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The BAT study for the meat and fish processing industry

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An Derden, Sander Vander Aa, Els Hooyberghs, Stella Vanassche and Diane Huybrechts

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VITO NV
Boeretang 200 - 2400 MOL - BELGIE
Tel. + 32 14 33 55 11 - Fax + 32 14 33 55 99
vito@vito.be - www.vito.be

BTW BE-0244.195.916 RPR (Turnhout)
Bank 375-1117354-90 ING
BE34 3751 1173 5490 - BBRUBEBB

ABSTRACT

The BAT study for the meat and fish processing industry selects and describes BAT for the industrial processing of meat and fish to food products (for human consumption) or feed products (for animal consumption, especially pet food).

→ **See chapter 1 for a description of the concept of Best Available Techniques (BAT) and its interpretation in Flanders, as well as the general framework of this BAT study.**

WHICH INSTALLATIONS?

Both IPPC installations and non-IPPC installations that process meat and fish at an industrial scale are studied. Activities within the scope of the BAT study are:

- all cut out activities, except those that are carried out in slaughterhouses;
- preparation of meat and fish;
- processing of poultry (is included under the part 'meat' in the title of the BAT study);
- processing of crustaceans and shellfish (is contained under the term 'fish' in the title of the BAT study);
- production of pet food based on meat and fish.

WHICH ACTIVITIES, PRODUCTS AND PROCESS STEPS?

Meat processing industry

Meat processing activities / products can be classified as follows:

- deboning plants;
- preparation of:
  - thermally treated and non-reduced meat products;
  - thermally treated and reduced meat products;
  - non-heat-treated and non-reduced meat products;
  - non-heat-treated meat products and reduced meat products.

Furthermore, a distinction can also be made between fresh meat, minced meat, mechanically separated meat, processed meat and meat products.

Fish processing industry

The fish processing industry can be categorized according to the type of fish being processed, eg. herring and mackerel, round and flat fish, shellfish, North Sea shrimps and smoked eel and salmon. Furthermore, a distinction can also be made between fish products, handled fish products and processed fish products.

OBJECTIVES OF THE BAT STUDY?

One of the objectives of the present study is to 'translate' the BAT conclusions of the BAT Reference Document for the Food, Drink and Milk Industries (2006) into the Flemish situation. The BAT study can also be used as input for the revision of the BREF FDM (started in 2014).

In addition to large companies, small and medium installations are also included in this BAT study. Slaughter activities are out of the scope of this study. This activity has already been examined in a separate Flemish BAT study and is also the subject of a separate BREF (Slaughterhouses and Animal Byproducts).

The BAT study contains on the one hand an inventory of environmentally friendly technologies that can be used for the industrial processing of meat and fish. Also support activities such as cleaning and disinfection, waste water treatment, storage / disposal of animal by-products, and air treatment techniques are studied. On the other hand, the study presents BAT for reducing waste, energy

consumption, odour, water consumption, emissions to water and it presents recommendations in the field of BAT-associated emission levels (BAT-AEL).

→ **See chapter 2 for a description of the meat and fish processing installations and the main socio-economic and environmental legal aspects of this activity.**

INSTALLATIONS IN FLANDERS?

The socio-economic analysis is based on 106 Flemish meat processing installations and 14 fish processing installations in Flanders, for which annual statements of accounts were available in the period 2003-2011 in the database Bel-First. In addition, socio-economic information of 4 pet food installations was available.

GLOBAL ENVIRONMENTAL ASPECTS?

In this BAT study, all environmental aspects are studied. Specific attention for processing meat and fish is given to valorizing animal by-products, reducing energy consumption, preventing odour, and reducing water consumption and the amount and load of the waste water. Other environmental concerns are chemicals, air emissions, noise / vibration and soil.

→ **See chapter 3 for a description of the typical processes in the sector and the associated environmental impact.**

APPLIED PROCESSES?

The applied processes in the meat and fish processing industry are roughly similar. After delivery/unloading/cooling/freezing, preparation, pickling/curing/aging/desalting, and grinding and mixing, a number of intermediate treatments can be carried out, such as coating/spraying, wrapping/encapsulation, forming and filling. Preservation can be carried out in various ways, eg. heat-treatment (eg. blanching, cooking/baking/roasting/grilling, frying and pasteurizing/sterilizing/autoclaving), chemical preservation (eg. irradiation), fermenting, smoking, cooling and drying. After cooling, the products may be frozen. After finishing (i.e. cutting off/distributing, burning, garnishing, filling, packaging, weighting/labeling and palletizing), products are stored/discharged. Supporting activities that are studied in this BAT study include cleaning and disinfection, wastewater treatment, storage/disposal of animal by-products and reduction of air emissions.

ENVIRONMENTAL IMPACT?

The meat and fish processing industry has a major impact on the areas of:

- consumption of materials, including animal raw materials, auxiliary materials and packaging materials;
- generation of by-products / waste, including animal by-products and packaging;
- use of energy, especially in heating and cooling processes;
- air emissions, dust (eg smoking of meat or fish) and odour (eg storage of animal by-products or smoking of meat or fish);
- water, eg disinfection and cleaning;
- emissions to water, eg organic compounds, detergents, disinfectants, nutrients (nitrogen and phosphorus), salt (chlorides) and heavy metals;
- use of chemicals (auxiliaries to the production process, for the production of process water and in relation to laboratory analyzes);
- noise (process activities and transport);
- accidental releases to soil (storage locations, installations for maintenance and washing of vehicles, leaking sewers and underground piping).

→ **See chapter 4 and 5 for a description of the environmentally friendly technologies and the selection of BAT for meat en fish processing installations.**

ENVIRONMENTALLY FRIENDLY TECHNIQUES AND BAT?

Chapter 4 provides an overview of the available environmentally friendly techniques for meat en fish processing installations based on literature, supplemented with practical information on the sector.
Chapter 5 evaluates the environmentally friendly techniques from chapter 4 on their technical feasibility, environmental benefits and economic feasibility. This evaluation indicates whether the specified environmentally friendly techniques are BAT or not for meat en fish processing installations.

In the BAT study, more than 30 techniques are selected as BAT. The study contains many examples of measures to concretize these BAT. The BAT selection was carried out in close consultation with industry representatives and experts from the administrations, and is based on literature research and company information.

SOME EXAMPLES OF BAT

Most of the BAT for the meat and fish processing industry are preventive and process-integrated measures such as (1) careful selection of raw materials; (2) prevention of spills and leaching in wastewater; (3) preventing or reducing water consumption by regularly and properly maintained water-consuming machines; (4) prevent the material falling on the ground by eg using wider conveyors, output trays, screens or dripping trays; (5) prevent excessive energy consumption by measuring the consumption of the most energy-consuming process steps, using energy meters (electric and thermal); (6) prevention of odour from installations and regularly cleaning materials; (7) tackling noise at source through encapsulation of noise-causing plants; (8) ensuring cleanliness and order in the workplace.

If preventive and process-integrated measures are not sufficient to achieve acceptable emission levels, it is BAT (1) to capture air emissions at source and to apply a suitable (combination of) end-of-pipe air treatment technique(s); (2) to apply, treat and / or discharge wastewater judiciously.

For meat and fish processing companies that directly discharge their wastewater into surface waters, BAT means at least that, in addition to pretreatment (eg sieve and grease trap), a biological treatment is applied. $FeCl_3$ is often used as an auxiliary substance for physicochemical P-removal. To prevent under- or overdosing of this $FeCl_3$ in the wastewater treatment plant, it is advisable to frequent monitor the P concentrations in wastewater (eg. through continuous on-line measurement) and to adapt / optimize chemical dosage. The measuring equipment must regularly be maintained and / or calibrated. By optimizing the wastewater treatment, the P-concentration (in case of under-dosing) as well as the Cl-concentration (in case of over-dosing) in the wastewater can be limited.

For meat and fish processing companies that discharge their wastewater into sewers, a biological treatment is not BAT because parameters such as BOD, COD, Ntot and Ptot are degraded / removed in the municipal wastewater treatment installation. A grease trap is appropriate as a pretreatment technique. Any peaks in volume and load of the wastewater (eg. suspended solids and attached particles eg. heavy metals) can be avoided by buffering the industrial waste water and/or treat it in a sedimentation basin before it is discharged to the municipal wastewater treatment installation (these particles then end up in the sediment / silt fraction).

Based on discharge data (from the years 2011, 2012, 2013 and 2014) of 91 Flemish meat processing installations and 11 fish processing installations in Flanders, BAT-AELs are determined.

→ **See Chapter 6 for recommendations on meat and fish processing installations based on BAT.**

Based on the BAT analysis in chapter 5, we formulate concrete recommendations and suggestions concerning environmental legislation, eco-investments and further research.

RECOMMENDATIONS FOR ENVIRONMENTAL LEGISLATION

We investigate how the BAT can be translated into environmental legislation, and we formulate suggestions to concretize and/or supplement the existing environmental regulations for meat and fish processing installations in Flanders.

Based on the BAT-AELs determined in chapter 5, recommendations for sectoral environmental conditions in Chapter 5 of VLAREM II for the meat and fish processing are formulated.

remark

There are no discharge data available from fish processing installations discharging into surface water. For this group of companies no analysis was carried out and no BAT-AELs were determined.

Meat processing installations – direct discharge into surface waters

Parameter	Actual sectoral environmental condition	IC[1] (RG[2])	BAT-AEL	Emission level IPPC installations [BREF FDM, 2006]*	Proposal environmental condition
lower pH	6,5 pH-unit	- (-)	/	/	6,5 pH-unit***
upper pH	9,0 pH-unit	- (-)	/	/	9,0 pH-unit***
temperature	30,0 °C	- (-)	/	/	30,0 °C***
suspended solids	30 mg/l – 60 mg/l**	- (2 mg/l)	<30 mg/l	<50 mg/l	30 mg/l
dimension suspended solids	2 mm	- (-)	/	/	2 mm***
precipitable solids	1,5 ml/l	- (0,1 mg/l)	/	/	1,5 ml/l***
perchloric ethylene-extractable non-polar substances	5,0 mg/l		/	/	5,0 mg/l***
oil and grease	not visually detectable		/	/	not visually detectable ***
sum of the anionic, non-ionic and cationic surface-active agents	3,0 mg/l	1, 1 mg/l (-)	/	/	3,0 mg/l***

[1] classification criterion

[2] reporting limit

Parameter	Actual sectoral environmental condition		IC[1] (RG[2])	BAT-AEL	Emission level IPPC installations [BREF FDM, 2006]*	Proposal environmental condition
BOD	25 mg/l	50 mg/l**	- (3 mg/l)	<25 mg/l	<25 mg/l	25 mg/l
COD	200 mg/l	300 mg/l**	- (7 mg/l)	<125 mg/l	<125 mg/l	125 mg/l
Kjeldahl nitrogen	30 mg/l	60 mg/l**	- (2 mg/l)	/	/	/
total nitrogen	30 mg/l	60 mg/l**	- (2 mg/l)	<15 mg/l	<10 mg/l	15 mg/l
total phosphorus	10 mg/l	30 mg/l**	1 mg/l (0,15 mg/l)	<2 mg/l	0,4-5 mg/l	2 mg/l
arsenic	/		5 µg/l (15 µg/l)	<15 µg/l	/	/
cadmium	/		0,8 µg/l (2 µg/l)	<2 µg/l	/	/
chrome	/		50 µg/l (10 µg/l)	<50 µg/l	/	/
cobalt	/		0,6 µg/l (10 µg/l)	<10 µg/l	/	/
cupper	/		50 µg/l (25 µg/l)	<50 µg/l	/	/
mercury	/		0,3 µg/l (0,25 µg/l)	<0,3 µg/l	/	/
lead	/		50 µg/l (25 µg/l)	<50 µg/l	/	/
nickel	/		30 µg/l (10 µg/l)	<30 µg/l	/	/
silver	/		0,4 µg/l (10 µg/l)	<10 µg/l	/	/
zinc	/		200 µg/l (25 µg/l)	<200 µg/l	/	/
chloride	/		- (25 mg/l)	<4000 mg/l	/	/****
fluoride	/		0,9 mg/l (0,2 mg/l)	<0,9 mg/l	/	/

* indicative emission levels achievable using the techniques that are widely regarded as BAT for IPPC food companies (BREF FDM, 2006).
** for discharges <25 m³/day
***actual sectoral environmental condition
**** proposal to enforce a standard using special discharge conditions if necessary

Meat processing installations – discharge into sewers

Parameter	Actual sectoral environmental condition	IC[3] (RG[4])	BAT-AEL		Proposal environmental condition
lower pH	6,5 pH-unit	- (-)	/		6,5 pH-unit**
upper pH	9,0 pH-unit	- (-)	/		9,0 pH-unit**
temperature	45,0 °C	- (-)	/		45,0 °C**
suspended solids	1000,0 mg/l	- (2 mg/l)	/		1000,0 mg/l**
dimension suspended solids	10,0 mm	- (-)	/		10,0 mm**
petroleum ether extractable substances	500,0 mg/l	- (0,1 mg/l)	/		500,0 mg/l**
arsenic	/	5 µg/l (15 µg/l)	<15 µg/l		/
cadmium	/	0,8 µg/l (2 µg/l)	<2 µg/l	<3 µg/l[5]	/*
chrome	/	50 µg/l (10 µg/l)	<50 µg/l	<100 µg/l[6]	/*
cupper	/	50 µg/l (25 µg/l)	<200 µg/l		200 µg/l
mercury	/	0,3 µg/l (0,25 µg/l)	<0,3 µg/l	<0,6 µg/l[7]	/*
lead	/	50 µg/l (25 µg/l)	<50 µg/l		/
nickel	/	30 µg/l (10 µg/l)	<30 µg/l	<60 µg/l[8]	/*
silver	/	0,4 µg/l (10 µg/l)	<10 µg/l		/
zinc	/	200 µg/l (25 µg/l)	<1000 µg/		1000 µg/l
chloride	/	- (25 mg/l)	<4000 mg/l		/*

* proposal to enforce a standard using special discharge conditions if necessary
** actual sectoral environmental condition

[3] classification criterion
[4] reporting limit
[5] when processing organ meat
[6] in processes where intensive cleaning is required (possibly leaching process materials)
[7] when processing organ meat
[8] in processes where intensive cleaning is required (possibly leaching process materials)

Fish processing installations – discharge into sewers

Parameter	Actual sectoral environmental condition	IC[9] (RG[10])	BAT-AEL			Proposal environmental condition
lower pH	6,5 pH-unit	- (-)	/			6,5 pH-unit**
upper pH	9,0 pH-unit	- (-)	/			9,0 pH-unit**
temperature	45,0 °C	- (-)	/			45,0 °C**
suspended solids	1000,0 mg/l	- (2 mg/l)	/			1000,0 mg/l**
dimension suspended solids	10,0 mm	- (-l)	/			10,0 mm**
petroleum ether extractable substances	500,0 mg/l	- (0,1 mg/l)	/			500,0 mg/l**
arsenic	/	5 µg/l (15 µg/l)	<100 µg/l	<150 µg/l[11]		/*
cadmium	/	0,8 µg/l (2 µg/l)	<2,0 µg/l	<3 µg/l[12]		/*
chrome	/	50 µg/l (10 µg/l)	<50 µg/l			/
cupper	/	50 µg/l (25 µg/l)	<200 µg/l			200 µg/l
mercury	/	0,3 µg/l (0,25 µg/l)	<0,3 µg/l			/
lead	/	50 µg/l (25 µg/l)	<50 µg/l	<225 µg/l[13]		/*
nickel	/	30 µg/l (10 µg/l)	<30 µg/l			/
selenium	/	3 µg/l (5 µg/l)	<75[14] µg/l			/*
silver	/	0,4 µg/l (10 µg/l)	<10 µg/l			/
zinc	/	200 µg/l (25 µg/l)	<1000 µg/l			1000 µg/l
chloride	/	-	<4000 mg/l	<7500 mg/l[15]	<15000 mg/l[16]	/*

[9] classification criterion

[10] reporting limit

[11] for processing shellfish and crustaceans

[12] for processing of oily fish such as sprat, mackerel and herring

[13] for processing of eel

[14] derived on the basis of the available discharge data of three companies processing shrimp and / or fatty fish - point of interest for further research (see Section 6.3.1)

[15] for processing shrimp

Parameter	Actual sectoral environmental condition	IC[9] (RG[10])	BAT-AEL			Proposal environmental condition
		(25 mg/l)				

* proposal to enforce a standard using special discharge conditions if necessary
** actual sectoral environmental condition

RECOMMENDATIONS FOR ECO-INVESTMENT SUPPORT

We examine the way environmentally friendly techniques for meat and fish processing installations can be taken into account for eco-investment support in Flanders. “Phosphates recovery from wastewater in the shape of struvite (food industry)" is a technology that is proposed to be included in the exhaustive list of technologies.

RECOMMENDATIONS FOR FURTHER RESEARCH

We identify a number of relevant items for meat and fish processing installations to enhance the available information and knowledge, for example: (1) emission data for a number of parameters such as AOX, sulfate, antimony, barium, beryllium, boron, iron, cobalt, manganese, molybdenum, tellurium, thallium, tin, titanium, uranium and vanadium, (2) origin of emissions in wastewater via raw materials and the use of aggressive products for cleaning; (3) shelf life of meat and fish products under alternative smoking techniques; (4) central softening of tap water.

Furthermore, we make a number of recommendations for the development of new environmental technologies, for example to reduce chloride discharges, the use of alternative chemicals and the reduction of energy consumption for preserving of meat and fish.

[16] when applying traditional smoking techniques (eg. using wood shavings) and regular and thorough cleaning with intensive cleaning agents is required to remove tar deposits in the smoke chambers

1.1 Measures within the chain

Some environmental issues in the meat and fish processing sector originate from activities that precede those of the food industry (upstream). In addition, activities in meat and fish processing plants may affect activities downstream (following on from activities in the fish and meat processing plants).
Such environmental issues could be tackled more effectively within other sector-specific studies or at a higher level. A number of possible measures within the chain are discussed in the sections below. These are intended for information purposes and have not been included in the BAT evaluation.

1.1.1 Production of flake ice by the fish processing plant

→ ***Description of measure***

Fish processing plants make frequent use of flake ice, such as for wrapping/packing fresh fish and for transporting to the wholesalers, retailers and restaurants. On the one hand, it is possible to purchase flake ice from a specialised ice plant, and this requires chilled transport of the flake ice to the fish processing plant. Alternatively, this flake ice can also be produced by fish processing plants themselves using an ice machine. This activity requires additional water of a high quality, as well as the additional energy consumed by the fish processing plant.

→ ***Place within the chain***

External producers of flake ice gain an environmental benefit where this measure is used by fish processing plants.

1.1.2 Optimising the storage of animal by-products

→ ***Description of measure***

Optimising the storage of animal by-products in terms of temperature (chilled) and containers (enclosed), and regular transport to external processors may contribute towards good quality of animal by-products and greater opportunities for valorisation, such as animal feedstuff. Odour nuisance caused to nearby residents and during transport, for example, can also be limited.

→ ***Place within the chain***

Processors of animal by-products (cat 3) into animal feed gain an environmental benefit if this measure is used by meat and fish processing plants.

1.1.3 Optimising packaging

→ ***Description of measure***

The products of the meat and fish processing plants are packed according to factors such as the type of product, the requirements of the client (e.g. retail) and the wishes of consumers (primary,

secondary and possibly tertiary packaging). By limiting the quantity of packaging, (e.g. thinner plastic films or thinner card, smaller packs for the same quantity of product, packing larger quantities together), it is possible to limit the amount of packaging waste for consumers of fish and meat products (e.g. consumers, retail, restaurants). What is more, it is possible to use bio-based packaging for certain meat and fish products.

→ ***Place within the chain***

Users of fish and meat products (e.g. consumers, retail, restaurants) gain an environmental benefit if meat and fish processing plants use this measure.

1.1.4 Optimising the re-use and recycling of packaging

→ ***Description of measure***

The quantity of packaging waste to be processed can be limited by using re-usable packaging (e.g. plastic trays). These can be re-used within the meat and fish processing plant after cleaning.
Furthermore, certain streams of non-contaminated and selectively collected packaging material (e.g. recyclable plates, waste plastic, metal and drinks cartons, card and paper) may be recycled (for example). By reducing the dimensions of materials to be disposed of in meat and fish processing plants, it is possible to achieve a reduction in the number of journeys required for transport to external processors.

> *Remark*
> In practice, it turns out that plants are often bound by the requirements (choice and purchasing) of retailers in relation to packaging, such as the mandatory use of styrofoam trays (single use) for packing fresh fish (e.g. salmon steaks) instead of recyclable plastic trays.

→ ***Place within the chain***

Processors of packaging materials gain an environmental benefit whenever this measure is used by meat and fish processing plants.

1.1.5 Use of polymers of NON-petrogene origin

See also section 4.7.1, candidate BAT 24

→ ***Description of measure***

Flocculants (polymers) are added in order to separate the slurry from the water treatment facility (slurry from the grease trap and primary slurry) or dewater it. Various types of these polymers are of mineral origin. As a result, the slurry may contain an elevated mineral oil concentration, and consequently it can no longer be processed into fertiliser by fermentation and/or composting, and has to be incinerated.
An alternative is the use of polymers of NON-petrogene origin. These polymers of plant origin are in some cases more expensive than those based on petroleum products. The conditions relating to composition and use as fertiliser or soil improver are listed in the VLAREMA Regulation (Annex 2.3.1.).

→ ***Place within the chain***

Processors of by-products into soil improvers gain an environmental benefit whenever this measure is used by meat and fish processing plants.

1.1.6 Limiting copper and zinc in animal feed

→ ***Description of measure***

Pigs, cattle and calves require copper and zinc for their growth and development. These elements are usually added to compound feed for these animals in excessive quantities. Some of the heavy metals present in the meat end up in waste water during the processing of this meat. The correct dosage in feedstuffs and the processing of high-quality raw materials may potentially have a positive effect on the concentration of heavy metals in the waste water generated by meat processing plants.

Remark
Copper/zinc are used in practice as an alternative to antibiotics (see below). Heavy metals are reported to be easier to remove from waste water than antibiotics, by means of techniques such as electrolysis, electrodialysis or chemical precipitation (http://www.emis.vito.be/node/94). No specific cases of this have been charted within the meat and fish processing industry, however.

→ ***Place within the chain***

Meat processing plants gain an environmental benefit from the use of this measure in livestock farming.

1.1.7 Limiting/avoiding the use of antibiotics in livestock farming

→ ***Description of measure***

Pigs, cattle and calves in the livestock farming sector may possibly be treated with medication in the event of disease. By avoiding the administration of antibiotics in a late stage of the life-cycle, it is possible to prevent/limit the release of these substances into the waste water generated by meat processing plants.

Remark
Antibiotics are difficult to remove from waste water. Possible purification techniques for treating waste water contaminated with medicines include UV/H_2O_2 oxidation and activated carbon filtration. No specific cases of this have been charted within the meat and fish processing industry, however. As stated earlier, copper/zinc may be used as an alternative to antibiotics.

→ ***Place within the chain***

Meat processing plants gain an environmental benefit if this measure is used in the livestock farming sector.

1.1.8 Limiting/avoiding the use of pesticides in animal feedstuff

→ ***Description of measure***

Pesticides are substances that are used to control diseases or plagues that cause a nuisance or are harmful, such as vermin around the production and storage of animal feed.
By avoiding the administration of pesticides in animal feedstuffs shortly before feeding, it is possible to prevent/limit the release of these substances into the waste water generated by meat processing plants.

→ ***Place within the chain***

Meat processing plants gain an environmental benefit as a result of the use of this measure in the livestock farming industry.

1.1.9 The supply of soft water by suppliers of mains water or grey water

→ ***Description of measure***

The hardness of the water received by meat and fish processing plants (via drinking water supply companies) for their production process affects the chloride concentration in their waste water. By supplying soft water to these plants (but also to other plants), the chloride concentration will decrease. If drinking water or grey water is produced from hard water, it is better to soften it centrally at sites where increased salt concentrations have no harmful effects on the receiving water course.

→ ***Place within the chain***

Meat and fish processing plants gain an environmental benefit where this measure is used by drinking water

Table 1: Evaluation of available environmentally friendly techniques and selection of BAT

Animal by-products/waste substances

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
1.	Limiting the quantity of process-specific by-products/waste substances by selecting high-quality raw materials, optimising processes and optimising the use of auxiliary substances	+	0	+	0	+	+	+	0	0	+	+	0	0	+	+	0/+	Yes
2.	Internal valorisation of auxiliary substances for processes	+	0	+/-	0/-	+/-	-/0	-/0	0	0	+	-/0	-/0	0	+	+	-/0	cbc (case by case) [17]

[17] on condition that the applicable quality requirements of the meat or fish product can be met

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
3.	Removing impurities from process-specific by-products/waste substances, judicious separation and separate collection of these by-products/substances, in a manner that optimises their use, re-use, recovery, recycling and removal	+	0	+	0	+	0	0	0	0	+	0	0	0	+	+	-/0	Yes
4.	Limiting the quantity of non-process-specific waste substances by means of optimum packaging design, a well thought-out procurement policy and selective collection	+	0	+/-	0/-	+/-	0	0	0	0	+	0	0	0	+	+	-/0	cbc[18]

[18] taking account of the statutory provisions relating to packaging and the pre-conditions that exist with regard to marketing

Energy

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
5.	Limiting energy consumption and preventing energy losses by optimising energy management and by using general technologies	+	0	+	0	+	0	0	+	0	0	+	0	0	+	+	-/+	Yes
6.	Limiting energy consumption for thawing, chilling and freezing processes by preventing excessive energy use and optimising or adjusting the processes involved	+	0	+	0	+	-[19]/+ 0	0	+	0	0	+	0	0	+	+	-[20]/+	Yes
7.	Limiting energy consumption for preserving meat and fish by preventing excessive energy use and optimising or adjusting the processes involved	+	0	+	0	+	0	0/+	+	0	0	+	0	0	0	+	-/+	Yes
8.	Using and optimising heat recovery	+	0	+	0	+	0	0	+	0	0	+	0	0	0	+	-/+	Yes
9.	Limiting the use of fossil fuels	+	0	+	0	+	0	0	+	0	0	+	0	0	+	+	-/+	Yes

[19] producing shelf ice requires an additional quantity of high-quality water

[20] when using cryogenic chilling/freezing

Air emissions/dust/odour

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
10.	Preventing/limiting odour nuisance by using general techniques	+	0	+	0	+	-/0	-/0	+	0	0	-/0	0	0	0	+	-/0	Yes
11.	Fitting a high chimney or raising the emission point to prevent odour nuisance	+[21]	0	-	0	+/-	0	0	+	0	0	0	0	0	0	0	-	cbc[22]
12.	Mixing air with fresh air to limit odour nuisance	+[23]	0	-	0	+/-	0	0	+	0	0	0	0	0	0	0	-	cbc[24]
13.	Preventing/limiting air emissions, odour nuisance and/or dust emissions into the air at the point of the smoking process by optimising processes and adapting the production process	+	0	+	0	+	0	0	+	0	0	0	0	0	0	+	-/0	Yes
14.	Preventing/limiting air emissions, odour nuisance and/or dust emissions into the air at the point of the preserving process (roasting, frying, smoking and boiling in particular) by optimising processes, and capturing baking vapours at the source and drawing them to a suitable (combination of) air treatment technique(s)	+	0	+	0	+	-/0	-/0	+	0	-/0	-/0	0	0	0	+	-/0	Yes
15.	Preventing/limiting air emissions in chilling or freezing processes by optimising processes and adjusting the production process	+	0	+	0	+	0	0	+	0	0	0	0	0	0	+	-/0	Yes

[21] This measure may offer a solution in the case of local odour nuisance and may be used in exceptional cases for existing meat and fish processing plants, where a local odour nuisance problem requires far-reaching measures. Fitting a high chimney or raising the emission point is not an efficient odour removal technique, however.

[22] Only worthwhile and useful in the case of densely populated areas, and only if no other (additional) odour removal techniques are possible.

[23] This measure may offer a solution in the case of local odour nuisance and may be used in exceptional cases for existing meat and fish processing plants, where a local odour nuisance problem requires far-reaching measures. Mixing air with fresh air to limit odour nuisance is not an efficient odour removal technique, however.

[24] Only worthwhile and useful in the case of densely populated areas, and only if no other (additional) odour removal techniques are possible.

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
16.	Preventing/limiting odour nuisance in storage activities by limiting the duration of storage of raw animal materials, optimising the storage of animal by-products and regularly disposing of animal by-products	+	0	+	0	+	0	0	+	0	+	0	0	0	+	+	-/0	Yes
17.	Preventing/limiting air emissions, odour pollution and/or dust emissions into the air at the point of the waste water treatment installation by optimising processes and regularly cleaning installations and materials	+	0	+	0	+	-/0	-/0	+	0	-/0	-/0	0	0	0	+	-/0	Yes

Water

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
18.	Preventing or limiting water consumption	+	0	+/-	0/-[25]	+/-	+	+	0	0	0	+	0	0	0	+	-/0	cbc[26]
19.	Preventing or limiting consumption of high-quality water	+	0	+/-	0/-[27]	+/-	+	+	0	0	0	-[28]/+[29]	-[30]/+[31]	0	0	+	-/0	cbc[32]

[25] potentially conflicts with the requirements relating to hygiene and food safety

[26] in so far as the applicable provisions relating to quality and hygiene requirements are complied with

[27] potentially conflicts with the requirements relating to hygiene and food safety

[28] energy required for the purification of waste water, depending on the technique(s) used

[29] less energy required for the production of process water

[30] chemicals used as auxiliary substances, depending on the waste water treatment technique(s) being used

[31] fewer chemicals required for the production of process water

[32] in so far as the applicable provisions relating to quality and hygiene requirements are complied with

Waste water

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
20.	Limiting the quantity and impact of waste water	+	0	+	0	+	0	+	0	0	0	0	0	0	0	+	-/0	Yes
21.	Judicious use, treatment and/or discharging of waste water	+	0	+	0	+	+	-[33]/+	0	0	-[34]/0	-[35]/0	-[36]/0	0	0	+	--[37]/-	Yes
22.	Recovering phosphates from waste water in the form of struvite	+[38]/-[39]	0	-	0	+[40]/-[41]	0	+	0		+	0	-	+	0	+	--	no[42]

[33] when using membrane-based techniques (UF and reverse osmosis) for advanced purification of waste water, a concentrate stream (including COD) is also created alongside a water stream (eluate)

[34] waste water treatment sludge

[35] energy required for the purification of waste water, depending on the technique(s) used

[36] chemicals used as auxiliary substances, depending on the waste water treatment technique(s) being used

[37] when using tertiary treatment techniques for advanced purification of waste water

[38] a number of specific practical examples in the food sectors: including potato processing, dairy industry and production of baby food (in so far as it concerns large water streams (minimum reactor feed flow rate: 20 m^3/h) with a high concentration of phosphorus (minimum reactor load: 50 mg $P\text{-}PO_4/l$) and few fluctuations)

[39] biological process not yet applied on a practical scale

[40] chemical process

[41] biological process

[42] This technique goes further than BAT and is being put forward for eligibility for the ecology premium.

Chemicals

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
23.	Avoiding and/or limiting the use of environmentally harmful chemicals	+	0	+	0	+	+[43]	+	0	0	0	+[44]	+	0	+	+	-/0	Yes
24.	Using non-petrogene polymers for the treatment of waste water	+	0	+	0	+	0	0	0	+	0	0	+	0	+	+	+	Yes
25.	Limiting/avoiding the use of chemicals that damage the ozone layer	+	0	+	0	+	0	0	+	0	0	0	+	0	0	+	-/0	Yes

[43] on condition that sufficient attention is paid to optimising the cleaning process

[44] on condition that sufficient attention is paid to optimising the cleaning process

Noise/vibrations/visual pollution

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations/visual pollution	Impact on the chain	Overall		
26.	Tackling noise pollution/nuisance from vibrations at the source	+	0	+	0	+	0	0	0	0	0	0	0	+	0	+	-/0	Yes
27.	Limiting noise pollution/nuisance from vibrations caused by vehicles	+	0	+	0	+	0	0	0	0	0	0	0	+	+	+	-/0	Yes
28.	Limiting visual pollution to nearby residents by using green screening	+	0	+/-	0	+/-	0	0	0	0	0	0	0	+	0	+	-	cbc[45]

[45] depending on the location of the meat or fish processing plant and the proximity of residents and those potentially affected

General measures

No.	Technique	Technical feasibility					Environmental benefit										Economical feasibility & cost effectiveness	BAT
		Proven	Safety	Generally applicable	Quality	Overall	Water consumption	Waste water	Air	Soil	Waste	Energy	Chemicals	Noise/vibrations	Impact on the chain	Overall		
29.	Setting up and applying an environmental management system	+	+	+	0	+	+	+	+	+	+	+	+	+	0	+	-/0	Yes
30.	Optimising the design of the installations	+	+	+	0	+	+	+	+	+	+	+	+	+	0	+	-/0	Yes
31.	Optimising operations	+	+	+	0	+	+	+	+	+	+	+	+	+	0	+	-/0	Yes
32.	Guaranteeing hygiene and food safety	+	+	+	+	+	-/0	-/0	0	0	-/0	-/0	-/0	+	+	+	-/0	Yes

1.2 Conclusions

The conclusions below can be formulated for the meat and fish processing sector based on Table 1.

A total of 24 techniques have been selected as BAT for all meat and fish processing plants (see Section 5.2.1). A further 7 techniques have been taken into consideration as BAT on a case by case basis, on condition that a number of specific pre-conditions are fulfilled (see Section 5.2.2).

1.2.1 BAT for all meat and fish processing plants

The techniques below have been taken into consideration as BAT for all meat and fish processing plants.

Animal by-products/waste substances

Limiting the quantity of process-specific by-products/waste substances by selecting high-quality raw materials, optimising processes and optimising the use of auxiliary substances (BAT-1).

This technique entails that

- only fresh or freshly frozen raw materials are used
- the duration of storage of perishable materials is limited
- meat goods are heated in sealed packaging in order to limit losses due to cooking
- the filling process is optimised by using check-weighing scales, for example
- a situation in which material falls onto the floor is prevented by using e.g. wider conveyor belts, setting them up more effectively and replacing them regularly, using splatter guards, screens or flaps or drip trays, draining dishes or waste pipes.

Removing impurities from process-specific by-products/waste substances, judicious separation and separate collection of these by-products/substances in order to optimise their use, re-use, recovery, recycling and removal (BAT-3).

As a minimum, this measure entails that process-specific by-products/waste substances are contaminated as little as possible by materials such as plastic or metal, or/and that any impurities are removed by manual intervention to remove e.g. plastic and/or mechanical adaptations (e.g. magnets to remove iron objects).

Energy

Limiting energy consumption and preventing energy losses by optimising energy management and by using general techniques (BAT-5)

This technique may take the form of the following, amongst others:

- measuring energy consumption
- maintaining machinery regularly and effectively
- limiting losses via doors, windows and gates
- using thermal insulation
- switching off installations that are not needed
- using energy efficient machinery/installations.

Limiting energy consumption for thawing, chilling and freezing processes by preventing excessive energy consumption (e.g. by using sensors and an automatic climate control system to prevent air-conditioned and chilled rooms becoming colder than necessary), and optimising or adjusting processes by using an air lock or air curtain to prevent/limit cold air flowing out when the doors of cold stores are opened (BAT-6).

Limiting energy consumption in the preservation of meat and fish by preventing excessive energy consumption (e.g. by working with sprayers or steam instead of immersion in baths), and optimising processes (e.g. limiting treatment temperature or time) or adapting processes (by using alternative preservation techniques such as injection-brining and high pressure pasteurisation) (BAT-7).

Using heat recovery (e.g. from drain water from the steam boiler or cooling water from autoclaves, or from flue gases in the smoking, baking or frying process) and optimising heat recovery (e.g. when recirculating and burning in an existing steam boiler or using a flue gas condenser or heat pump) (BAT-8).

Limiting the use of fossil fuels by using alternative fuels (such as biogas, biodiesel or sustainable wood pellets) and/or sustainable energy systems (e.g. photovoltaic panels, heat pump, heat pump boiler) (BAT-9).

Air emissions/dust/odour

Preventing/limiting odour nuisance by using general techniques (BAT-10).

As a minimum, this measure entails that a control strategy is used and maintained, that installations and materials are cleaned regularly, that process installations expected to produce odours are housed in an enclosed room (in underpressure, to prevent diffusion emissions and odour nuisance), and that odour-causing emissions are effectively extracted at the source and drawn to a suitable (combination of) end-of-pipe air treatment technique(s).

Preventing/limiting air emissions, odour pollution and/or dust emissions into the air at the point of the smoking process by optimising processes and making adaptations to the production process (BAT-13).

The measure entails that auxiliary substances are used as effectively as possible and that a situation is avoided in which substances are emitted into the air without monitoring or cleaning (for example, by efficiently extracting emissions at source and drawing them to a suitable (combination of) end-of-pipe air treatment technique(s)). In addition, the measure may entail that an in-depth study is conducted in order to find out how the production process can be adapted (for example, using alternative smoking techniques).

Preventing/limiting air emissions, odour nuisance and/or dust emissions into the air at the point of the preserving process (roasting, frying, smoking and boiling in particular) by optimising processes, and catching baking vapours at source and drawing them to a suitable (combination of) air treatment technique(s) (BAT-14).

Optimising the preservation process involves the following as minimum requirements: preventing the formation of odorous oil degradation products (by limiting the baking temperature, for example), enclosing/covering baking and frying lines, placing rooms in underpressure and correct use of ventilation and air conditioning systems.

Preventing/limiting air emissions and odour nuisance in chilling or freezing processes by optimising processes and adjusting the production process (BAT-15).

Optimising processes entails that, among other things, chilling or freezing processes that cause air emissions are enclosed, and that emissions are extracted at source and drawn to a suitable (combination of) end-of-pipe air conditioning technique(s). Selective arrangement of collection of installations and materials that contain ozone-depleting products and controlled collection of ozone-depleting products are additional measures that must be taken if installations containing coolants composed of ozone-depleting substances are used.

Preventing/limiting odour nuisance in storage activities by limiting the duration of storage of raw animal materials, optimising the storage of animal by-products and regularly disposing of animal by-products (BAT-16)

Animal by-products must be regularly removed (e.g. daily) and taken for external processing in order to prevent spontaneous biodegradation and the development of odours. Optimisation of the storage of animal by-products entails, as a minimum requirement, that sealed receptacles or water-tight bins are used in an enclosed, chilled room (maximum temperature of 10°C) in underpressure, so that emissions are extracted at the source and drawn to a suitable (combination of) end-of-pipe air conditioning technique(s).

Preventing/limiting odour nuisance at the point of the waste water treatment installation by optimising processes and regularly cleaning installations and materials (BAT-17).

This measure may specifically take the form of e.g. preventing stagnation of waste water, fitting built-in primary waste water treatment techniques (including grease traps and DAF), covering (parts of) the water treatment facility where odours may develop and emptying the grease traps of the waste water treatment installation at least twice per week to remove grease, oil or sludge deposits, and immediately after cleaning storing these deposits in air-tight package to await removal from the plant.

Waste water

Limiting the quantity and impact of waste water (BAT-18)

quantity

The quantity of waste water that is released at the point of the actual process stages in the processing of meat and fish may be limited by limiting/preventing water consumption. The flow rate of waste water can be monitored by using an electromagnetic flow rate meter with or without a data logger, for example.

load – general

The impact of waste water released at the actual process stages in the processing of meat and fish can be limited by e.g. preventing overflows and spillages, and limiting/preventing leaching of raw materials (e.g. blood, proteins) and auxiliary substances (cleaning agents, detergents, disinfectants/biocides, AOX, nitrate, nitrite and phosphates).

load – link to raw materials

Certain types of contamination can be directly linked to processed raw materials, such as organ meat (e.g. kidneys, liver) and fish (e.g. muscular tissue of eel) and crustaceans and shellfish. This is the case with regard to e.g. arsenic, cadmium, cobalt and mercury that enter waste water by means of leaching (e.g. thaw water). In the case of a number of parameters (e.g. copper, zinc), it is possible that such substances may enter via the feedstuffs.

BAT in this situation primarily entails that all possible preventative measures are used, such as careful selection of raw materials and the prevention of spillages and leaching into waste water.

load – link to water source

Some parameters may enter from the water source being used, e.g. fluoride via deep well water. In this situation, BAT primarily entails that all possible preventative measures are used, such as careful selection of water sources (by switching or mixing if necessary). Any ingress of substances may be taken into account in accordance with the provisions of Article 4.2.3.1.3°c of the VLAREM regulation:

"if the discharged plant waste water originates from the use of normal surface water or from ground water or from water intended for human consumption as stated in Article 2, 17° of the Decree of 24 May 2002 concerning water intended for human use, the emission limit values stated in points a) and b) may be increased by the concentration or quantity in the received water, if that principle is stated in the environmental permit in addition to the imposed standard".

comment regarding drinking water standards

Drinking water standards have been determined within the framework of human consumption. The sectoral discharge standards and the classification criterion relate to ecological toxicity. In many cases, however, the actual concentrations of the parameters in drinking water are significantly lower than the associated standards (see Report on drinking water quality, VMM).

Example of cadmium (Cd)

We have data on the composition of drinking water supplied by 3 drinking water suppliers. In a number of regions (e.g. West Flanders, Flemish Brabant and Limburg), the reported cadmium concentrations are < 0.03 and < 0.1 µg/l) The EU drinking water standard (98/83/EC) for this parameter is 5 µg/l[46].

If it emerges that the concentrations of certain parameters actually measured in drinking water are higher than the respective classification criterion, this may be taken into account in accordance with the provisions of Article 4.2.3.1.3°c of the VLAREM regulation (see above).

pollution – link to cleaning activities

A number of parameters (e.g. chromium and nickel) can be linked to the use of INOX materials (e.g. pipelines and process equipment) and enter waste water during intensive cleaning activities (e.g. removal of tar from smoke boxes when using strong alkaline products). In this situation, BAT entails finding out whether it is possible to switch to alternative (less aggressive) cleaning products, and whether it is possible to switch to alternative smoking techniques (e.g. liquid smoke), while taking account of the plant-specific situation.

[46] 3 µg/l according to the World Health Organization (WHO, 2006) and the Decree of the Flemish Government of 13/12/2002 containing regulations on the quality and supply of water intended for human consumption (in the distribution network).

impact – chlorides

If the 'brining' process stage is used, the losses during brining can be reduced by preventing the brining baths overflowing when immersing the products for brining (level measurement, avoiding overfilling, providing overflow and drip tray), recovering salt from brining baths by using membrane filtration and recovering the brine (when dry-brining).

If the plant discharges into chloride-sensitive surface water, the impact of the waste water can be limited by adjusting the production process: using dry-brining or injection-brining as an alternative to wet brining (brining baths of salt dissolved in water).

Chloride discharge resulting from the auxiliary substances that are used in the production of process water (e.g. softening) can be limited by using suitable process water as input (via a drinking water company that uses alternative softening techniques such as nano membranes), making a conscious and specific choice of water source (e.g. soft(er) water), only treating the effectively required quantities of water up to the particular level of quality based on the application, by using e.g. reverse osmosis as a softening technique, and by using concentrate streams created at the point of water preparation in order to generate resins used for water softening.

Chloride pollution of waste water can also be limited by avoiding overdosing of $FeCl_3$, for example, in the water treatment installations.

Furthermore, it is possible to use alternative chemicals for cleaning and disinfecting (to limit/prevent AOX).

Judicious use, treatment and/or discharging of waste water (BAT-21).

Waste water released in meat and fish processing plants must be treated, whether or not using advanced methods, based on the discharging situation and possible reuse or recycling. The waste water treatment can be optimised by, for example:

- receiving the outgoing waste water streams separately in order to optimised reuse and treatment
- using self-neutralisation by mixing waste water streams with a suitable variation in pH (originating from CIP or other process stages) using a neutralisation tank
- using suitable treatment of waste water consisting of primary and/or secondary and/or tertiary treatment techniques, incl. good structural design, monitoring and adjustment.

BAT for meat and fish processing plants that discharge directly into surface water entails as a minimum requirement that, as well as pre-treatment (including a filter and grease trap), a biological treatment facility is used. Filters and grease traps must be cleaned regularly.

With regard to plants that discharge into sewers, the use of a biological treatment facility is not BAT because parameters such as BOD, COD Ntot and Ptot are degraded/removed with the aid of the waste water treatment techniques (including biological) of the sewage waste water treatment installation. With regard to other parameters (e.g. fat droplets), a grease trap has been designated as a pre-treatment technique. Any peaks in quantity and impact of waste water (e.g. suspended solids and attached particles such as heavy metals) can be prevented by buffering the plant's waste water and/or treating it in a settling tank before transport to the sewage waste water treatment installation (these particles end up in the sediment/sludge fraction). The criteria for assessing the discharging of plant waste water to a sewage waste water treatment installation are listed in the implementation decree of 21/02/2014 (Decree of the Flemish Government establishing the rules for discharging of plant waste water into a public sewage waste water treatment installation).

In order to prevent under dosing or overdosing of substances such as $FeCl_3$ in the water treatment installations, it is recommended that P concentrations in the waste water are frequently monitored (e.g. continuously by online measurement) and that dosing is coordinated to this. The measurement equipment must be regularly maintained and/or calibrated. By optimising waste

water treatment, the P concentration (in the case of under dosing) and the Cl concentration (in the case of overdosing) in the waste water can be limited.

Using membrane techniques (e.g. ultrafiltration and reverse osmosis) creates a water stream (eluate) and a concentrate stream. A concentrate stream is a mixture of different impurities (including COD).

- the concentrate streams that are created when using reverse osmosis at the point of water preparation can be used to generate resins, which are used to soften water (these may potentially contain impurities that may contaminate the resins, however)

  Remark

  This technique is a proven technique, but it cannot yet be regarded as standard technology in the meat and fish processing industry (however, it is being used on waste water from a meat processing plant that is treated by an external company together with the waste water from a neighbouring food company)
- the salts present in the concentrate streams can be further concentrated using e.g. electrodialysis[47]. The salts can be returned to the production process (salt baths), used as road salt or used in other industries.

  Remark

  The techniques of 'recovering salt from brine baths by using membrane filtration' and 'recovering salt from concentrate streams by using electrodialysis' are proven techniques, but they cannot yet be regarded as standard technology in the meat and fish processing industry.

The concentrations of a number of parameters in the discharged waste water, namely cadmium, chromium, copper, mercury, lead, nickel and zinc, are higher in meat processing plants that discharge into sewers compared with those that discharge directly into surface water. The cause of higher concentrations of heavy metals can be found in the elevated concentrations of suspended solids. It was not possible to make this comparison for fish processing plants, in view of the fact that there were no meta-data available for those that discharge directly into surface water. Heavy metals, linked to suspended solids, may well be removed in the sewage waste water treatment installation.

Chemicals

Avoiding and/or limiting the use of environmentally harmful chemicals (BAT-23).

This measure entails, on the one hand, that the use of chemicals is optimised by e.g. using automatic dosing equipment, using frequent/continuous monitoring in the water treatment installations in order to prevent overdosing of e.g. $FeCl_3$ and limiting the P concentration in the waste water, and working according to a step-by-step plan for cleaning/disinfecting, e.g.

- one alkaline cleaning agent (without hypochlorite)
- one acidic cleaning agent
- one disinfectant (properly dosed, with sufficient germicidal effect).

An efficient production schedule (limiting the number of cleaning times), optimising the cleaning processes and reusing cleaning solution may also contribute towards limiting the use of chemicals.

On the other hand, the use of environmentally harmful chemicals must be avoided and/or limited. The latter entails that fully biodegradable and/or bioeliminable substances should preferably be used, with low human and ecological toxicity and low levels of emissions and odours.

[47] a detailed description of the technique can be found in the Guide on Water Treatment Techniques (http://www.emis.vito.be/node/35387)

When choosing alternative chemicals, the applicable statutory provisions must be complied with (e.g. official list of permitted cleaning and disinfection products, the EU Detergents Regulation, the EU Biocides Regulation). The company may also voluntarily choose products with an EU Ecolabel. Alternative chemicals for cleaning and disinfecting include e.g.

- detergents with a low P content
- non-oxidising biocides (such as readily biodegradable quaternary ammonium salts), ozone, UV radiation, steam, as alternatives to halogenated oxidising biocides
- peracetic acid (5-15%), citric acid, phosphoric acid and enzyme-based cleaning agents as alternatives to EDTA.

Using non-petrogene polymers for treatment of waste water (BAT-24)

The use of biopolymers makes it possible to prevent an elevated mineral oil concentration in waste water treatment sludge. This offers the possibility of processing waste water treatment sludge in a fermentation or composting plant, in so far as the applicable conditions of the VLAREMA regulation (Annex 2.3.1) are complied with.

Limiting/avoiding the use of chemicals that damage the ozone layer (BAT-25).

Possible alternatives to halons and coolants are: iced water, ammonia, CO_2, nitrogen, argon, Inergen, propane/butane, ethylene glycol, propylene glycol, calcium chloride and HFCs.

Noise/vibrations/visual pollution

Tackling noise pollution/nuisance from vibrations at the source (BAT-26).

This measure entails as a minimum requirement that doors and windows are kept closed as much as possible and that sources of noise/noisy installations are enclosed (e.g. metal housing fitted with sound-absorbing material on the inside). Nuisance noise can also be limited at the level of production planning by only carrying out noise-generating process stages such as mixing, cutting, boiling and frying during the day. At the level of design and/or selection of installations, this measure entails that low-noise equipment is chosen (e.g. compressors, condensers, ventilators, loading and unloading bays with dock shelters) and that noise-generating installations are localised as much as possible (away from neighbours).

Limiting noise pollution/nuisance from vibrations caused by vehicles (BAT-27).

In addition to optimising production planning, an adjustment to the frequency and time of transport requires that effective agreements are made with upstream and downstream partners. Furthermore, this measure entails that when approaching the plant premises, the drive of the chilling units in freight vehicles is shut down, engines and cooling aggregates are turned off during loading/unloading, the bridge between the loading area of the freight vehicle and the storage area is properly fastened in place, and that low-noise vehicles are used (such as electric fork-lift trucks). In the case of new plants or where plant sites are being re-built, parking bays must be provided in such locations that noise that may cause a nuisance to nearby residents is kept to a minimum.

General measures

Setting up and applying an environmental management system (BAT-29).

An environmental management system may assist in applying a proactive environmental policy. The three major stages in the environmental management system are:

- satisfying the board of management, e.g. by means of an energy policy declaration drawn up by the management team,
- designating (a) responsible person(s) e.g. appointing an energy coordinator or energy team
- informing personnel, e.g. by means of internal communications and training programmes.

In addition, this measure consists of regular and appropriate communication to the company's local area with regard to the results achieved in terms of e.g. reduction of energy consumption and measures to be taken in relation to odour.

Optimising the design of the installations (BAT-30).

Carefully considered design of installations involves: designing/selecting equipment in such a way that consumption and emission levels are optimised and noise nuisance is limited, and that proper operations and maintenance are facilitated, effective structural design of installations (e.g. cooling systems, waste water treatment), fitting liquid-proof floors or drip trays, and equipping floors with an adapted water disposal system connected to a drain fitting with a grating and traps.

Optimising operations (BAT-31).

This measure entails as a minimum requirement that processes are regularly monitored with regard to consumption and emission values (water, energy, detergents) and emissions into the air (flue gases), that an effective production schedule is used to optimise the consumption of resources such as water and chemicals (e.g. limiting the number of cleaning stages when changing product), that installations are checked regularly and well maintained, and that leaks (e.g. steam and pressurised air pipelines) are detected and repaired immediately. Furthermore, the measure also entails that personnel work according to the code of good practice (e.g. if smoke boxes are used) and that effective cooperation is maintained with e.g. suppliers of raw materials and auxiliary materials, and carriers with regard to e.g. the purchase of materials in bulk or bulk packaging, and the use of reusable packaging, the use of environmentally friendly auxiliary materials such as labels, inks and glues and limiting noise nuisance caused by vehicles.

Ensuring hygiene and food safety (BAT-32).

Measures that contribute to a guarantee of hygiene and food safety are: keeping surfaces clean that come into contact with meat or fish, cleaning and disinfecting equipment, tables, floors and used containers on a daily basis (limiting microbial contamination), neatness and tidiness on the work floor, selecting suitable cleaning and disinfection products and applying checks.

Within the statutory framework concerning hygiene and food safety, the number of cleaning activities (and therefore also the quantity of water and chemicals) must be optimised, on the basis of the specific procedure (e.g. continuous or batch or degree of variety of products).

In order to limit the administrative burdens for individual plants, reports and actions relating to quality, food safety and the environment must be structured and coordinated with one another as much as possible. Integration with other players within the chain (e.g. suppliers of raw materials, external laboratories) in relation to e.g. product specifications, analysis results and quality certificates is also a plus.

1.2.2 Additional BAT, subject to pre-conditions

The techniques below are additional BAT for meat and fish processing plants if the relevant pre-conditions have been fulfilled.

Animal by-products/waste substances

On condition that the applicable quality requirements of the meat or fish product can be met:

Internal valorisation of auxiliary substances for processes (BAT-2).

This technique entails that:

- the quantity of auxiliary materials is limited by e.g. avoiding spillages and re-using surpluses
- recovered auxiliary substances are re-used in the production process, such as salt (e.g. from brining baths by using membrane filtration, or from concentrate streams by using electrodialysis) or frying oil or fat (after purification by e.g. filtration, if necessary).
- the service life of soaking baths is extended by e.g. preventing contamination by covering baths or using a filter system to remove impurities.

Taking account of the statutory provisions relating to packaging and the pre-conditions that exist with regard to marketing:

Limiting the quantity of non-process-specific waste substances by means of optimum packaging design, a well thought out procurement policy and selective collection (BAT-4).

This measure entails as a minimum requirement that materials are purchased in bulk or wholesale packs, that reusable packaging is used and that packaging material is collected selectively with a view to recycling.

Other measures include, for example:

- using environmentally friendly auxiliary materials such as labels, inks and glues that contain few or no heavy metals and/or VOCs, or biodegradable/water-soluble glues
- optimising the packaging design by e.g. improving the weight, volume and/or percentage of recycled material and the ratio of primary/secondary/tertiary packaging
- using bio-based and/or biodegradable packaging.

Odour

In the case of densely populated areas, and only if no other (additional) odour removal techniques are possible:

Fitting a high chimney or raising the emission point to limit odour nuisance (BAT-11). Mixing air with fresh air to limit odour nuisance (BAT-12).

These measures may offer a solution in the case of local odour nuisance and may be used in exceptional cases for existing meat and fish processing plants, where a local odour nuisance problem requires far-reaching measures. Fitting a high chimney or raising the emission point, or mixing air with fresh air, are not efficient odour removal techniques, however.

Water

In so far as the applicable provisions relating to quality and hygiene requirements are complied with:

Preventing or limiting water consumption (BAT-18).

Water consumption in the meat and fish processing industry can be prevented by e.g. transporting solid materials in dry form (unless water is being used as a coolant), removing coarse dirt from equipment, installations and floors while dry as much as possible (after dismantling the

installations, if necessary), allowing floors to pre-soak and (partially) dismantling installations in order to remove hardened and baked-on dirt before wet cleaning (chemical cleaning), chilling using air (e.g. smoking lines) (instead of with water) or thawing in tempering rooms (instead of water baths).
Limiting water consumption in the meat and fish processing industry entails as a minimum requirement that the water supply of water-consuming processes is monitored with the aim of optimising water consumption.

Preventing or limiting consumption of high-quality water (BAT-19).

This measure entails as a minimum requirement that the water sources used are selected on the basis of the required quality and that recovered water, whether or not after treatment, is reused as much as possible in the production process (e.g. use treated effluent for producing polymers) or for cleaning activities. Cleaning activities can be optimised by e.g. using optimised cleaning-in-place/washing-in-place.

Visual pollution
Depending on the location of the meat or fish processing plant and the proximity of nearby residents and those potentially affected:

Limiting visual pollution to nearby residents by using green screening (BAT-28).

When using green screening, preference should be given to using plants that are less likely to attract vermin; sufficient attention must also be paid to pest control. A possible alternative to green screening is noise screens featuring plants or embankments (= raising of earth).

1.3 BAT-AEL

Determining BAT-AEL (as described in Polders, C. et al, 2012) consists of the following five stages:
1) selection and grouping of industrial installations
2) collection of discharge data
3) selection of parameters
4) analysis of available discharge data in relation to BAT
5) determining the (activity-specific) BAT-AEL.

In this section, BAT-AELs have been derived for 3 groups of plants based on a detailed analysis of the discharge data (2011–2014) of a number of parameters (see section 3.2.6):
- meat processing plants that discharge directly into surface water
- meat processing plants that discharge into the sewer
- fish processing plants that discharge into the sewer

No BAT-AELs have been determined for a number of parameters and/or categories of plants (see also section 3.2.6):
- because there were no or insufficient amounts of discharge data available (including for fish processing plants that discharge into surface water)
- for parameters that are removed/degraded in the sewage waste water treatment installation
  Remark
  In the case of plants that discharge directly into the sewer, the use of their own biological treatment facility is not BAT. Parameters such as BOD, COD, SS, Ntot and Ptot are removed/degraded in the sewage waste water treatment installation. The criteria for assessing the discharging of plant waste water to a sewage waste water treatment installation are listed in the implementation decree of 21/02/2014 (Decree of the Flemish Government establishing

the rules for discharging of plant waste water into a public sewage waste water treatment installation).

Meat processing plants – directly into surface water

An overview of BAT-AEL for meat processing plants that discharge directly into surface water can be found in Table 2. The discharge data (2011–2014) from 15 meat processing plants were analysed in detail to produce this overview.

Remark
Plants that discharge less than 25 m³/day are expressly disregarded from the analysis of the discharge data (no data available). Therefore, no specific BAT-AEL have been derived for this category of plants.

Table 2: BAT-AEL for a number of parameters for meat processing plants that discharge directly into surface water

Parameter	BAT-AEL	Remarks
SS	< 30 mg/l	BAT = use of a biological waste water treatment facility (incl. good structural design, monitoring, maintenance, etc.) BAT-AEL = current sectoral standard for plants that discharge more than 25 m³/day.
BOD	< 25 mg/l	BAT = use of a biological waste water treatment facility (incl. good structural design, monitoring, maintenance, etc.) concentrations of > 25 mg/l are in many cases linked to higher SS concentrations; the likely cause of this is inefficient functioning of the biological process (therefore not in line with BAT) BAT-AEL = current sectoral standard for plants that discharge more than 25 m³/day
COD	< 125 mg/l	BAT = use of a biological waste water treatment facility (incl. good structural design, monitoring, maintenance, etc.) concentrations of > 125 mg/l are in many cases linked to higher BOD and SS concentrations; the likely cause of this is inefficient functioning of the biological process (therefore not in line with BAT)
Ntot	< 15 mg/l	BAT = use of a biological waste water treatment facility incl. good structural design, optimum nitrification/denitrification, monitoring, maintenance, etc. concentrations of > 15 mg/l are linked to higher concentrations of ammonia, Kjeldahl nitrogen, nitrite and/or nitrate; the likely cause of this is

Parameter	BAT-AEL	Remarks
		inefficient functioning of the biological nitrification/denitrification process (therefore not in line with BAT) the BREF FDM (2006) only contains general information relating monitoring, but no specific information concerning the monitoring of the parameter Ntot in the meat or fish sector. The reference document does contain any specific provisions in this regard either.
Ptot	< 2 mg/l	BAT = optimising the physico-chemical removal of P by using e.g. online P measurement and automatic correction of the $FeCl_3$ dosing (to prevent underdosing or overdosing)
arsenic	< 15 µg/l	BAT-AEL<RL
cadmium	< 2 µg/l	BAT-AEL<RL[48] a number of outliers (up to 9.2 µg/l): link with processed raw materials (e.g. organ meat)
chromium	< 50 µg/l	BAT-AEL<CC a number of outliers (up to 80 µg/l): possible link with use of INOX material and cleaning
cobalt	< 10 µg/l	BAT-AEL<RL a number of outliers (up to 13.9 µg/l) possible link with raw materials
copper	< 50 µg/l	BAT-AEL<CC a number of outliers (up to 58 µg/l): possible link with use of INOX material and cleaning
mercury	< 0.3 µg/l	BAT-AEL<CC a number of outliers (up to 0.36 µg/l) link with raw materials
lead	< 50 µg/l	BAT-AEL<CC
nickel	< 30 µg/l	BAT-AEL<CC a number of outliers (up to 47 µg/l): possible link with use of INOX material and cleaning
silver	< 10 µg/l	BAT-AEL<RL
zinc	< 200 µg/l	BAT-AEL<CC a number of outliers (up to 340 µg/l) possible link with cattle feed, pipelines, cleaning products
chloride	< 4000 mg/l	BAT-AEL<160*RL a number of plants discharge higher Cl concentrations (up to 5100 mg/l) the chloride concentration is highly dependent on the processes used, e.g. brining, physico-chemical removal of P from the waste water (e.g. using $FeCl_3$), ingress via deep bore well water, softening of received water (regeneration of the softeners), advanced waste water

48 the Decree of the Flemish Government amending various decrees relating to the environment (known as "VLAREM-trein 2015") contains the following change for the parameter 'cadmium': namely RL (=CC) 0.8 µg/l (instead of 2 µg/l)

Parameter	BAT-AEL	Remarks
		treatment (e.g. reverse osmosis; this waste water technique is not currently used by meat processing plants; the discharge data for deriving BAT-AEL **do not** imply the use of this technique) the degree of desired chloride removal is highly dependent on the receiving surface water (water quality and flow rate of the water course)
fluoride	< 0.9 mg/l	BAT-AEL<CC a number of outliers: ingress via deep bore well water (with fluoride concentrations between 5.7 and 6.0 mg/l, (n=3), used in the ratio 80/20) gives potentially higher concentrations (up to 5 mg/l) in the waste water

Meat processing plants – into the sewer

The discharge data (2011–2014) of 68 meat processing plants that discharge into the sewer were analysed in detail in order to determine BAT-AEL. An overview can be found in Table 3. For some parameters, 2 values are given for BAT-AEL. The first value is regarded as feasible for most plants, while the second value applies in specific cases (see Remarks column).

Table 3: BAT-AEL for a number of parameters for meat processing plants that discharge into the sewer

Parameter	BAT-AEL	Remarks
arsenic	< 15 µg/l	BAT-AEL<RL (15 µg/l) taking account of the measurement uncertainty of 30%[49], practically all discharge data fall below BAT-AEL
cadmium	< 2 µg/l; < 3 µg/l	BAT-AEL<RL (2 µg/l[50]) BBT-AEL<1.5*RL: link with processed raw materials, e.g. organ meat
chromium	< 50 µg/l; < 100 µg/l	BAT-AEL < CC (50 µg/l) BAT-AEL<2*CC: link with intensive cleaning (potential leaching of process materials)
copper	< 200 µg/l	BAT-AEL < 4*CC (50 µg/l)
mercury	< 0.3 µg/l; < 0.6 µg/l	BAT-AEL < CC (0.3 µg/l) BBT-AEL < 2*CC: link with processed raw materials, e.g. organ meat
lead	< 50 µg/l	BAT-AEL < CC (50 µg/l)
nickel	< 30 µg/l; < 60 µg/l	BAT-AEL < CC (30 µg/l) BBT-AEL < 2*CC: link with process materials and

[49] VLAREM II, Annex 4.2.5.2, Art. 4, section 1

[50] the Decree of the Flemish Government amending various decrees relating to the environment (known as "VLAREM-trein 2015") contains the following change for the parameter 'cadmium': namely RL (=CC) 0.8 µg/l (instead of 2 µg/l)

Parameter	BAT-AEL	Remarks
		cleaning
silver	< 10 µg/l	BAT-AEL < RL (10 µg/l)
zinc	< 1000 µg/l	BAT-AEL < 5*CC (200 µg/l)
chloride	< 4000 mg/l	BAT-AEL < 160*RL (25 mg/l) the chloride concentration is highly dependent on the processes used, e.g. brining, ingress via deep bore well water, softening of received water (regeneration of the softeners)

Fish processing plants – into the sewer

BAT-AEL for a number of parameters have been derived on the basis of a detailed analysis of the discharge data (2011–2014) from 11 fish processing plants that discharge into the sewer. An overview can be found in Table 4. For some parameters, 2 values are given for BAT-AEL. The first value is regarded as feasible for most plants, while the second value applies in specific cases (see Remarks column).

Table 4: BAT-AEL for a number of parameters for fish processing plants that discharge into the sewer

Parameter	BAT-AEL	Remarks
arsenic	< 100 µg/l; < 150 µg/l	BAT-AEL < 6.66*RL (15 µg/l) BAT-AEL < 10*RL: arsenic accumulates in shellfish and crustaceans; leaching via thaw water
cadmium	< 2 µg/l; < 3 µg/l	BAT-AEL<RL (2 µg/l[51]) BAT-AEL < 1.5*RL link with processed raw materials (e.g. oily fish such as sprat, mackerel and herring)
chromium	< 50 µg/l	BAT-AEL < CC (50 µg/l)
copper	< 200 µg/l	BAT-AEL < 4*CC (50 µg/l)
mercury	< 0.3 µg/l	BAT-AEL < CC (0.3 µg/l)
lead	< 50 µg/l; < 225 µg/l	BAT-AEL < CC (50 µg/l) BBT-AEL < 4.5*CC: higher concentrations are found in waste water when eel are processed (up to 225 µg/l)
nickel	< 30 µg/l	BAT-AEL < CC (30 µg/l)
selenium	< 75 µg/l	BAT-AEL < 15*RL (5 µg/l) derived on the basis of the available discharge data from a limited number of plants (3 processors of shrimp and/or oily fish) – area for attention for further research (see section 6.3.1)
silver	< 10 µg/l	BAT-AEL < RL (10 µg/l)
zinc	< 1000 µg/l	BAT-AEL < 5*CC (200 µg/l)

51 the Decree of the Flemish Government amending various decrees relating to the environment (known as "VLAREM-trein 2015") contains the following change for the parameter 'cadmium': namely RL (=CC) 0.8 µg/l (instead of 2 µg/l)

Parameter	BAT-AEL	Remarks
chloride	< 4000 mg/l < 7500 mg/l < 15,000 mg/l	BAT-AEL < 160*RL (25 mg/l) There are significant variations in the discharge data: - plants that thaw raw materials (e.g. shrimp) in saltwater baths: concentrations of up to 7500 mg/l - plants that 'smoke using wood shavings', in which case the smoke boxes require regular and thorough cleaning with intensive cleaning products due to tar deposits: concentrations of up to 15,000 mg/l

Overview of BAT-AELs

Table 5 provides an overview of BAT-AELs for meat processing plants that discharge directly into surface water and into the sewer, and for fish processing plants that discharge into the sewer.

Table 5: BAT-AELs for meat processing plants that discharge directly into surface water or into the sewer, and for fish processing plants that discharge into the sewer

Parameter	BAT-AEL meat processing plants that discharge directly into surface water	BAT-AEL meat processing plants that discharge into the sewer	BAT-AEL fish processing plants that discharge into the sewer
SS	< 30 mg/l < 60 mg/l[52]	/	/
BOD	< 25 mg/l	/	/
COD	< 125 mg/l	/	/
Ntot	< 15 mg/l	/	/
Ptot	< 2 mg/l	/	/
arsenic	< 15 µg/l	< 15 µg/l	< 100 µg/l; < 150 µg/l[53]
cadmium	< 2 µg/l	< 2 µg/l; < 3 µg/l[54]	< 2 µg/l; < 3 µg/l[55]
chromium	< 50 µg/l	< 50 µg/l; < 100 µg/l[56]	< 50 µg/l

[52] for plants that discharge less than 25 m³/day

[53] when processing shellfish and crustaceans

[54] when processing organ meat

[55] when processing oily fish such as sprat, mackerel and herring

[56] in processes requiring intensive cleaning (potential leaching of process materials)

Parameter	BAT-AEL meat processing plants that discharge directly into surface water	BAT-AEL meat processing plants that discharge into the sewer	BAT-AEL fish processing plants that discharge into the sewer
cobalt	< 10 µg/l	/	/
copper	< 50 µg/l	< 200 µg/l	< 200 µg/l
mercury	< 0.3 µg/l	< 0.3 µg/l; < 0.6 µg/l[57]	< 0.3 µg/l
lead	< 50 µg/l	< 50 µg/l	< 50 µg/l; < 225 µg/l[58]
nickel	< 30 µg/l	< 30 µg/l; < 60 µg/l[59]	< 30 µg/l
selenium	/	/	< 75[60] µg/l
silver	< 10 µg/l	< 10 µg/l	< 10 µg/l
zinc	< 200 µg/l	< 1000 µg/l	< 1000 µg/l
chloride	< 4000 mg/l	< 4000 mg/l	< 4000 mg/l < 7500 mg/l[61] < 15,000 mg/l[62]
fluoride	< 0.9 mg/l	/	/

Remark

There are no data available from fish processing plants that discharge directly into surface water No analysis was performed for this group of plants, nor were any BAT-AELs derived.

[57] when processing organ meat

[58] when processing eel

[59] in processes requiring intensive cleaning (potential leaching of process materials)

60 derived on the basis of the available discharge data from a limited number of plants (3 processors of shrimp and /or oily dish) – area for attention for further research (see section 6.3.1)

[61] when processing shrimp

[62] when using traditional smoking methods (e.g. wood shavings), in which case the smoke boxes require regular and thorough cleaning using cleaning products as a result of tar deposits

1.3.1 Material and energy streams in the chain

The meat and fish processing sector is inextricably linked to a number of other sectors in the product chain. Energy and material streams are exchanged within this chain and the output of one sector forms the input for another.
The source of environmental issues that arise in one sector may be found in another sector (which also determines their solution). With a view to making the economy greener, it is extremely important not only to devote attention to the direct environmental impact of the sector, but to also take account of the interactions in the chain.

An overview of the energy, water and material streams of which the processing of meat and fish forms part, is shown in Table x (not included in the English translation). This overview may be regarded as a general representation. Additional specific streams may also arise that have not been included in it.
By charting these energy, water and material streams, we gain an insight into how the sector is connected with other sectors, where loops can be closed, and how certain environmental issues can be resolved in the interaction between sectors.

Environmental issues in other sectors whose causes are found in the meat and fish processing industry

- flake ice

Fish processing plants make frequent use of flake ice, such as for wrapping/packing fresh fish and for transporting to the wholesalers, retailers and restaurants. Flake ice can be purchased from a specialised ice plant and this way of working requires chilled transport of flake ice to the fish processing plant[63].

- animal by-products

If animal by-products that are produced during the processing of meat and fish are not stored effectively and disposed of regularly, this has a negative impact on the quality of these products. As a result, the optimum valorisation of this stream is made more difficult for external processors of animal by-products and odour nuisance may occur, e.g. for nearby residents and during transport.

- the packaging used

The products of the meat and fish processing plants are packed according to the type of product, the requirements of the client (e.g. retail) and the wishes of the consumer (primary, secondary and, if applicable, tertiary packaging). This packaging forms a waste stream for the users of fish and meat products (e.g. consumer, retailers, restaurants).

- packaging waste

Packaging waste that is contaminated and has not been stored selectively and collected in the proper manner makes it more difficult for external parties to efficiently recycle/process the waste streams in question (e.g. waste plastic, metal and drinks cartons, card and paper).

- flocculating agent (polymers)

Flocculating agents (polymers) are used in order to separate or dehydrate the sludge from the water treatment facility (sludge from the grease trap and primary sludge). The use of polymers of petrogene origin may pose problems in the processing and deposition of sludge and, because the sludge (e.g. due to the mineral oil concentration) no longer fulfils the conditions of the VLAREMA regulation (see Annex 2.3.1).

[63] it is also possible for fish processing plants to produce flake ice themselves using an ice machine; the environmental impact of the activity is that additional water of high quality also requires additional energy

Environmental issues in the meat and fish processing industry whose causes are found in other sectors

- copper and zinc in waste water
  Copper is used as an additive in certain types of cattlefeeds. Such substances may be released in the waste water from meat processing plants during the processing of meat.

- chlorides in waste water
  The hardness of the water received by meat and fish processing plants for their production process has an impact on the chloride concentration in the waste water from these plants. The chloride concentration may decrease if soft water is used.

- antibiotics in waste water
  If animals reared as livestock are treated against diseases at a late stage in their life cycle, antibiotics may be released in the waste water when the meat is processed.

  For example:
  Antibiotics in the meat become noxious if the 'fermentation' process stage is used, e.g. in the preparation of dried sausage.

- pesticides in waste water
  If pesticides are applied to feedstuffs shortly before feeding, these substances may be released in the waste water during processing of the meat.