodorous substances and abatement techniques incur significant cross-media effects, including energy consumption and often they require significant economic investment and running costs. Taking account of the cross-media effects and their global implications and the economic factors, the TWG concluded that BAT is to implement some such techniques, but only if the animal by-products cannot be treated before the malodorous substances form, if the animal by-products are inherently malodorous or if the process is inherently malodorous.

Some examples of the BAT identified include: store animal by-products for short periods and possibly to refrigerate them; where it is not possible to treat blood or other animal by-products before their decomposition starts to cause odour problems and/or quality problems, refrigerating them as quickly as possible and for as short a time as possible, to minimise decomposition; where inherently malodorous substances are used or are produced during the treatment of animal by-products, to pass the low intensity/high volume gases through a biofilter. For rendering, when it has been impossible to use fresh raw materials and thereby to minimise the production of malodorous substances, BAT is to do either of the following: to, burn the non-condensable gases in an existing boiler and to pass the low intensity/high volume odours through a biofilter or to burn the whole vapour gases in a thermal oxidiser and to pass the low intensity/high volume odours through a biofilter. For fish-meal and fish-oil production, BAT is to use fresh, (low total volatile nitrogen) feedstock and incinerate malodorous air, with heat

recovery. For incineration of animal by-products, some examples of BAT include, to duct air from the installation and the pre-combustion equipment to combustion chambers, operate odour arrestment techniques, when the incinerator is not working, when odour prevention is not reasonably practicable and use a carbon filter for odour abatement, when incinerators are not operating.

Collaboration with upstream and downstream activities

The operations of those involved in the supply of animals to slaughterhouses, including the farmers and the hauliers, can have environmental consequences in the slaughterhouse. The suppliers of feedstock to animal-by-products installations and other downstream users can also influence the environmental impact of those installations. Their impact can be affected by the properties of the feedstock, e.g. the freshness, degree of separation of different materials and the specification.

BAT is to seek collaboration with upstream partners, to create a chain of environmental responsibility, to minimise pollution and to protect the environment as a whole. Several BAT are identified and most of these are associated with the delivery and feeding of animals or the storage of animal by-products.

Sites with more than one activity

Several examples have been identified where sites with more than one activity can collaborate to minimise consumption and emission levels. BAT is to re-use heat and/or power produced in one activity in other activities and to share abatement techniques, where these are required, e.g. for waste water or odour treatment.

Three examples are listed in the BREF, but the principle can probably be applied to any same-site activities, of which there are many, for instance, slaughterhouses may, e.g. be on the same site as fat melting plants, rendering plants, blood processing plants, incinerators and composting plants.

It is also very common for slaughterhouses to have meat cutting plants and further processing plants on the same site. In such cases information from the "Food, drink and milk" BREF can be used to identify opportunities for collaboration.

The TWG also concluded that BAT is to export any heat and/or power produced which cannot be used on-site

BAT associated levels

BAT associated levels were identified for waste water treatment and for the incineration of animal by-products.

The emission levels given below are generally considered to be appropriate for protecting the water environment and are indicative of the emission levels that would be achieved when applying those techniques generally considered to represent BAT. They do not necessarily represent levels currently achieved within the industry but are based on the expert judgment of the TWG.

Parameter	COD	BOD_5	SS	Nitrogen (total)	Phosphorus (total)	FOG
Achievable emission level (mg/l)	25 - 125	10 - 40	5 - 60	15 – 40	2 - 5	2.6 - 15

Emission levels associated with BAT for minimising waste water emissions from slaughterhouses and animal by-products installations

BAT for the incineration of animal by-products, is to achieve emission levels as low as reasonably practicable below those shown in the table below.

Releases to air		Performance associated with BAT [3]	
		Typical	Monitoring
SO_2	(mg/m^3)	< 30 [2]	Continuous
HCl	(mg/m^3)	< 10 [2]	Continuous
HF	(mg/m^3)	n/a	
NO_x	(mg/m^3)	< 175 [2]	Continuous
CO	(mg/m^3)	< 25 [2]	Continuous
VOCs	(mg/m^3)	< 10 [2]	Periodic
Dust	(mg/m^3)	< 10 [2]	Continuous
Dioxins and furans	(ng/m^3)	< 0.1 [4]	Periodic
Heavy metals total (Cd, TI)	(mg/m^3)	< 0.05 [5]	
Heavy metals (Hg)	(mg/m^3)	< 0.05 [5]	
Heavy metals total (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	(mg/m^3)	< 0.5 [5]	
NH_3	(mg/m^3)	< 10	
Residence time	>850 ºC	3.5 s	
Oxygen	(minimum after last injection)	9 %	Continuous
Pressure, Temperature, Water vapour; Volumetric flow			Continuous
Ash - (total carbon)		< 1 % [6]	Periodic
Ash – (total protein)	(Aqueous extract) (mg/100g)	0.3 – 0.6	Periodic

(2) Releases control – "95 % percentile hourly average over 24 hours". Measurements at 273 K (temp.), 101.3 kPa (pressure) and 11 % O_2 dry gas

(3) Actual performance results operating a dry flue gas-cleaning system with bag filters and injected reagents

Values measured over a sample period of a minimum of 6 hours and a maximum of 8 hours expressed as toxic equivalent in accordance with Annex 1 of the Waste Incineration Directive

(5) Values measured over a sample period of a minimum of 6 hours and a maximum of 8 hours

(6) Total organic carbon

Note: Protein analysis is not relevant to the dedicated incineration of poultry by-products

Emission levels associated with the dedicated incineration of animal by-products in either bubbling fluidised bed, circulating fluidised bed or rotary kiln incinerators

Emerging techniques (Chapter 6)

Chapter 6 includes 2 techniques that have not yet been commercially applied and are still in the research or development phase. They are "Bio-refining of animal by-products to produce soil improvers and fertilisers" and "Biotechnological treatment of animal by-products in order to increase energetic valorisation". They have been included here to raise awareness for any future revision of this document.

Concluding remarks (Chapter 7)

Information provided

Many reports from industry and Member State authorities were used as sources of information in the drafting of this BREF and these were supplemented by information from individuals based on example plants. A great deal of information was received during and following site visits to slaughterhouses and animal by-products installations in several Member States. The formal consultations on each draft of the document also prompted the provision of a huge amount of information as well as providing the main opportunities for the TWG to verify the information already submitted.

Although over 350 pieces of information were provided, some significant gaps remain. Energy consumption is a key environmental issue in slaughterhouses, due to chilling and refrigerated storage and in many animal by-products installations, especially during drying. In spite of this, very little data or information about energy saving techniques was submitted.

There is a lack of consistency in the data on the measurement of odour and the identification of the options for keeping odour streams separate for treatment. Prevention of odour is addressed, however, albeit qualitatively.

In general the consumption and emission data provided was not well explained in terms of operating conditions and analytical methods and its relationship with the techniques described was not always made clear. This is one of the reasons why there are very few associated BAT levels quoted. The TWG attempted to collect data "per tonne of carcase produced" and "per tonne of animal by-product treated" for each unit operation, to allow direct comparisons to be made and to identify the areas with high consumption and emission levels, so that these could be addressed. Large gaps remain in this data.

Very little information was received about bone processing, glue manufacture, gasification of meat and bone meal, land spreading/injection, shellfish shell cleaning and the manufacture of fertiliser from animal meal. This may in some cases be due to local legislation prohibiting or restricting the application of animal by-products to land and restrictions under the new *Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption*.

Driving forces

The content of the BREF, as well as its time-scale for preparation has been strongly influenced by issues such as food and feed safety concerns, e.g. arising from BSE; food hygiene and animal welfare. The focus has remained on the prevention and control of pollution, but care has been taken to ensure there is consistency with legislation and good practice associated with these other important drivers. The main legal driver has been the new *Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules concerning animal by-products not intended for human consumption*.

Level of consensus

The conclusions of the BREF were agreed at the final TWG meeting and there are no split views.

Recommendations for future work

The gaps in the information indicate areas where future work could provide results which might assist in the identification of BAT when the BREF is revised, thereby helping operators and permit writers to protect the environment as a whole.

The lack of data "per tonne of carcase produced" and "per tonne of animal by-product treated", for each unit operation, could be addressed via the regulatory authorities and the various industry NGOs which represent the slaughterhouses and animal by-products operators. They could encourage and co-ordinate the increased measurement of consumption and emission levels at the unit operation level, including details on operating conditions; descriptions of techniques applied; sampling protocols; analytical methods and statistical presentation.

A great deal of the information provided about techniques was incomplete. The TWG decided that although there was insufficient information in these techniques to help with the determination of BAT, they should still be included in the document. The incomplete techniques are appended to chapter 7. They are included to provoke both the collection and provision of further information, when the BREF is revised.

Suggested topics for future R & D projects

The following topics might be considered for future research and development projects:

1 minimisation of energy consumption associated with chilling and refrigerated storage
2 minimisation of energy consumption associated with the drying of animal by-products
3 opportunities to use non-potable water at slaughterhouses, without compromising hygiene and food safety
4 optimisation of the use of animal by-products, to minimise waste and
5 the development of benchmarking tools to improve the quality of future information exchanges and revisions of the BREF.