



Review of some EU normative documents and legislation and their relevance for the tanning industry in developing countries

Best Available Techniques Reference Document (BREF)



UNITED NATIONS

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countries

Part I

Best Available Techniques Reference Document (BREF)

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Summary

The aim of the Integrated Pollution Prevention and Control, IPPC, Directive 96/61/EC (subsequently recodified as 2008/1/EC) is to “..establish a general framework for integrated pollution prevention and control. It should lay down the measures necessary to implement integrated pollution prevention and control in order to achieve a high level of protection for the environment as a whole. Application of the principle of sustainable development should be promoted by an integrated approach to pollution control.”

In that context an attempt has been made to identify and agree on techniques that can be considered as Best Available Techniques (BAT) in a certain industrial sector. For that purpose a series of BAT reference documents (BREF) for key sectors, including tanning industry, have been developed to serve as a reliable source of information to decision makers, environmental authorities and manufacturers in EU member states, especially those relevant to the permitting of installations according to the IPPC Directive.

The specific implementation bodies established under the Directive are the European IPPC Bureau (EIPPCB) and the Information Exchange Forum (IEF) together with the Technical Working Groups (TWG) comprising representatives from Member States and industry experts, accession countries, environmental NGOs and EU Commission/EIPPCB.

Since the changes proposed in the draft prepared in year 2007 have not been accepted by the TWG, the BREF from February 2003 is still the official document for this sector. In conformity with the Directive, BATs recommended in the BREF document are not mandatory.

In general, the document in a very balanced manner proposes well known and proven BATs under chapters Management & good housekeeping (Operation and maintenance, Accident prevention), Substitution of chemicals), Process-integrated BAT measures, Water management and treatment, Waste management and treatment, Air pollution abatement, Energy and Decommissioning. However, it is necessary to point out that:

- The size of the plant taken as reference i.e. 12 tonnes a day corresponding to the input of some 50 tonnes of wet salted hides per day is rather high. Very few tanneries in developing countries are of such size and very likely none in the sheep & goat skin category.
- The document is rather lenient towards methods well known for their strong negative environmental impact: curing – salinity; chrome vs. lime splitting and vague concerning exhaustion levels in retanning, dyeing and fatliquoring.
- The referent plant size affects the choice & viability of BATs; for example, despite its cost and technical deficiencies (mentioned later on), separate – prior treatment of sulphide containing beamhouse streams is preferred over mixed joint treatment of all effluents.
- There is no consensus regarding separate treatment of sulphide containing (beamhouse) streams, recycling of pickle floats, chrome recovery and recycling from spent floats.
- Treatment of wastes lacks the depth and specifics expected in such document.

It is to UNIDO’s credit that it is often quoted as reference on BATs; it would be important if UNIDO could maintain that status and reputation.

Despite some deficiencies the BREF document Tanning of hides and skins is a very useful paper. It can serve as a valuable source of information not only on currently BATs but also on principles to follow while searching ways and means to make the leather and leather products industry more environmentally friendly than it is today.

National, regional and international organisations such as leather associations, IULTCS, UNIDO etc. should intensify their efforts in spreading the information and training of industry as well as personnel of environmental authorities in better understanding and interpretation of BATs and avoidance of “mechanical” implementation of listed technologies.

Part of that effort should also be directed towards education of the public who will have access to permit applications and monitoring.

1. Introduction

In the last few years the European Union has intensified its effort on environmental protection with particular emphasis on integrated pollution prevention and control.

In that context an attempt has been made to identify and agree on techniques that can be considered as Best Available Techniques (BAT) in a certain industrial sector. For that purpose a series of BAT reference documents (BREF) for key sectors, including tanning industry, have been developed to serve as a reliable source of information to decision makers, environmental authorities and manufacturers in EU member states.

Similarly, with the view of protecting all that might be affected along the production and utilization chain, including ultimate consumers and wide public, a special legislation has been promulgated concerning Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

This paper, prepared as a desk survey supplemented with informal information obtained through author's personal contacts as in the leather sector worldwide, presents the main features of the BREF document as well as its relevance and possible impact on the leather sector in developing countries.

2. Integrated Pollution Prevention and Control, IPPC

2.1. The overall purpose of **Directive 2008/1/EC of 15 January 2008 concerning integrated pollution prevention and control**¹ is to “..establish a general framework for integrated pollution prevention and control. It should lay down the measures necessary to implement integrated pollution prevention and control in order to achieve a high level of protection for the environment as a whole. Application of the principle of sustainable development should be promoted by an integrated approach to pollution control.”

2.2. Article 16(2) of the **IPPC 96/61/EC Directive**² requires the European Commission to organise "an exchange of information between Member States and the industries concerned on best available techniques, associated monitoring and developments in them", and to publish the results of the exchange.

2.3. The purpose of this information exchange is given in recital 25 of the Directive, which states that "the development and exchange of information at Community level about best available techniques will help to redress the technological imbalances in the Community, will promote the world-wide dissemination of limit values and techniques used in the Community and will help the Member States in the efficient implementation of this Directive."

¹ *For selection of text and articles see Annex 1.*

² *In December 2007 seven existing Directives related to industrial emissions were recast into a single document subsequently (re)codified as [Directive 2008/1/EC](#). However, the substance of Directive 96/61/EC has not been changed.*

2.4. To implement the actions required under Article 16(2) the European Commission (Environment DG) firstly established the **Information Exchange Forum (IEF)** and then, under its umbrella, a number of **Technical Working Groups (TWG)**. Both the IEF and the technical working groups include representation from Member States and industry experts, accession countries, environmental NGOs and EU Commission/EIPPCB.

2.5. In that context the European Commission (EC), has also established the **European IPPC Bureau, EIPPCB**, to develop exchange of information between the Member States, its main scope of work being the preparation of the draft texts of BAT documents, (BREFs).

2.6. The EIPPCB acts as a neutral, technically competent secretariat to all TWGs. The life span of a TWG and the time to prepare a final draft BREF varies according to the detail of the subject but normally it is expected to complete a final draft within two years of starting the work.

2.7. In the IEF meeting in April 2009 an Updated Generic Schedule for the review of existing BREFs was agreed with the view of highlighting the new information and changes carried out in comparison with the former BREF; it is expected that the final drafts will be produced within 23 – 32 weeks.

2.8. IPPC is applicable and mandatory for plants for the tanning of hides and skins where the treatment capacity exceeds 12 tonnes of finished products per day

3. The purpose of BREF documents

3.1. The aim of a BREF is to offer information to the competent authorities of Member States, industrial operators, the Commission and the public at large to guide the determination of BAT-based permit conditions or general rules by providing information relevant to the permitting of installations according to the IPPC Directive 96/61/EC.

3.2. A BREF should serve as a driver towards improved environmental performance across the European Union. A BREF does not interpret the Directive itself, nor does it remove the obligations on operators and Member States under the Directive to make decisions at national, regional or local level including the necessary balanced decisions required by the Directive. BREFs do not prescribe techniques or emission limit values.

3.3. The BREF should remain a primarily **technical** document.

3.4. One of the sectors for which a specific BREF document has been prepared is the tanning sector under the title **Tanning of hides and skins**.

3.5. Since the changes proposed in the draft prepared in year 2007 have not been accepted by the TWG, the **Reference Document on Best Available Techniques for the Tanning of Hides and Skins, February 2003** is still the official document for this sector.

4. Definition of Best Available Techniques, BATs

Most readers will find the official definition a bit cumbersome:

- Best available techniques means “the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to

prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole.”

whereas:

- “techniques” includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;
- “available” techniques are those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;
- “best” means most effective in achieving a high general level of protection of the environment as a whole.

5. The general BREF format

Every BREF document is expected to follow the prescribed format: Executive Summary, Preface, Scope, General Information, Applied Processes and Techniques, Current Emission and Consumption Levels, Techniques to Consider in the Determination of BAT, Best Available Techniques (BAT), Emerging Techniques, Concluding Remarks, Annexes.

While the titles appear self-explanatory, understanding of the methodology and approach applied in the substantive chapters is essential for correct interpretation of their content.

5.1. The Executive Summary

It can be read and understood as a “stand- alone” document but it is not meant to replace the main text or to encourage decision-making on BAT in specific cases without reference to the full text.

5.2. Applied Processes and Techniques

This chapter contains general descriptions of production processes and techniques applied apparently intended for the benefit of non-specialist in the particular sector; in particular, it includes:

- raw material used (including secondary/recycled) and consumables, including energy;
- auxiliary chemicals/materials used;
- raw material preparation (including storage and handling);
- material processing;
- product manufacture;
- product finishing;
- intermediate and final product storage and handling;
- handling of by-products and residues.
- actual or possible relationships, e.g. wastes act as feedstock to another activity

5.3 Current Emission and Consumption Levels

Reports on the range of currently observed emission and consumption levels such as:

- usage of energy, water and raw materials
- indication of issues such as noise or odour.
- emissions to air, water and solid residues

- options for recycling and re-use of output streams

These data may be compared to relevant standards set in national or international legislation.

5.4. Techniques to Consider in the Determination of BAT

This chapter:

- Provides a **catalogue** of emission reduction or other environmentally beneficial techniques
- Includes both process integrated and "end-of-pipe" techniques
- Consideration given to inspection routines, maintenance systems, process control methods and contingency provisions
- Identifies environmental benefits to be gained
- Indicates possible cross-media effects together with the costs of implementation, practical applicability, technical problems and the overall economic impact.
- Techniques presented may apply to the improvement of existing installations, or to new installations or a combination of both.
- The range of techniques presented shall span various cost/benefit situations, including both lower and higher cost techniques.

Information on each technique should preferably include the following elements:

- Brief technical description with pictures, diagrams and flow sheets
- Main achieved environmental benefits
- Operational data- actual performance
- Cross-media (whole environment) effects: Potential effects due to implementing the technique:
 - energy consumption and contributions to global warming
 - stratospheric ozone depletion and photochemical ozone creation potential
 - acidification resulting from emissions to air
 - particulate matter (including micro-particles and metals)
 - eutrophication of land and waters resulting from emissions to air or water
 - oxygen depletion potential in water
 - persistent/toxic/bioaccumulable components in water or to land (incl metals)
 - creation or reduction in (waste) residues
 - ability to re-use or recycle (waste) residues
 - noise and/or odour
 - risk of accidents
 - consumption of raw materials and water
- Applicability: Consideration of plant age (new or existing), size (large or small), the scope for retrofitting (e.g. space availability).
- Economics: Information on costs (investment and operating costs, any savings (e.g. reduced raw material consumption, waste charges)
- Driving force for implementation such as specific conditions, legislation, increased yield, product quality improvement
- References to literature and example plants in operation be it in Europe or world-wide.

5.5. Best Available Techniques, BATs

Based upon the information in the previous, this chapter:

- Concludes on what is considered to be BAT in a general sense for the sector.
- Consider the costs of techniques and their environmental performance, including cross-media implications
- If the best of the achieved levels as described in the previous chapter are excluded, the reason for this should be explained.
- Indicate reference conditions and measurement periods.
- However, it does **not** set emission limit values but rather suggest emission and/or consumption levels that are associated with the use of BAT and explain the basis for the conclusions.

5.6. Emerging Techniques

This chapter offers a kind of educated look into a crystal ball on future developments. Thus it:

- Identifies any novel pollution prevention and control techniques under development that might bring some cost and/or environmental benefits;
- Indicates the potential efficiency of the technique, a preliminary cost estimate and the time needed to have it commercially “available“;
- Alerts about possible environmental issues that have only recently gained interest in relation to the sector at hand.

6. Some considerations concerning the BREF for Tanning of hides and skins

- It refers to plants for the tanning of hides and skins where the treatment capacity exceeds 12 tonnes of finished products per day;
- Information contained in a BREF is descriptive and neither prescriptive nor exhaustive;
- Information not provided by the technical working group is generally not included;
- It is not site specific;
- The BREF is a result of the exchange of information for the guidance of decision makers involved in the implementation of the IPPC Directive;
- It does not contain or prescribe emission limits;
- The evidence to support a technique as BAT can come from one or more plants applying the technique somewhere in the world; exceptionally, pilot projects can also provide a sufficient basis;
- Some feel that significant time, effort and costs are needed to provide relevant information to the EIPPCB;
- There are serious problems in obtaining reliable and technically well elaborated information on processing methods, innovations and cost aspects in the tanning sector in EU. The R & D capacities of the remaining technology centres are nowadays quite limited (many of them focussed on testing services), producers of chemicals have their own (vested) interests whereas the individual tanneries are understandably concerned about confidentiality issues and competitiveness but also regarding production/emissions data.
- The IPPC Bureau has limited capacities/resources to carry out its own research, there have been difficulties with continuity and speed of process; constraints in translation of the subtleties and technical complexity of BREFs – new possible source of bias.

7. The current official BREF document for Tanning of hides and skins

Although a more recent version of the document (February 2009) can be downloaded from the IPPC site it should not be used as a reference document because it has not been endorsed by the TWG. Therefore, for the time being the February 2003 version is still valid.

For the convenience of the readers of this report, the most important chapter of the BREF document i.e. Best Available Techniques, is here fully reproduced under original title(s) and numbering.

8. Best Available Techniques according to BREF

On the basis of the assessment, techniques, and as far as possible emission and consumption levels associated with the use of BAT, are presented in this chapter that are considered to be appropriate to the sector as a whole and in many cases reflect current performance of some installations within the sector. Where emission or consumption levels “associated with best available techniques” are presented, this is to be understood as meaning that those levels represent the environmental performance that could be anticipated as a result of the application, in this sector, of the techniques described, bearing in mind the balance of costs and advantages inherent within the definition of BAT. However, they are neither emission nor consumption limit values and should not be understood as such. In some cases it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross-media considerations, they are not considered to be appropriate as BAT for the sector as a whole. However, such levels may be considered to be justified in more specific cases where there are special driving forces.

The emission and consumption levels associated with the use of BAT have to be seen together with any specified reference conditions (e.g. averaging periods).

The concept of “levels associated with BAT” described above is to be distinguished from the term “achievable level” used elsewhere in this document. Where a level is described as “achievable” using a particular technique or combination of techniques, this should be understood to mean that the level may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using those techniques.

Where available, data concerning costs have been given together with the description of the techniques presented in the previous chapter. These give a rough indication about the magnitude of costs involved. However, the actual cost of applying a technique will depend strongly on the specific situation regarding, for example, taxes, fees, and the technical characteristics of the installation concerned.

It is intended that the general BAT in this chapter are a reference point against which to judge the current performance of an existing installation or to judge a proposal for a new installation. In this way they will assist in the determination of appropriate "BAT-based" conditions for the installation or in the establishment of general binding rules under Article 9(8). It is foreseen that new installations can be designed to perform at or even better than the general BAT levels presented here. It is also considered that existing installations could move towards the general BAT levels or do better, subject to the technical and economic applicability of the techniques in each case.

While the BREFs do not set legally binding standards, they are meant to give information for the guidance of industry, Member States and the public on achievable emission and consumption levels when using specified techniques

BAT summarised below is applicable to existing and new plants, unless otherwise stated. The feasibility of implementing a technique is, however, not only driven by the fact that a plant is

new or existing. Other factors to be considered are e.g. disproportionate cost to smaller installations, limitations of some techniques, available space and infrastructure at a site. Such infrastructure might include sewage treatment plants, waste treatment plants and landfills.

Because of the wide variation of raw materials and product specifications in the tannery industry, it is sometimes difficult to make generalisations about BAT. Furthermore, many BAT will have an influence on the whole product line, potentially requiring process adaptations or changes. Another limit to generalisation might be set by the local environmental requirements. A detailed assessment and, finally, the choice of particular techniques can only be made on a site-by-site basis.

5.1. Management & good housekeeping

5.1.1. Operation and maintenance

Commitment of the tannery management is a prerequisite for good environmental performance. Technology by itself is not sufficient; it needs to go together with good housekeeping measures.

A key to good performance is awareness of the inputs to and outputs of the process with regard to the characteristics of the materials, the quantities, and their potential environmental impacts. Criteria that ensure a better environmental performance can then be taken into account as well as technological criteria that focus on the properties of the end-product.

Reduction of spills, accidents, water wastage and chemical usage is achieved by the choice of appropriate techniques, good maintenance and operation control – by monitoring and adjusting process parameters – and good staff training.

BAT is to implement provisions for segregation of waste streams in order to allow for recycling of certain waste streams. These provisions include training of personnel.

5.1.2. Accident prevention

Chemicals used in the tannery should be stored and handled in such a way as to minimise the risk of spillages and accidents. BAT is:

- To store chemicals appropriately. Basic requirements are: separation of chemicals which could react to generate dangerous emissions; labelling and use of appropriate containers; adaptation of storage rooms and areas to provide proper ventilation and soil protection, especially for halogenated and non-halogenated organic solvents and waste containing these substances
- To implement measures such as information and training of personnel; technical provisions for safety, personal protection and organisation to minimise handling of potentially harmful agents:
 - handling and accidental spillage might lead to unforeseen chemical reactions such as, e.g. the release of sulphides etc
 - protection has to be provided against releases of harmful substances. To substitute organic solvents and other agents where possible
 - to ensure that Material Safety Data Sheets for all chemicals and preparations used and stored on site are available and easily accessible
- To provide first-aid facilities and to establish evacuation procedures
- To make contingency plans for avoiding shock loads to sewage treatment plants
- To monitor the operation of end-of-pipe abatement measures
- To have clean-up materials readily available for dealing with spillages

- To ensure efficient capture of waste water from clean-up operations
- To keep records of accidents and incidents.

5.2. Substitution of chemicals

When it comes to substitution of chemicals, BAT is:

- To substitute less harmful chemicals for agents and auxiliaries that are known to be harmful to the environment
- To maintain an inventory of inputs and outputs, their fate in processes and releases
- To measure appropriate parameters to monitor the environmental releases
- To exercise responsible management including e.g, awareness of the chemicals applied in the process (including ready-made supplies), staff training, information and safety measures for workforce and environment.

In Table 5.1, categories/substances to be substituted are listed in the left and BAT substitutes in the right column.

SUBSTANCE	BAT SUBSTITUTE
Biocides	<ul style="list-style-type: none"> • Products with the lowest environmental and toxicological impact, used at the lowest level possible e.g. sodium- or potassium-di-methyl-thiocarbamate
Halogenated organic compounds	<ul style="list-style-type: none"> • They can be substituted completely in almost every case. This includes substitution for soaking, degreasing, fatliquoring, dyeing agents and special post-tanning agents - Exception: the cleaning of Merino sheepskins
Organic solvents (non-halogenated) The finishing process and the degreasing of sheepskins are the major areas of relevance.	Finishing: <ul style="list-style-type: none"> • Aqueous-based finishing systems - Exception: if very high standards of topcoat resistance to wet-rubbing, wet-flexing and perspiration are required • Low-organic solvent-based finishing systems • Low aromatic contents Sheepskin degreasing: <ul style="list-style-type: none"> • The use of one organic solvent and not mixtures, to facilitate possible re-use after distillation
Surfactants APEs such as NPEs	<ul style="list-style-type: none"> • e.g. alcohol ethoxylates, where possible
Complexing agents EDTA and NTA	<ul style="list-style-type: none"> • EDDS and MGDA, where possible
Ammonium deliming agents	<ul style="list-style-type: none"> • Partially with carbon dioxide and/or weak organic acids
Tanning agents - Chromium - Syntans and resins	<ul style="list-style-type: none"> • 20 – 35 % of the fresh chrome input can be substituted by recovered chrome • products with low formaldehyde, low phenol and low acrylic acid monomer content
Dyestuffs	<ul style="list-style-type: none"> • De-dusted or liquid dyestuffs • High-exhausting dyes containing low amounts of salt • Substitution of ammonia by auxiliaries such as dye penetrators • Substitution of halogenic dyes by vinyl sulphone reactive dyes

SUBSTANCE	BAT SUBSTITUTE
Fatliquoring agents	<ul style="list-style-type: none"> Free of agents building up AOX - Exception: waterproof leathers Applied in organic solvent-free mixtures or, when not possible, low organic solvent mixtures High-exhausting to reduce the COD as much as possible
Finishing agents for topcoats, binders (resins) and cross-linking agents	<ul style="list-style-type: none"> Binders based on polymeric emulsions with low monomer content Cadmium- and lead-free finishing systems
Others: - Water-repellent agents - Brominated and antimony-containing flame retardant	<ul style="list-style-type: none"> Free of agents building up AOX - Exception: waterproof leathers Applied in organic solvent-free mixtures or, when not possible, low organic solvent mixtures Free of metal salts - Exception: waterproof leathers Phosphate-based flame retardants

Table 5.1: BAT for the substitution of chemicals

5.3. Process-integrated BAT measures

With the implementation of BAT in the process rather than choosing an end-of-pipe abatement, improvement is gained with regard to:

- consumption of chemicals
- substitution of hazardous chemicals by less hazardous ones
- water and waste management
- emissions to air
- energy savings.

It is therefore essential in selecting BAT that the equipment used, e.g. processing vessels, the dosage of chemicals and the process control devices are also examined for their efficiency and compatibility with the above-mentioned goals. These pre-requisites are also discussed in Section 5.1.

There was no consensus in the TWG in two cases: recycling of the pickle liquor and about chrome tanning. The split view is noted at the bottom of the table.

PROCESS UNIT		BAT is:
BEAMHOUSE	Curing and soaking	<ul style="list-style-type: none"> To process fresh hides as far as they are available <p>Exceptions:</p> <ul style="list-style-type: none"> - When long transport time is necessary (max 8 - 12 hours for fresh, unchilled hides; 5 - 8 days if a cooling chain of 2 °C is maintained) - For certain types of end-products - Sheepskins, calf skins <ul style="list-style-type: none"> To reduce the amount of salt used as far as possible.
	Unhairing & liming	<ul style="list-style-type: none"> To use hair-save technology, but economics can be an issue for existing plants when re-use of the saved hair is not possible To reduce sulphide consumption by the use of enzyme preparations; not for sheepskins To recycle spent liquors only when processing sheepskins, which are dewoolled by painting

PROCESS UNIT		BAT is:
	Splitting	<ul style="list-style-type: none"> To use lime splitting <p>Exceptions:</p> <ul style="list-style-type: none"> When the starting material is wet blue When a firmer leather has to be produced (e.g. shoe-leather) When a more uniform and accurate thickness is needed in the final product <ul style="list-style-type: none"> To maximise the use of split
TANYARD OPERATIONS	Deliming and bating	<ul style="list-style-type: none"> To make a partial substitution of ammonium salts with CO₂ and/or weak organic acids
	Sheepskin degreasing	<ul style="list-style-type: none"> To optimise wet degreasing using surfactants, with or without organic solvents Closed machines with abatement for air and waste water releases when organic solvents are used to degrease skins in dry state
	Pickling	<ul style="list-style-type: none"> To use partial recycling or re-use of pickle liquors (*) split view; see below To use a volume of floats in the range of 50 – 60 % (based on fleshed weight) for ovine skins and bovine hides in order to reduce salt consumption
	Tanning (**) split view; see below	<ul style="list-style-type: none"> To increase the efficiency of the chrome tanning process through careful control of pH, float, temperature, time and drumspeed, all in combination with chrome recovery through precipitation for waste water streams containing Cr_{total} > 1 g/l (**) To use high-exhaustion tanning methods where chrome recovery is not possible (**) To maximise exhaustion of the vegetable tanning liquor with counter-current (pit system) or recycling (drum tanning)
POST-TANNING	Retanning, chrome fixation and neutralisation	<ul style="list-style-type: none"> To enhance exhaustion of post-tanning treatment agents and fixation of tanning agents in the leather To reduce the salt content of spent liquors
	Dyeing	<ul style="list-style-type: none"> To enhance exhaustion of dyestuffs
	Fatliquoring	<ul style="list-style-type: none"> To enhance exhaustion of fatliquor
	Drying	<ul style="list-style-type: none"> To optimise mechanical dewatering prior to drying where possible
	Applying a surface coat	<ul style="list-style-type: none"> To use roller coating To use curtain coating To use HVLP spray guns To use airless spray guns <p>Exception for all four above-mentioned techniques:</p> <ul style="list-style-type: none"> When very thin finishes are applied, e.g. on aniline and aniline-type leather
<p>(*) split view on Pickling: The majority in the TWG agreed that partial recycling or re-use of pickle liquors is BAT. Experts representing one Member State and some experts representing industry in the TWG did not fully agree because in their view an exception has to be made. In their view BAT is:</p> <ul style="list-style-type: none"> To use partial recycling or re-use of pickle liquors with an exception for high quality leathers. <p>(**) split view on Tanning: This BAT conclusion on chrome recovery is not fully supported by one Member State or by some experts representing industry in the TWG. Their opinion is that a separate treatment of chrome-containing liquors is not currently economically viable for a large part of the European leather industry, particularly in situations where a common specialised treatment plant is not available. In their view BAT is:</p> <ul style="list-style-type: none"> To increase the efficiency of the chrome tanning process through careful control of pH, float, temperature, time and drumspeed To use chrome recovery through precipitation Exceptions: - When common specialised recovery plants are not available - When the recovered chrome cannot be recycled in order to produce high quality leathers To use high-exhaustion tanning methods Exception: - High quality leather production. 		

Table 5.2: Process-integrated BAT Measures

5.4. Water management and treatment

BAT for water management and treatment comprises:

- reduction of water consumption
- good housekeeping
- process-integrated measures (listed in) and, finally,
- effluent treatment.

What is in this segment considered as BAT is given in the table below. However, again, there were dissenting views, mainly from the industry, concerning treatment of sulphide and chromium containing waste water streams. The split view is noted at the bottom of the table.

GOOD HOUSE-KEEPING AND PROCESS-INTEGRATED MEASURES	To improve the matching of water flow to the requirements of the process
	To use 'batch' versus 'running water' washes
	To modify existing equipment to use short floats
	To use modern equipment for short floats
	To re-use waste water in less critical processes
	To recycle or re-use process liquors where possible (see
EFFLUENT TREATMENT	To keep sulphide-containing effluent from the beamhouse separate and at high pH until the sulphide is removed. The associated emission level after treatment is 2 mg S ²⁻ /l in a random sample in the separate effluent. After the sulphide is removed (on site or in a jointly used dedicated treatment plant) the effluent can be mixed. (***) split view; see below.
	To collect chromium-containing partial effluent (e.g. from tanning and samming) with a concentration of Cr _{total} > 1 g/l separately and send it for chrome recovery. Chrome recovery can be done on or off site (***)
	To treat (on or off site) chromium-containing effluent with a concentration of Cr _{total} < 1 g/l in combination with other effluent (***)
	To use mechanical treatment (on or off site)
	To use biological treatment (on or off site)
	To use post-purification sedimentation and sludge handling (on or off site)
<p>(***) split view on sulphide and chromium treatment: Industry supports the conclusion that separate treatment of sulphide-containing effluent is BAT, but in their view the mixed treatment – on site – of sulphide- and chrome-containing effluent is also BAT. The arguments are the following:</p> <ul style="list-style-type: none"> • lower costs • less chemicals have to be used • the technique is simple and reliable • emission levels for the total effluent – depending on the mixing rate – of 2 mg S²⁻/l and 1 mg Cr_{total} /l can be achieved. (e.g. if 50 % of the mixed effluent consist of the chrome-bearing effluent and 50 % of the mixed effluent consist of the sulphide-bearing effluent, emission levels for the total effluent will be 1 mg S²⁻/l and 0.5 mg Cr_{total} /l). <p>(****) see split view on chrome recovery in note (**) in Table 5.2 and see split view on separate treatment in note (***) on this table.</p>	

Table 5.3: BAT for water management and treatment

For all the techniques mentioned in it has to be decided site-specifically whether primary, secondary or even tertiary treatment is more environmentally and economically efficient on site

or in a jointly used dedicated waste water treatment plant. It can also be efficient for a tannery to treat its effluent partly on site and then discharge it to a municipal sewage treatment works. The removal of particular substances from the waste water effluents e.g, biocides, halogenated organic compounds, surfactants and other process agents that need specific treatment, also has to be decided on a case-by-case basis.

5.5. Waste management and treatment

In waste management and treatment, BAT, in order of priority is:

- prevention
- reduction
- re-use
- recycling / recovery
- thermal treatment for certain types of waste.

Landfill is not BAT, although, in some cases it is the only option available.

A large amount of waste, in particular organic waste, is inherent to production in tanneries. Both organic waste fractions and other residues can be prevented and reduced to a large extent by using BAT in the process units (see Sections 0 and 0). Recycling options are numerous and carried out on site and off site. The potential for recycling should be exploited by ensuring segregation of waste. Of equal importance is commercialisation of wastes as by-products and co-operation between tanners to make recycling and re-use options economically feasible.

Waste that arises in the tannery has to be handled and stored in such a way as to avoid leaching, odour problems and emissions to air.

In Table 5.4. re-use, recycling / recovery and treatment options are given in the first column and waste fractions that can be used for the respective option are listed in the second column. BAT is to identify opportunities to implement these measures where feasible, ensuring that actions are carried through.

RE-USE / RECYCLING / RECOVERY AND TREATMENT	TYPE OF WASTE
Leather production	Splits
Leather fibre board production	Tanned wastes in general, e.g., splits, shavings, trimmings
Small leather goods etc.	Splits and tanned trimmings
Filling material, wool	Hair and wool
Gelatine and/or hide glue	Raw trimmings, green and limed fleshings and splits
Sausage casings	Untanned splits
Fat recovery	Raw trimmings, green and limed fleshings
Protein hydrolysate	Hair, raw and limed trimmings, green and limed fleshings, green, limed and tanned splits and shavings
Collagen	Limed trimmings and splits
Agriculture and fertiliser	Hair for the nitrogen content, residues from composting and anaerobic digestion, sludges from waste water treatment. The legal requirements for the application of waste to land require sophisticated waste separation and treatment of the various fractions
Composting	Hair, green and limed fleshings, green, limed and tanned splits and shavings, fats, grease and oil; sludges from waste water treatment
Anaerobic digestion	Hair, raw trimmings, green and limed fleshings, green, limed splits, fats, grease and oil; sludges from waste water treatment

RE-USE / RECYCLING / RECOVERY AND TREATMENT	TYPE OF WASTE
Thermal treatment	Fats, grease, mixtures of non-halogenated organic solvents and oil
Recycling of organic solvents	Organic solvents (no mixtures)
Regeneration of air abatement filters	Activated carbon filters
Re-use and recycling of packaging material by feeding it back to the supplier via an appropriate recycling system	Container, pallets, plastic, cardboard

Table 5.4: BAT for waste management

5.6. Air abatement

BAT is to prevent the generation of odours through process control, maintenance and proper handling and storage of raw hides and wastes, in some cases requiring the installation of filters, e.g. at waste water treatment plants or for VOC releases. BATs to prevent releases of e.g. hydrogen sulphides, ammonia, VOCs and dust, are mentioned in and/or Table 5.2. and Table 5.3.

In addition, the following end-of-pipe measures are BAT for the abatement of hydrogen sulphides, ammonia and VOCs in particular:

- wet scrubbing, for example, to abate ammonia and hydrogen sulphides from delimiting, pickling and dyeing
- wet scrubbing, absorption, bio-filters, cryogenic removal or incineration to abate VOC from degreasing, drying and finishing
- wet scrubbing, absorption or bio-filters to abate various releases from waste water treatment.

Techniques exist that are suitable for the abatement of a combination of releases, e.g. wet scrubbing for removal of aerosols, organic solvents and odours.

5.7. Energy

BAT is to record the energy consumption for electricity, heat (steam and heating) and compressed air, particularly for the units with the highest consumption, such as waste water treatment and drying procedures.

Operators therefore need a system for monitoring energy usage and performance. The scale of this needs to match the level of energy usage, but the following activities should be considered:

- recording actual energy usage, split by energy type and major end-uses, on a specified and appropriate regular basis (e.g. hourly, daily, weekly, etc.)
- generating energy performance indicators (historical energy performance or normalised to an indicator of production/external temperature/building occupancy etc.)
- monitoring energy performance, including mechanisms to alert the operator to significant variations from predicted energy performance
- ensuring appropriate investigative and corrective action is taken, and recorded, in response to variations
- delivering concise, appropriate and timely energy performance information to all individuals with identified responsibilities for energy management
- setting, reviewing and revising performance targets.

5.8. Decommissioning

In general, BAT for decommissioning of a tannery includes all provisions and measures that have to be taken into account to prevent environmental impact during and after the shutdown process. The aim is to prevent impact on the environment in general, and in particular the immediate surroundings, by activities that have to be carried out to leave the area in such a way that it can be re-used (depending on the enforcement bodies' decision on land use planning). This includes activities from the shutdown of a plant itself, the removal of buildings, equipment, residues etc. from the site, and contamination of surface water, groundwater, air or soil.

9. A brief review of BATs proposed

General:

- The size of the plant taken as reference i.e. 12 tonnes a day corresponding to the input of some 50 tonnes of wet salted hides per day is rather high. Very few tanneries in developing countries are of such size and very likely none in the sheep & goat skin category.
- As a rule, both advantages and disadvantages of a certain BAT are elaborated; furthermore, it is very useful that there are always some information about the main emissions levels, cross-media effects, reference plants, economics and reference literature.
- It is certainly to UNIDO's credit that it is often quoted as reference on BATs.

Table 5.1: BAT for the substitution of chemicals

It is quite unlikely that exceptions agreed concerning use of halogenated organic compounds in cleaning of Merino sheepskins and agents building up AOX in the case of waterproof leathers will in the long run, "survive" pressures by environmental authorities.

Table 5.2: Process-integrated BAT Measures

The overall approach in this certainly key-area is very "soft" showing a surprisingly level of flexibility and tolerance towards methods which are well known for their strong negative environmental impact: curing – salinity; chrome vs. lime splitting; vague wording concerning exhaustion levels in retanning, dyeing and fatliquoring

Such plant size affects the choice & viability of BATs; for example, despite its cost and technical deficiencies (mentioned later on), separate – prior treatment of sulphide containing beamhouse streams is preferred over mixed joint treatment of all effluents.

- It is interesting to note that recycling of spent lime streams strongly advocated only a few years ago is now virtually recommended only "...when processing sheepskins, which are dewooled by painting"; there is also no full consensus whether recycling of pickle floats is BAT.
- The "lenient" attitude mentioned earlier is evident in the case of splitting stage. The environmentally sound splitting in lime is in effect overruled by too many exceptions, including that "to maximise the use of split".
- While it is claimed that 20 – 35 % of the fresh chrome input can be substituted by recovered chrome, there is obviously strong resistance (producers of high quality leathers?) to reuse of recovered chrome.

- Apparently adhering to the principle that BREF documents are not meant to be prescriptive there is no indication whatsoever what could be considered as satisfactory exhaustion in the main tanning, retanning, dyeing or fatliquoring.
- There is no suggestion that water or predominantly water based finishing (coating) is BAT vs. organic solvent based finishing.

Table 5.3: BAT for water management and treatment

- “To re-use waste water in less critical processes”; Such as? Only soaking and washing?
- “Effluent treatment: To use mechanical treatment (on or off site).” It sounds somewhat odd because prior (on-site) physical-chemical treatment stage before secondary treatment in municipal water works is unavoidable and compulsory for all tanneries.

Table 5.4: BAT for waste management

- Interestingly, a wide spread practice of utilizing limed split scraps for dog-chews is not mentioned.
- The suggestion about utilization of hair, residues from composting and anaerobic digestion, sludges from waste water treatment as fertilizer and in agriculture sounds very academic as it is nearly negated in the sentence following it: “The legal requirements for the application of waste to land require sophisticated waste separation and treatment of the various fractions.”
- There is no reference/position concerning some industrial or semi-industrial scale technologies for treatment of tannery solid wastes – sludges such as vitrification or conversion into tar/Diesel oil.
- The position that “Landfill is not BAT, although, in some cases it is the only option available.” may sound rather disappointing in many (developing) countries.

On the whole, the chapters on waste water treatment and waste management is possibly the weakest part of the BREF document lacking the required depth and specifics.

Energy

BAT is here reduced to well managed monitoring and control without any attempt or suggestion about possible saving methods or supplementing the needs from “greener” sources such as solar supported water heating or heat pumps.

Emerging technologies

A viable and cost effective low- or salt-free preservation of raw hides and skins would be a genuine break-through with immense long-term positive impact on the tanning operations worldwide. Short term preservation with flo-ice sounds very promising but, regrettably, it seems that it has not been developed further.

10. The relevance of the BREF document to developing countries

As said earlier, the size of the plant taken as reference i.e. 12 tonnes a day corresponding to the input of some 50 tonnes of wet salted hides per day is rather high. Very few tanneries in developing countries are of such size and very likely none in the sheep & goat skin category.

Nevertheless, the BREF document is certainly a valuable source of information for all concerned (tanners, environmental authorities, NGOs) on well proven, viable and/or desirable options in tanning operations.

Very regrettably, some tanneries in Europe and possibly elsewhere have already experienced unreasonable pressures by environmental authorities insisting on nearly prompt implementation of BATs mention in BREF without due consideration of specific local conditions. It could be counterproductive if environmental authorities – environmental protection agencies (EPAs) in developing countries would more or less mechanically press for introduction of (all) technologies listed as BATs overlooking the fact that even in Europe BREF suggestions of BATs are not mandatory.“

11. Conclusion

There are serious problems in obtaining reliable and technically well elaborated information on processing methods, innovations and cost aspects in the tanning sector in EU. The R & D capacities of the remaining technology centres are nowadays quite limited (many of them focussed on testing services), producers of chemicals have their own (vested) interests, whereas the individual tanneries are understandably concerned about confidentiality issues and competitiveness but also regarding production/emissions data.

It also appears that some BATs proposed are the result of consensus reached during negotiations within the TWG group rather than of strictly technical considerations.

It is very important that, as a rule, for each BAT both advantages and disadvantages are elaborated; furthermore, it is very useful that there are it consistently provides some information about cross-media effects, reference plants, economics and reference literature.

It is also to UNIDO credit that it is often quoted as reference on BATs; it would be important if UNIDO could maintain that status and reputation.

A valuable feature of the BREF document is extensive elaboration of principles and criteria determining which methods can be considered Best Available Techniques.

It is quite remarkable that it was not possible to reach consensus regarding separate treatment of sulphide containing (beamhouse) streams and, more importantly, on chrome recovery and recycling from spent floats.

Treatment of wastes lacks the depth and specifics expected in such kind of document.

Nevertheless, despite some deficiencies the BREF document Tanning of hides and skins is a very useful paper. It can serve as a valuable source of information not only on currently Best Available Techniques but also on principles to follow while searching ways and means to make the leather and leather products industry more environmentally friendly than it is today.

In that context it would be important if the national, regional and international organisations such as leather associations, IULTCS, UNIDO etc. could intensify their efforts in spreading the information and training of industry as well as personnel of environmental authorities in better understanding and interpretation of BATs and avoidance of “mechanical” implementation of listed technologies. Part of that effort should also be directed towards education of the public who will have access to permit applications and monitoring.

12. References

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13. GLOSSARY

Abbreviations and chemical formulae used in the document³	
AOX	Adsorbable Organic Halogen (X): The total concentration in milligrams per litre, expressed as chlorine, of all halogen compounds (except fluorine) present in a sample of water that are capable of being adsorbed on activated carbon.
APE	Alkyl Phenol Ethoxylates
BAT	Best Available Techniques
BOD	Biochemical Oxygen Demand: a measure of the oxygen consumed by bacteria to biochemically oxidise organic substances present in water to carbon dioxide and water. The higher the organic load, the larger the amount of oxygen consumed. As a result, with high organic concentrations in the effluent, the amount of oxygen in water may be reduced below acceptable levels for aquatic life. BOD tests are carried out at 20 °C in dilute solution and the amount of oxygen consumed is determined after 5, 7, 20 or, less commonly, 30 days. The corresponding parameters are called BOD ₅ , BOD ₇ , BOD ₂₀ and BOD ₃₀ . The unit of measurement is mg O ₂ /l.
BOD₅, BOD₇, BOD₂₀ and BOD₃₀.	The unit of measurement is mg O ₂ /l.
BREF	BAT Reference Document
Bronopol	2-bromo-2-nitro-propane-1,3-diol
BSE	Bovine Spongiform Encephalopathy
CFC	Chlorofluorohydrocarbons
CH₂Cl₂	Dichloromethane or methylene chloride
COD	Chemical Oxygen Demand: The amount of potassium dichromate, expressed as oxygen, required to chemically oxidize at approximately 150 °C substances contained in waste water. The unit of measurement is mg O ₂ /l or mg O ₂ /g of substance.
DAF	Dissolved Air Flotation
DDT	An organochlorine pesticide which has been banned in most European countries. The isomer used as pesticide is: p,p'-DDT1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane.
DG	Directorate General (of the European Commission)
DS	Dry Solids
DSP	Di-sodium phthalates
DTPA	Diethylene-triamine-penta-acetate
EC	European Commission
EC₅₀	Effect Concentration: The concentration at which effects are observed in 50 % of the test population after administering a single dose. Effects include the immobilization of daphnia, inhibition of growth, cell division or biomass production, or the production of chlorophyll by algae.
EDDS	Ethylene-diamine-di-succinate
EDTA	Ethylene-diamine-tetra-acetate
HCH	Hexachlorocyclohexane (pesticide)
HVLP	High Volume Low Pressure

³ In the full BREF document; not all of them appear in this report.

IPPC	Integrated Pollution Prevention and Control
IUE	International Environment Commission of the International Union of Leather Technologists and Chemists Societies, IULTCS
LAS	Linear alkylated benzenesulphonacids
LC₅₀	The lowest concentration of a substance in water or ambient air in milligrams per litre sufficient to cause death in 50 % of the test population within a defined period (e.g. 96 hours for fish, 48 hours for daphnia).
LD₅₀	Lethal Dose: The lowest dose of a substance administered to species such as mice or rats sufficient to cause death in 50 % of the test population within a defined period (no more than 14 days), expressed in milligrams of test substance per kilogram of body weight.
LOEC	Lowest Observed Effect Concentration: The lowest experimentally determined concentration of a test substance at which adverse effects can be observed.
LTD	Low-Temperature Drying
MBR	Membrane Bioreactor
MGDA	Methyl-glycine-di-acetate
MBT	Methylene bis-thiocyanate
MLSS	Mixed Liquor Suspended Solids
N-tot b	Total nitrogen
NOAC	No Observed Acute Effect Concentration
NOEC	No Observed Effect Concentration:b
NP	Nonylphenol
NPE	Nonylphenol ethoxylates
NTA	Nitrilo-tri-acetate
PAH	Poly-aromatic hydrocarbons
PCP	Pentachlorophenol
PCDD/F	Polychlorinated dibenzodioxins / polychlorinated dibenzofurans
PDTA	Propylene-diamine-tetra-acetatebb
pH	The measure of acidity or alkalinity of a chemical solution, from 0 to 14. Anything neutral has a pH of 7. Acids have a pH less than 7, bases (alkaline) greater than 7
QAC	Quaternary Ammonium Compound
SMEs	Small and Medium Sized Enterprises
SS	Suspended Solids
TCMTB	Thiocyanomethylthiobenzothiazole
TDS bb	Total Dissolved Solids
THP	Tetrakis (hydroxymethyl) phosphonium compound
TKN	Total Kjeldahl Nitrogen. The Kjeldahl technique is used to determine fixed nitrogen in organic and inorganic materials
TOC	Total Organic Carbonbbbb
TS	Total Solids
TWG	Technical Working Group
VOC	Volatile Organic Compound

Note: Some abbreviations and formulae do not appear in the text but have been retained for general information.

Annex 1 Selected text and articles from DIRECTIVE 2008/1/EC

DIRECTIVE 2008/1/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 15 January 2008 concerning integrated pollution prevention and control

(1) Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control ⁽³⁾ has been substantially amended several times ⁽⁴⁾. In the interests of clarity and rationality the said Directive should be codified.

(2) The objectives and principles of the Community's environment policy, as set out in Article 174 of the Treaty, consist in particular of preventing, reducing and as far as possible eliminating pollution by giving priority to intervention at source and ensuring prudent management of natural resources, in compliance with the 'polluter pays' principle and the principle of pollution prevention.

(3) The Fifth Environmental Action Programme, the broad outline of which was approved by the Council and the Representatives of the Governments of the Member States, meeting within the Council, in the Resolution of 1 February 1993 on a Community programme of policy and action in relation to the environment and sustainable development ⁽⁵⁾, accorded priority to integrated pollution control as an important part of the move towards a more sustainable balance between human activity and socioeconomic development, on the one hand, and the resources and regenerative capacity of nature, on the other.

(4) The implementation of an integrated approach to reduce pollution requires action at Community level in order to modify and supplement existing Community legislation concerning the prevention and control of pollution from industrial plants.

(7) Although Community legislation exists on the combating of air pollution and the prevention or minimisation of the discharge of dangerous substances into water, there is no comparable Community legislation aimed at preventing or minimising emissions into soil.

(8) Different approaches to controlling emissions into the air, water or soil separately may encourage the shifting of pollution between the various environmental media rather than protecting the environment as a whole.

(9) The objective of an integrated approach to pollution control is to prevent emissions into air, water or soil wherever this is practicable, taking into account waste management, and, where it is not, to minimise them in order to achieve a high level of protection for the environment as a whole.

(10) This Directive should establish a general framework for integrated pollution prevention and control. It should lay down the measures necessary to implement integrated pollution prevention and control in order to achieve a high level of protection for the environment as a whole.

Application of the principle of sustainable development should be promoted by an integrated approach to pollution control.

(11) The provisions of this Directive should apply without prejudice to the provisions of Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment

(i). When information or conclusions obtained further to the application of that Directive have to be taken into consideration for the granting of authorisation, this Directive should not affect the implementation of Directive 85/337/EEC.

(12) Member States should take the necessary steps in order to ensure that the operator of the industrial activities referred to in this Directive is complying with the general principles of certain basic obligations. For that purpose it would suffice for the competent authorities to take those general principles into account when laying down the authorisation conditions.

(13) Some of the provisions adopted pursuant to this Directive must be applied to existing installations after 30 October 2007 and others had to be applied as from 30 October 1999.

(14) In order to tackle pollution problems more effectively and efficiently, environmental aspects should be taken

into consideration by the operator. Those aspects should be communicated to the competent authority or authorities so that they can satisfy themselves, before granting a permit, that all appropriate preventive or pollution-control measures have been laid down. Very different application procedures may give rise to different levels of environmental protection and public awareness. Therefore, applications for permits under this Directive should include minimum data.

(15) Full coordination of the authorisation procedure and conditions between competent authorities should make it possible to achieve the highest practicable level of protection for the environment as a whole.

(16) The competent authority or authorities should grant or amend a permit only when integrated environmental protection measures for air, water and land have been laid down.

(17) The permit should include all necessary measures to fulfil the authorisation conditions in order thus to achieve a high level of protection for the environment as a whole.

Without prejudice to the authorisation procedure, those measures may also be the subject of general binding requirements.

(18) Emission limit values, parameters or equivalent technical measures should be based on the best available techniques, without prescribing the use of one specific technique or technology and taking into consideration the technical characteristics of the installation concerned, its geographical location and local environmental conditions. In all cases the authorisation conditions should lay down provisions on minimising long-distance or transfrontier pollution and ensure a high level of protection for the environment as a whole.

(19) It is for the Member States to determine how the technical characteristics of the installation concerned, its geographical location and local environmental conditions can, where appropriate, be taken into consideration.

(20) When an environmental quality standard requires more stringent conditions than those that can be achieved by using the best available techniques, supplementary conditions should in particular be required by the permit, without prejudice to other measures that may be taken to comply with the environmental quality standards.

(21) Because best available techniques will change with time, particularly in the light of technical advances, the competent authorities should monitor or be informed of such progress.

(22) Changes to an installation may give rise to pollution. The competent authority or authorities should therefore be notified of any change which might affect the environment.

Substantial changes to plant must be subject to the granting of prior authorisation in accordance with this Directive.

(23) The authorisation conditions should be periodically reviewed and if necessary updated. Under certain conditions, they should in any event be re-examined.

(24) Effective public participation in the taking of decisions should enable the public to express, and the decision maker to take account of, opinions and concerns which may be relevant to those decisions, thereby increasing the accountability and transparency of the decision-making process and contributing to public awareness of environmental issues and support for the decisions taken. In particular, the public should have access to information on the operation of installations and their potential effect on the environment and, before any decision is taken, to information relating to applications for permits for new installations or substantial changes and to the permits themselves, their updating and the relevant monitoring data.

(25) Participation, including participation by associations, organisations and groups, in particular non-governmental organisations promoting environmental protection, should accordingly be fostered, including by promoting environmental education of the public.

(26) On 25 June 1998 the Community signed the UNECE Convention on Access to Information, Public Participation

in Decision-Making and Access to Justice in Environmental Matters (the Århus Convention). Among the objectives of the Århus Convention is the desire to guarantee rights of public participation in decision making in environmental matters in order to contribute to the protection of the right to live in an environment which is adequate for personal health and well-being.

(27) The development and exchange of information at Community level about best available techniques should help to redress the technological imbalances in the Community, should promote the worldwide dissemination of limit values and techniques used in the Community and should help the Member States in the efficient implementation of this Directive.

(28) Reports on the implementation and effectiveness of this Directive should be drawn up regularly.

(29) This Directive is concerned with installations whose potential for pollution, and therefore transfrontier pollution, is significant. Transboundary consultation should be organised where applications relate to the licensing of new installations or substantial changes to installations which are likely to have significant negative environmental effects. The applications relating to such proposals or substantial changes should be available to the public of the Member State likely to be affected.

(30) The need for action may be identified at Community level to lay down emission limit values for certain categories of installation and pollutant covered by this Directive. The European Parliament and the Council should set such emission limit values in accordance with the provisions of the Treaty.

(31) The provisions of this Directive should apply without prejudice to Community provisions on health and safety at the workplace.

(32) This Directive should be without prejudice to the obligations of the Member States relating to the time-limits for transposition into national law of the Directives as set out in Annex VI, Part B,

HAVE ADOPTED THIS DIRECTIVE:

Article 1, Purpose and scope

The purpose of this Directive is to achieve integrated prevention and control of pollution arising from the activities listed in Annex I. It lays down measures designed to prevent or, where that is not practicable, to reduce emissions in the air, water and land from the abovementioned activities, including measures concerning waste, in order to achieve a high level of protection of the environment taken as a whole, without prejudice to Directive 85/337/EEC and other relevant Community provisions.

Article 2, Definitions

For the purposes of this Directive the following definitions shall apply:

1. 'substance' means any chemical element and its compounds, with the exception of radioactive substances within the meaning of Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation ⁽¹⁾ and genetically modified organisms within the meaning of Council Directive 90/219/EEC of 23 April 1990 on the contained use of genetically modified micro-organisms ⁽²⁾ and Directive 2001/18/EC of the European Parliament and of the Council of 12 March 2001 on the deliberate release into the environment of genetically modified organisms ⁽³⁾;

2. 'pollution' means the direct or indirect introduction, as a result of human activity, of substances, vibrations, heat or noise into the air, water or land which may be harmful to human health or the quality of the environment, result in damage to material property, or impair or interfere with amenities and other legitimate uses of the environment;

3. 'installation' means a stationary technical unit where one or more activities listed in Annex I are carried out, and any

other directly associated activities which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution;

5. 'emission' means the direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in the installation into the air, water or land;

6. 'emission limit values' means the mass, expressed in terms of certain specific parameters, concentration and/or level of an emission, which may not be exceeded during one or more periods of time; emission limit values may also be laid down for certain groups, families or categories of substances, in particular for those listed in Annex III. The emission limit values for substances normally apply at the point where the emissions leave the installation, any dilution being disregarded

when determining them; with regard to indirect releases into water, the effect of a water treatment plant may be taken into account when determining the emission limit values of the installation involved, provided that an equivalent level is guaranteed for the protection of the environment as a whole and provided this does not lead to higher levels of pollution in the environment, without prejudice to Directive 2006/11/EC or the Directives implementing it;

7. 'environmental quality standard' means the set of requirements which must be fulfilled at a given time by a given environment or particular part thereof, as set out in Community legislation;

8. 'competent authority' means the authority or authorities or bodies responsible under the legal provisions of the Member States for carrying out the obligations arising from this Directive;

9. 'permit' means that part or the whole of a written decision (or several such decisions) granting authorisation to operate all or part of an installation, subject to certain conditions which guarantee that the installation complies with the requirements of this Directive. A permit may cover one or more installations or parts of installations on the same site operated by the same operator;

12. 'best available techniques' means the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole:

(a) 'techniques' shall include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

(b) 'available techniques' means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;

(c) 'best' means most effective in achieving a high general level of protection of the environment as a whole.

14. 'the public' means one or more natural or legal persons and, in accordance with national legislation or practice, their associations, organisations or groups;

15. 'the public concerned' means the public affected or likely to be affected by, or having an interest in, the taking of a decision on the issuing or the updating of a permit or of permit conditions; for the purposes of this definition, nongovernmental organisations promoting environmental protection and meeting any requirements under national law shall be deemed to have an interest.

Article 3, General principles governing the basic obligations of the operator

1. Member States shall take the necessary measures to provide that the competent authorities ensure that installations are operated in such a way that:

(a) all the appropriate preventive measures are taken against pollution, in particular through application of the best available techniques;

(b) no significant pollution is caused;

(c) waste production is avoided in accordance with Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste (1); where waste is produced, it is recovered or, where that is technically and economically impossible, it is disposed of while avoiding or reducing any impact on the environment;

(d) energy is used efficiently;

(e) the necessary measures are taken to prevent accidents and limit their consequences;

(f) the necessary measures are taken upon definitive cessation of activities to avoid any pollution risk and return the site of operation to a satisfactory state.

2. For the purposes of compliance with this Article, it shall be sufficient if Member States ensure that the competent authorities take account of the general principles set out in paragraph 1 when they determine the conditions of the permit.

Article 4, Permits for new installations

Member States shall take the necessary measures to ensure that no new installation is operated without a permit issued in accordance with this Directive, without prejudice to the exceptions provided for in Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (2).

Article 6, Applications for permits

1. Member States shall take the necessary measures to ensure that an application to the competent authority for a permit includes a description of:

- (a) the installation and its activities;
- (b) the raw and auxiliary materials, other substances and the energy used in or generated by the installation;
- (c) the sources of emissions from the installation;
- (d) the conditions of the site of the installation;
- (e) the nature and quantities of foreseeable emissions from the installation into each medium as well as identification of significant effects of the emissions on the environment;
- (f) the proposed technology and other techniques for preventing or, where this not possible, reducing emissions from the installation;
- (g) where necessary, measures for the prevention and recovery of waste generated by the installation;
- (h) further measures planned to comply with the general principles of the basic obligations of the operator as provided for in Article 3;
- (i) measures planned to monitor emissions into the environment;
- (j) the main alternatives, if any, studied by the applicant in outline.

An application for a permit shall also include a non-technical summary of the details referred to in points (a) to (j).

Article 7, Integrated approach to issuing permits

Member States shall take the measures necessary to ensure that the conditions of, and procedure for the grant of, the permit are fully coordinated where more than one competent authority is involved, in order to guarantee an effective integrated approach by all authorities competent for this procedure.

Article 8, Decisions

Without prejudice to other requirements laid down in national or Community legislation, the competent authority shall grant a permit containing conditions guaranteeing that the installation complies with the requirements of this Directive or, if it does not, shall refuse to grant the permit.

All permits granted and modified permits must include details of the arrangements made for air, water and land protection as referred to in this Directive.

3. The permit shall include emission limit values for polluting substances, in particular those listed in Annex III, likely to be emitted from the installation concerned in significant quantities, having regard to their nature and their potential to transfer pollution from one medium to another (water, air and land). If necessary, the permit shall include appropriate requirements ensuring protection of the soil and ground water and measures concerning the management of waste

generated by the installation. Where appropriate, limit values may be supplemented or replaced by equivalent parameters or technical measures.

For installations under point 6.6 in Annex I, emission limit values laid down in accordance with this paragraph shall take into account practical considerations appropriate to these categories of installation.

4. Without prejudice to Article 10, the emission limit values and the equivalent parameters and technical measures referred to in paragraph 3 shall be based on the best available techniques, without prescribing the use of any technique or specific technology, but taking into account the technical characteristics of the installation concerned, its geographical location and the local environmental conditions. In all circumstances, the conditions of the permit shall contain provisions on the minimisation of long-distance or transboundary pollution and ensure a high level of protection for the environment as a whole.

5. The permit shall contain suitable release monitoring requirements, specifying measurement methodology and frequency, evaluation procedure and an obligation to supply the competent authority with data required for checking compliance with the permit.

For installations under point 6.6 in Annex I, the measures referred to in this paragraph may take account of costs and benefits.

6. The permit shall contain measures relating to conditions other than normal operating conditions. Thus, where there is a risk that the environment may be affected, appropriate provision shall be made for start-up, leaks, malfunctions, momentary stoppages and definitive cessation of operations.

The permit may also contain temporary derogations from the requirements of paragraph 4 if a rehabilitation plan approved by the competent authority ensures that these requirements will be met within six months and if the project leads to a reduction of pollution.

Article 10, Best available techniques and environmental quality standards

Where an environmental quality standard requires stricter conditions than those achievable by the use of the best available techniques, additional measures shall in particular be required in the permit, without prejudice to other measures which might be taken to comply with environmental quality standards.

Article 14, Compliance with permit conditions

Member States shall take the necessary measures to ensure that:

- (a) the conditions of the permit are complied with by the operator when operating the installation;
- (b) the operator regularly informs the competent authority of the results of the monitoring of releases and without delay of any incident or accident significantly affecting the environment;
- (c) operators of installations afford the representatives of the competent authority all necessary assistance to enable them to carry out any inspections within the installation, to take samples and to gather any information necessary for the performance of their duties for the purposes of this Directive.

Article 15, Access to information and public participation in the permit procedure

1. Member States shall ensure that the public concerned is given early and effective opportunities to participate in the procedure for:

- (a) issuing a permit for new installations;
- (b) issuing a permit for any substantial change;
- (c) updating of a permit or permit conditions for an installation in accordance with Article 13(2)(a).

4. When a decision has been taken, the competent authority shall inform the public in accordance with the appropriate procedures and shall make available to the public the following information:

- (a) the content of the decision, including a copy of the permit and of any conditions and any subsequent updates; and
- (b) having examined the concerns and opinions expressed by the public concerned, the reasons and considerations on which the decision is based, including information on the public participation process.

Article 17, Exchange of information

1. With a view to exchanging information, Member States shall take the necessary measures to send the Commission every three years, and for the first time before 30 April 2001, the available representative data on the limit values laid down by specific category of activities in accordance with Annex I and, if appropriate, the best available techniques from which those values are derived in accordance with, in particular, Article 9.

On subsequent occasions the data shall be supplemented in accordance with the procedures laid down in paragraph 3 of this Article.

2. The Commission shall organise an exchange of information between Member States and the industries concerned on best available techniques, associated monitoring, and developments in them.

Every three years the Commission shall publish the results of the exchanges of information.

The report shall be drawn up on the basis of a questionnaire or

4. Member States shall establish or designate the authority or authorities which are to be responsible for the exchange of information under paragraphs 1, 2 and 3 and shall inform the Commission accordingly.

Article 18, Transboundary effects

1. Where a Member State is aware that the operation of an installation is likely to have significant negative effects on the environment of another Member State, or where a Member State likely to be significantly affected so requests, the

Member State in whose territory the application for a permit pursuant to Article 4 or Article 12(2) was submitted shall

forward to the other Member State any information required to be given or made available pursuant to Annex V at the same time as it makes it available to its own nationals. Such information shall serve as a basis for any consultations necessary in the framework of the bilateral relations between the two Member States on a reciprocal and equivalent basis.

Article 19, Community emission limit values

1. Where the need for Community action has been identified, on the basis, in particular, of the exchange of information provided for in Article 17, the European Parliament and the Council, acting on a proposal from the Commission, shall set emission limit values, in accordance with the procedures laid down in the Treaty, for:

- (a) the categories of installations listed in Annex I except for the landfills covered by points 5,1 and 5,4 of that Annex, and
- (b) the polluting substances referred to in Annex III.

2. In the absence of Community emission limit values defined pursuant to this Directive, the relevant emission limit values contained in the Directives listed in Annex II and in other Community legislation shall be applied as minimum emission limit values pursuant to this Directive for the installations listed in Annex I.

3. Without prejudice to the requirements of this Directive, the technical requirements applicable for the landfills covered by points 5,1 and 5,4 of Annex I, have been fixed in Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste (1).

Article 23, Entry into force

This Directive shall enter into force on the 20th day following its publication in the *Official Journal of the European Union*.

*ANNEX I***CATEGORIES OF INDUSTRIAL ACTIVITIES REFERRED TO IN ARTICLE 1**

1. Installations or parts of installations used for research, development and testing of new products and processes are not covered by this Directive.

2. The threshold values given below generally refer to production capacities or outputs. Where one operator carries out several activities falling under the same subheading in the same installation or on the same site, the capacities of such activities are added together.

1. Energy industries**2. Production and processing of metals****3. Mineral industry****4. Chemical industry****5. Waste management**

5.4. Landfills receiving more than 10 tonnes per day or with a total capacity exceeding 25 000 tonnes, excluding landfills of inert waste.

6. Other activities

6.1. Industrial plants for the production of:

(a) pulp from timber or other fibrous materials;

(b) paper and cardboard with a production capacity exceeding 20 tonnes per day.

6.2. Plants for the pre-treatment (operations such as washing, bleaching, mercerisation) or dyeing of fibres or textiles where the treatment capacity exceeds 10 tonnes per day.

6.3. Plants for the tanning of hides and skins where the treatment capacity exceeds 12 tonnes of finished products per day.

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

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

*ANNEX III***INDICATIVE LIST OF THE MAIN POLLUTING SUBSTANCES TO BE TAKEN INTO ACCOUNT IF THEY ARE RELEVANT FOR FIXING EMISSION LIMIT VALUES****Air**

1. Sulphur dioxide and other sulphur compounds.

2. Oxides of nitrogen and other nitrogen compounds.

3. Carbon monoxide.

4. Volatile organic compounds.

5. Metals and their compounds.

6. Dust.

7. Asbestos (suspended particulates, fibres).

8. Chlorine and its compounds.

9. Fluorine and its compounds.

10. Arsenic and its compounds.
11. Cyanides.
12. Substances and preparations which have been proved to possess carcinogenic or mutagenic properties or properties which may affect reproduction via the air.
13. Polychlorinated dibenzodioxins and polychlorinated dibenzofurans.

Water

1. Organohalogen compounds and substances which may form such compounds in the aquatic environment.
2. Organophosphorus compounds.
3. Organotin compounds.
4. Substances and preparations which have been proved to possess carcinogenic or mutagenic properties or properties which may affect reproduction in or via the aquatic environment.
5. Persistent hydrocarbons and persistent and bioaccumulable organic toxic substances.
6. Cyanides.
7. Metals and their compounds.
8. Arsenic and its compounds.
9. Biocides and plant health products.
10. Materials in suspension.
11. Substances which contribute to eutrophication (in particular, nitrates and phosphates).
12. Substances which have an unfavourable influence on the oxygen balance (and can be measured using parameters

ANNEX IV

Considerations to be taken into account generally or in specific cases when determining best available techniques, as defined in Article 2(12), bearing in mind the likely costs and benefits of a measure and the principles of precaution and prevention:

1. the use of low-waste technology;
2. the use of less hazardous substances;
3. the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate;
4. comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
5. technological advances and changes in scientific knowledge and understanding;
6. the nature, effects and volume of the emissions concerned;
7. the commissioning dates for new or existing installations;
8. the length of time needed to introduce the best available technique;
9. the consumption and nature of raw materials (including water) used in the process and energy efficiency;
10. the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it;
11. the need to prevent accidents and to minimise the consequences for the environment;
12. the information published by the Commission pursuant to Article 17(2), second subparagraph, or by international organisations.

ANNEX V

PUBLIC PARTICIPATION IN DECISION-MAKING

1. The public shall be informed (by public notices or other appropriate means such as electronic media where available) of the following matters early in the procedure for the taking of a decision or, at the latest, as soon as the information can reasonably be provided:

(a) the application for a permit or, as the case may be, the proposal for the updating of a permit or of permit conditions in accordance with Article 15(1), including the description of the elements listed in Article 6(1);

(b) where applicable, the fact that a decision is subject to a national or transboundary environmental impact assessment or to consultations between Member States in accordance with Article 18;

(c) details of the competent authorities responsible for taking the decision, those from which relevant information can be obtained, those to which comments or questions can be submitted, and details of the time schedule for transmitting comments or questions;

(d) the nature of possible decisions or, where there is one, the draft decision;

(e) where applicable, the details relating to a proposal for the updating of a permit or of permit conditions;

(f) an indication of the times and places where, or means by which, the relevant information will be made available;

(g) details of the arrangements for public participation and consultation made pursuant to point 5.

2. Member States shall ensure that, within appropriate time-frames, the following is made available to the public concerned:

(a) in accordance with national legislation, the main reports and advice issued to the competent authority or authorities at the time when the public concerned were informed in accordance with point 1;

(b) in accordance with the provisions of Directive 2003/4/EC, information other than that referred to in point 1 which is relevant for the decision in accordance with Article 8 and which only becomes available after the time the public concerned was informed in accordance with point 1.

3. The public concerned shall be entitled to express comments and opinions to the competent authority before a decision is taken.

4. The results of the consultations held pursuant to this Annex must be taken into due account in the taking of a decision.

5. The detailed arrangements for informing the public (for example by bill posting within a certain radius or publication in local newspapers) and consulting the public concerned (for example by written submissions or by way of a public inquiry) shall be determined by the Member States. Reasonable time-frames for the different phases shall be provided, allowing sufficient time for informing the public and for the public concerned to prepare and participate effectively in environmental decision-making subject to the provisions of this Annex.

Source: Official Journal of the European Union 29.1.2008

Annex 2: List of references used to produce the BREF:

Reference	Title
tan/tm/2	Chief Inspector's Guidance to Inspectors - Processing of Animal Hides and Skins, Process Guidance Note IPR 6/7, 1995
tan/tm/3	Umwelthandbuch für die Ledererzeugenden Betriebe, Hans Andres, November 1995, draft version
tan/tm/4	BAT - Documentation of Tanneries & Leather factories in Austria
tan/tm/5	Branchenkonzept für die Ledererzeugenden Betriebe Österreichs, Arbeitsgemeinschaft Lederwirtschaft (ARGELE), Bundeskammer der gewerblichen Wirtschaft, Bundesministerium für Umwelt, Jugend und Familie
tan/tm/6	European BAT documentation OE 013868/LR/sh
tan/tm/7	Industrielle und gewerbliche Abwassereinleitung in öffentliche Abwasseranlagen
tan/tm/9	Low Waste Technology Suitable For Tanneries in Developing Economies
tan/tm/10	Audit and Reduction Manual for Industrial Emissions and Wastes
tan/tm/11	Possibilities for a Reduction of the Pollution Load from Tanneries
tan/tm/12	Leather
tan/tm/13	Furs
tan/tm/14	Textilfärberei und Farbstoffe
tan/tm/15	Wirkung einer anaerob-aeroben biologischen Behandlung auf gelöste organische Stoffe in Gerbereiabwasser
tan/tm/16	Aplicaciones del Manual Media a Sectores Industriales - Sector de Curtidos de Pieles Animales
tan/tm/17	UNEP Cleaner Production - Industrial Sector Guide Leather Industry (Provisional version)
tan/tm/18	Tanneries and the Environment (Technical Guide)
tan/tm/19	Textilhilfsmittel
tan/tm/20	Procedure for the Evaluation of Substances and Preparations in the Context of the Pollution of Surface Waters Act
tan/tm/21	Biocides in Cooling Water Systems (final report)
tan/tm/22	The Evaluation of Substances and Preparations in the Context of the Pollution of Surface Waters Act
tan/tm/23	Panorama of EU Industry
tan/tm/24	La recuperación del cromo de los baños de curtición, Recrisa: Una realidad
tan/tm/25	Estabilización del Pelo Recuperado de las Pieles Vacunas y sus Aplicaciones
tan/tm/26	Información Técnica
tan/tm/27	The Finnish Background Report for the EC Documentation of BAT for Tanning Industry
tan/tm/28	The ecological aspects of leather manufacture
tan/tm/29	Recycling von Gerbereiabwasser
tan/tm/30	Abwasser aus der Zellstoffindustrie und der Lederherstellung
tan/tm/31	Environmental Contaminants Encyclopedia Chromium (In General) Entry
tan/tm/32	Environmental Contaminants Encyclopedia Chromium III (Trivalent Chromium) Entry
tan/tm/33	Environmental Contaminants Encyclopedia Chromium VI (Hexavalent Chromium) Entry

tan/tm/34	Umweltbeeinträchtigende Stoffe im Abwasser der Leder-, der Pelzveredlungs- und der Lederfaserwerkstoffindustrie
tan/tm/35	BAT in Tanneries
tan/tm/36	Current Practices in UK Tanneries
tan/tm/37	Stand der Technik der Lederherstellung in Deutschland (State of the art and future processes in German tanneries)
tan/tm/38	Preliminary Danish contribution to the draft BAT notes on tanneries
tan/tm/39	Italian BAT Contribution
tan/tm/40	Resposta ao questionário da DG Industria
tan/tm/41	candidate BAT from Greece
tan/tm/42	Mass Balance in Leather Processing
tan/tm/43	Various articles of World Leather 1996/97
tan/tm/44	Vorbehandlung und biologische Schmutzfrachtreduktion von Gerbereiabwässern in der Praxis
tan/tm/45	Various articles of "Leather Technology"
tan/tm/46	World Statistical Compendium for Raw Hides and Skins, Leather and Leather Footwear 1979 - 1997
tan/tm/47	Dissolved Organics in Tannery Wastewaters and their Alteration by a Combined Anaerobic and Aerobic Treatment
tan/tm/48	Microbial Transformations and Biological Effects of Fungicide-Derived Benzothiazoles Determined in Industrial Wastewater
tan/tm/49	Emerging Techniques in Tanneries
tan/tm/50	BAT Candidate for tanning Industry: Deliming Using Carbon Dioxide
tan/tm/51	Pollution Control in the Treatment and Processing of Animal and Vegetable Matter. DoE Report No: DoE/HMIP/PR/93/058, 1993
tan/tm/52	Leather Technician's Handbook
tan/tm/53	Demonstration project for the extensive introduction of clean technologies, conservation of raw materials and optimisation of production processes in tanneries - final report
tan/tm/54	Ökologischer Vergleich verschiedener Gerbarten
tan/tm/55	Air Emissions and Control Technology for Leather Tanning and Finishing Operations
tan/tm/56	Sperimentazione Prodotti Chimici in Fase Acquosa nella Rifinitura delle Pelli
tan/tm/57	R&D of new technologies for: hides mechanical dehairing; production of stabilised hides after deliming/bating phase
tan/tm/58	BAT Reference Document
tan/tm/59	Lederfabricage
tan/tm/60	Lederindustrie
tan/tm/61	Untersuchungen zum Einsatz von Konservierungsmitteln in der Chromgerbung und ihrer quantitativen Verteilung im Wet-blue
tan/tm/62	Maßnahmen zur Vermeidung, Verminderung und Verwertung von Reststoffen aus der Lederindustrie, Pelzveredlung und Lederfaserstoffherstellung
tan/tm/63	Zur Nomenklatur der Textilhilfsmittel, Leder- und Pelzhilfsmittel, Papierhilfsmittel und Tenside
tan/tm/64	Stellungnahme der LAWA zu Kapitel 4 des BREF-Entwurfs
tan/tm/65	Flame Resistance of Leather
tan/tm/66	Assessment of Procedures for Reducing VOC Emissions from Leather Finishing Operations

tan/tm/67	La toxicité des effluents de tannerie et mégisserie
tan/tm/68	Ermittlung der Lösungsmittlemission bei der Lederzurichtung
tan/tm/69	Teilstrombehandlung sulfid- und chromhaltiger Gerbereiabwässer
tan/tm/70	Aufbereitung von Salzlake aus der Hautkonservierung
tan/tm/71	Wasserseitige Emission aus der lederherstellenden Industrie
tan/tm/72	Verschiedene Unterlagen über Komplexbildner
tan/tm/73	Abwasserreinigung der Firma Bayern-Leder-GmbH & Co.
tan/tm/74	Information of reference tanneries in Germany
tan/tm/75	Centralized plant for the recovery of basic chromium sulfate from tannery effluent
tan/tm/76	Information about chrome recovery Installations in India and Nicaragua
tan/tm/77	Ökologische Aspekte wichtiger Gerbverfahren