

Best Available Techniques (BAT) in European Environmental Legislation

Alina Ruonala-Lindgren
Finnish Forest Industries Federation
Helsinki
Finland
e-mail: alina.ruonala-lindgren@forestindustries.fi

Summary

All EU countries must have new environmental permits where all pollutants (air, water, land) are considered jointly at the same time by 2007 for all IPPC installations. Unless the installation has a permit, it is not allowed to operate. The permits must be based on the concept of Best Available Techniques (BAT). In the consideration of what is BAT environmental, technical and economical aspects must be taken into account. BAT is a combination of techniques considered as a package. BAT-levels cannot usually be described as single value but the best way is to use range of specific emissions and consumption levels associated with the use of BAT.

BREF stands for BAT reference document. Brefs suggest some techniques as examples of BAT but does not give a comprehensive list of all alternatives that are the results of exchanges of information concerning BAT. The Bref-document does not set demands or propose limits and it does not take into account local circumstances but it gives the frame for starting the permission negotiations. Bref document is a very important source of information and can be used as a yardstick in permit consideration.

The specific emissions to air and water from Finnish kraft pulp mills have gone down radically during past 15 years and the vast majority of the mills are within the ranges given in Bref document. The specific emissions between different mills vary because of the age and technical solutions of the mill.

Key words: environment, environmental legislation, best available techniques, BAT, environmental permit, emission limit value, IPPC, BAT reference document, BREF

Introduction

EU IPPC (Integrated Pollution Prevention and Control) directive (96/61/EC) was adopted 24 September 1996. The aim of this directive is to minimise pollution from various point sources throughout the European Union. IPPC is implemented in all EU countries and it says that by 2007 all IPPC installations must have new environmental permits where all pollutants (air, water, land) are jointly considered at the same time. Unless the installation has a permit, it is not allowed to operate. The permits must be based on the concept of Best Available Techniques (or BAT). All pulp mills and those paper and paperboard mills if their production is over 20 t/a are within the scope of IPPC. Other industrial sectors than pulp and paper sector that are within the scope of IPPC are for example energy industries, production and processing of metals, mineral industry and chemical industry.

In IPPC directive the article 2(11) provides the definition of BAT and article 16(2) requires the European Commission to organise an exchange of information between EU Member States and the industries concerned on BAT, associated monitoring and developments in them. Every three years the European Commission will publish the results of the exchanges of information and these documents are called BAT reference documents or BAT Brefs. Information published pursuant to article 16(2) shall be taken into account when determining BAT in specific cases. EU Member States, industry and environmental organizations take part in making Bref documents.

BAT and Bref

What does Best Available techniques (BAT) mean? According to IPPC directive:

'best available techniques' mean 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:

'techniques' include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned,

'available' techniques mean 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.

In determining the best available techniques, special consideration should be given to the items listed in Annex IV of IPPC directive and at the same time take into account the 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 their 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 16 (2) or by international organisations.

“BREF” stands for BAT reference document. Brefs are the results of exchanges of information concerning BAT. The series of Brefs consists of “vertical” sector specific Brefs addressing one or more industrial activities and “horizontal” subject BREFs addressing IPPC issues across industry sectors. In August 2005 all together 17 Bref-documents were formally adopted, of which one is for pulp and paper industry. The Bref-documents are available in Sevilla IPPC bureau web-page in English and can be downloaded there (<http://eippcb.jrc.es/pages/FActivities.htm>)

What BREFs are not

- BREFs are not standards or demands
- They do not set or propose emission limit values either at sector, national, regional, local or site specific level
- Shopping lists for different equipment
- They do not provide any legal interpretation of the IPPC Directive itself
- They cannot be exhaustive nor can they fully take account of all local conditions in determining BAT
- They cannot determine BAT at specific (national, regional, local) levels

What BREFS are

Brefs could be described as follows:

- Brefs are information
- They might give information about what can be done
- Bref can give information what is possible
- Bref does not say what should be done
- Brefs can be used as a benchmark or a yardstick for permit conditions and will give the overall frame to start negotiations of permits, where local circumstances will be taken into account

Brefs are addressed at a very wide audience such as industry operators needing to apply for a permit, permit writers (authorities) of Member States (and other countries) and other interested parties.

Brefs do not take into account of all local circumstances. The document can only conclude on BAT in a general sense for the sector as a whole as a reference point to assist the determination of BAT in specific cases, such as in national rules or individual permits.

When determining BAT generally or in specific cases, includes the consideration of the length of time needed to introduce BAT into the installation. In many cases a technique which for technical and economic reasons can only be fitted at a time of major rebuild of plant. On the other hand there are techniques identified as BAT which can be technically and economically fitted very quickly.

BAT is a combination of techniques considered as a package. BAT-levels cannot usually be described as single value but the best way is to use range of values and consumption levels associated with the use of BAT. The range reflects a benchmark level of environmental performance. Good environmental performance can be reached by using different kinds of techniques also outside what is mentioned in Bref document.

No installation or mill can be at the 'top' level in all parameters at the same time. In the consideration of what is BAT for each mill and what are the demands in environmental permits, the Bref-document is a very important yardstick but not the only thing to consider. Local situation must be taken into account and all other possible information available worldwide.

BAT Bref for Pulp and Paper Industry

BAT Bref document for pulp and paper sector was adopted 2001. It contains 475 pages and an executive summary. Pulp and paper Bref-document has been divided into following chapters:

1. General Information
2. The Kraft (Sulphate) Pulping Process
3. The Sulphite Pulping Process
4. Mechanical Pulping and Chemi-mechanical Pulping
5. Recovered Paper Processing
6. Papermaking and Related Processes
7. Conclusions and Recommendation

Each chapter contain following information:

1. Applied processes and techniques
2. Present consumption/emission level
3. Techniques to consider in the determination of BAT
4. Best available techniques
5. Emerging techniques

How BAT for kraft pulp production is described in the Bref-document?

This presentation will concentrate on kraft pulping process. General BAT for all processes:

During the information exchange it emerged that the most effective measure for the reduction of emissions/consumption and the improvement of economic performance is the implementation of the best available process and abatement technologies in combination with the following:

- Training, education and motivation of staff and operators
- Process control optimisation
- Sufficient maintenance of the technical units and the associated abatement techniques
- Environmental management system which optimises management, increases awareness and includes goals and measures, process and job instructions etc.

Best available techniques for kraft pulp mills are considered to be:

- Dry debarking of wood
- Increased delignification before the bleach plant by extended or modified cooking and additional oxygen stages
- Highly efficient brown stock washing and closed cycle brown stock screening
- Elemental chlorine free (ECF) bleaching with low AOX or Totally chlorine free (TCF) bleaching
- Recycling of some, mainly alkaline process water from the bleach plant
- Effective spill monitoring, containment and recovery system
- Stripping and reuse of the condensates from the evaporation plant
- Sufficient capacity of the black liquor evaporation plant and the recovery boiler to cope with the additional liquor and dry solids load
- Collection and reuse of clean cooling waters
- Provision of sufficiently large buffer tanks for storage of spilled cooking and recovery liquors and dirty condensates to prevent sudden peaks of loading and occasional upsets in the external effluent treatment plant
- In addition to process-integrated measures, primary treatment and biological treatment is considered BAT for kraft pulp mills

For bleached and unbleached kraft pulp mills the BAT emission levels to water that are associated with the use of a suitable combination of these techniques are the following:

Table 1. The BAT emission levels to water with the use of a suitable combination of techniques for bleached and unbleached kraft pulp mills

	Flow	COD	BOD	TSS	AOX	Total N	Total P
	m ³ /Adt	kg/Adt	kg/Adt	kg/Adt	kg/Adt	kg/Adt	kg/Adt
Bleached pulp	30 - 50	8-23	0.3-1.5	0.6-1.5	< 0.25	0.1-0.25	0.01-0.03
Unbleached pulp	15 - 25	5-10	0.2-0.7	0.3-1.0	-	0.1-0.2	0.01-0.02

These emission levels refer to yearly averages and are based on harmonized measurement techniques in EU-level. The water flow is based on the assumption that cooling water and other clean water are discharged separately. The values refer to the contribution of pulping only. In integrated mills emissions from papermaking have to be added according to product mix manufactured.

Best available techniques for reducing emissions to air are:

- Collection and incineration of concentrated malodorous gases and control the resulting SO₂ emissions. The strong gases can be burnt in the recovery boiler, in the lime kiln or a separate, low NO_x furnace. The flue gases of the latter have a high concentration of SO₂ that is recovered in a scrubber.
- Diluted malodorous gases from various sources are also collected and incinerated and the resulting SO₂ controlled.
- TRS emissions of the recovery boiler are mitigated by efficient combustion control and CO measurement
- TRS emissions of the lime kiln are mitigated by controlling the excess oxygen, by using low-S fuel, and by controlling the residual soluble sodium in the lime mud fed to the kiln.
- The SO₂ emissions from the recovery boilers are controlled by firing high dry solids concentration black liquor in the recovery boiler and/or by using a flue gas scrubber
- BAT is further the control of NO_x emissions from the recovery boiler (i.e. ensuring proper mixing and division of air in the boiler), lime kiln and from auxiliary boilers by controlling the firing conditions, and for new or altered installations also by appropriate design
- SO₂ emissions from auxiliary boilers are reduced by using bark, gas, low sulphur oil and coal or controlling S emissions with a scrubber.
- Flue gases from recovery boilers, auxiliary boilers (in which other biofuels and/or fossil fuels are incinerated) and lime kiln are cleaned with efficient electrostatic precipitators to mitigate dust emissions.

For bleached and unbleached kraft pulp mills the BAT emission levels to air from the process that are associated with a combination of these techniques are shown in the following table. The emission levels refer to yearly averages and standard conditions. Emissions from auxiliary boilers e.g. due to production of steam used for drying of pulp and/or paper are not included.

Table 2. The BAT emission levels to air for bleached and unbleached kraft pulp mills from the process.

	Dust kg/Adt	SO ₂ (as S) kg/Adt	NO _x (NO+NO ₂ as NO ₂) in kg/Adt	TRS (as S) kg/Adt
Bleached and unbleached kraft pulp	0.2-0.5	0.2-0.4	1.0-1.5	0.1-0.2

The values refer to the contribution of the pulp production only. That means that in integrated mills the figures for the process emissions are related to the kraft pulp production only and do not include air emissions from steam boilers or power plants that might be operated to provide the energy needed for paper production.

Best available techniques for reducing waste:

- Minimise the generation of solid waste and recover, recycle and re-use these materials, wherever practicable
- Separate collection and intermediate storage of waste fractions at source can be beneficial to meet this aim.

- When the collected waste is not re-usable in the process external utilisation of residuals/waste as substitutes or incineration of organic materials in suitably designed boilers with energy recovery.

In order to reduce the consumption of fresh steam and electric power, and to increase the generation of steam and power internally, a number of measures are available. In energy efficient non-integrated pulp mills the heat generated from black liquor and incineration of bark exceeds the energy required for the entire production process. However, fuel oil will be needed at certain occasions like start-up and also at many mills in the lime kiln.

Energy efficient kraft pulp and paper mills consume heat and power as follows:

- Non-integrated bleached kraft pulp mills: 10-14 GJ/Adt process heat and 0.6-0.8 MWh/Adt of power
- Integrated bleached kraft pulp and paper mills (e.g. uncoated fine paper): 14-20 GJ/Adt process heat and 1.2-1.5 MWh/Adt of power
- Integrated unbleached kraft pulp and paper mills (e.g. kraftliner): 14-17.5 GJ/Adt process heat and 1-1.3 MWh/Adt power.

CASE: Kraft pulp production in Finland

In Finland, there are 19 mills producing sulphate pulp. In 2004 the mills produced 7,8 million tons of chemical pulp of which 4,0 mill tons was bleached softwood pulp and 3,2 million tons was bleached hardwood pulp. The majority of the pulp is bleached nowadays and only 5 % of produced pulp was not bleached. Majority of the mills were integrated.

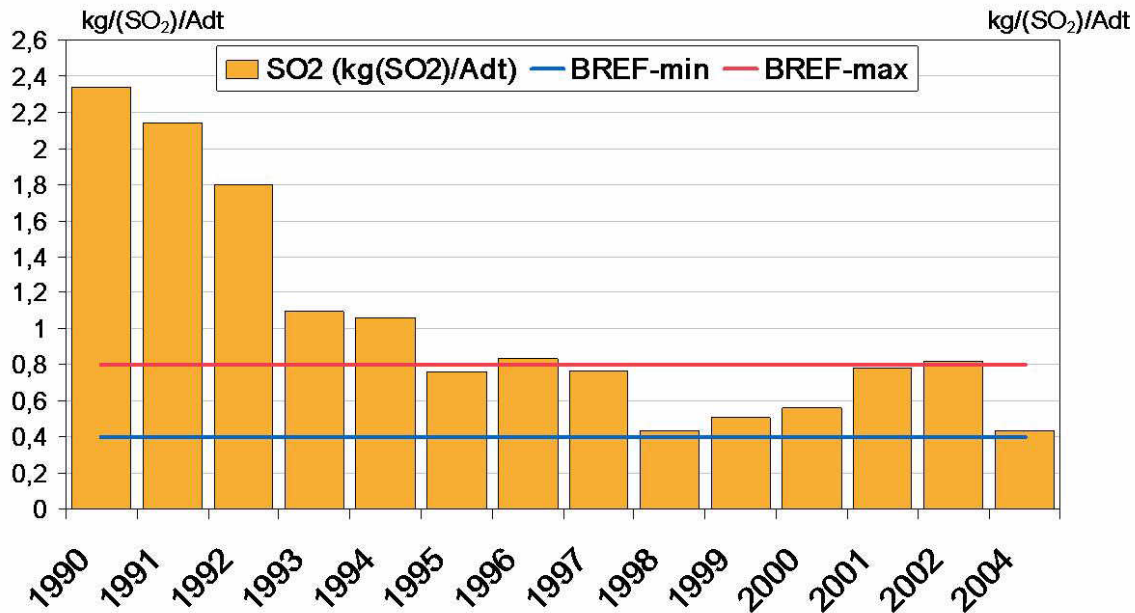
All Finnish kraft pulp mills have applied for new environmental permits by the end of 2004 and new emission limit values will be based on BAT. In the mid August 2005 only three kraft mills had gotten their new environmental permits from the Finnish authorities, so no far reaching conclusions can be made yet.

Table 3. Air emission levels in Finnish kraft pulp mills in 2004 and the range in BAT Bref-document for pulp and paper industry.

	Dust kg/Adt	SO ₂ (as S) kg/Adt	NO _x (as NO ₂) kg/Adt	TRS (as S) kg/Adt
Bleached and unbleached kraft pulp/ Finnish mills	0,05-3	0,01-0,8	0,8-2,1	0,03-0,5
Bleached and unbleached kraft pulp/ BAT Bref	0.2-0.5	0.2-0.4	1.0-1.5	0.1-0.2

In picture 1 there are specific SO₂-emissions to air from Finnish kraft pulp mills from 1990 to 2004. The data for year 2003 was not available. SO₂-emissions have gone down radically from 1990's. There is variation between years but as a result from investments and rebuilds the level of specific SO₂ emission has gone down.

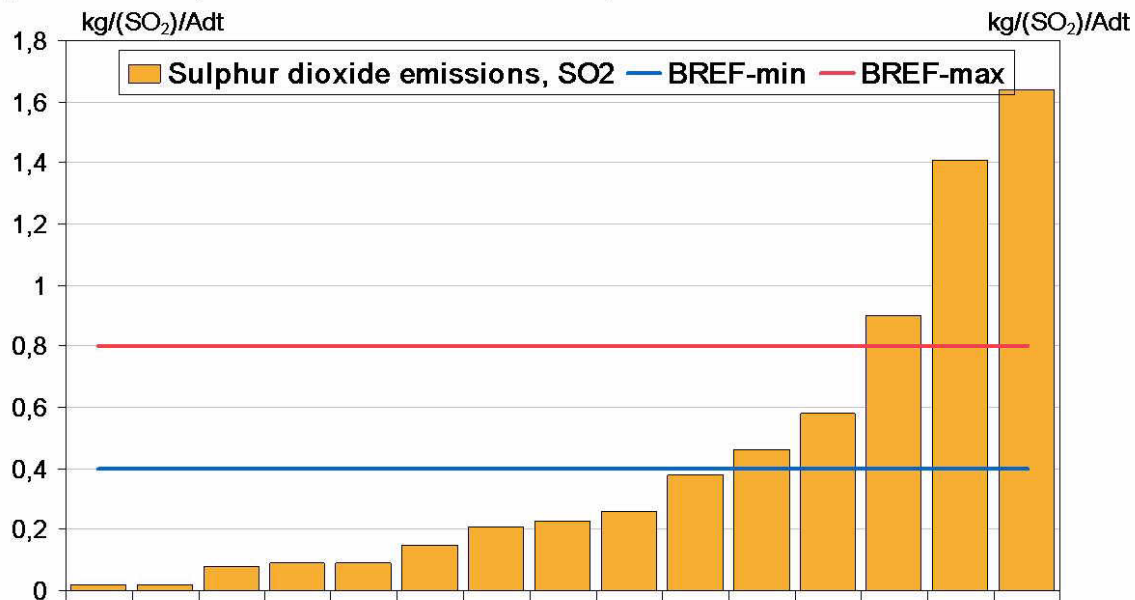
A lot of attention has been put to the collection and incineration of concentrated and more and more also diluted malodorous gases. In the burning processes the resulting SO₂ emissions are controlled by using e.g. scrubbers.



Source: Finnish Forest Industries Federation
Specific_Emissions2004.ppt

Picture 1. Specific SO₂-Emissions, Kraft Pulp Mills in Finland 1990-2004.

In picture 2 is represented the variation between different mills in 2004. The majority of the mills are below the upper level for SO₂-emission described in Bref-document. The specific SO₂ emissions are higher from older plants and at lower level from new plants.



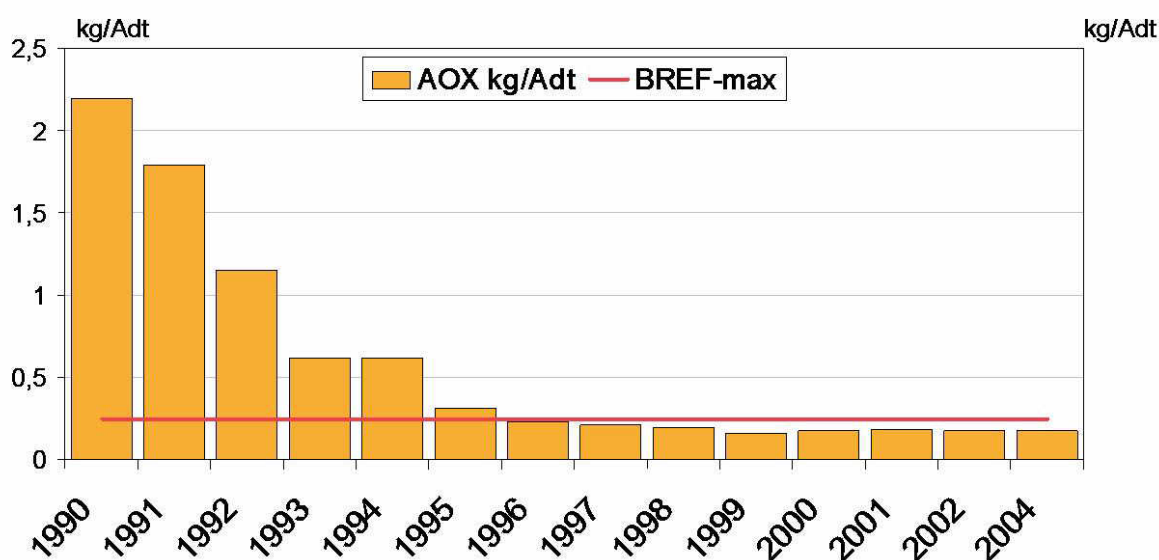
Source: Finnish Forest Industries Federation
Specific_Emissions2004.ppt

Picture 2. Specific SO₂-Emissions, Kraft Pulp Mills in Finland 2004

Table 4: Water emission levels in Finnish kraft pulp mills in 2004 and the range in BAT Bref-document for pulp and paper industry.

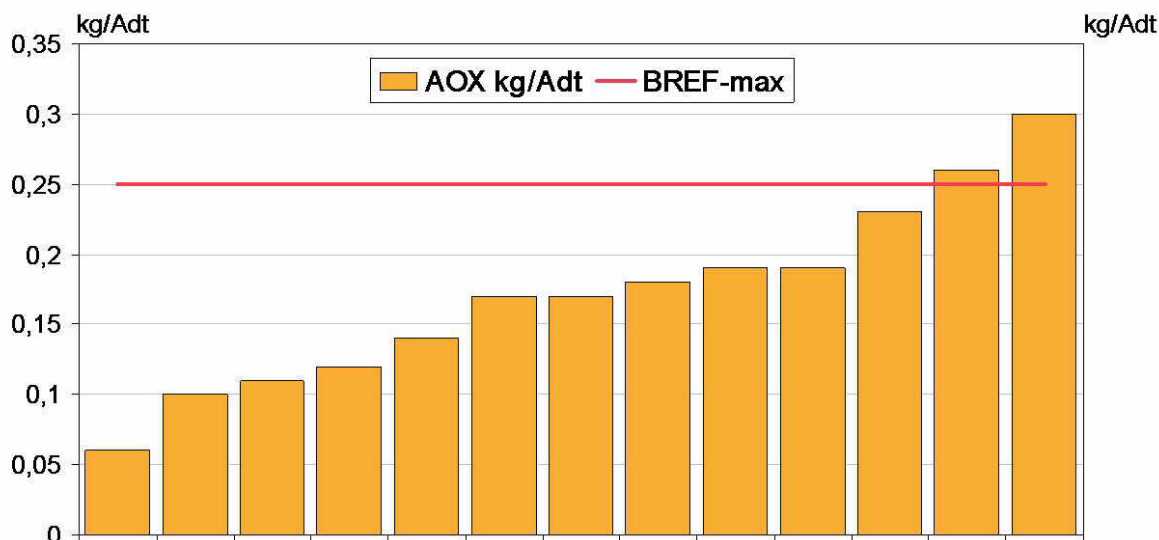
	Flow	COD	BOD	TSS	AOX	Total N	Total P
	m ³ /Adt	kg/Adt	kg/Adt	kg/Adt	kg/Adt	kg/Adt	kg/Adt
Bleached kraft pulp/ Finnish mills	20-95	4,3-33,2	0,2-4,8	0,2-3,9	0,06-0,3	0,05-0,51	0,003-0,038
Bleached pulp/ BAT Bref	30 - 50	8-23	0.3-1.5	0.6-1.5	< 0.25	0.1-0.25	0.01-0.03

As an example of specific water emission are AOX emissions from Finnish kraft pulp mills. In pictures 3 and 4 it can be seen that AOX emission to water from kraft pulp mills have gone radically down since the 1990's. The use of chlorine bleaching was stopped and instead chlorine dioxide and ozone is used. The majority of AOX emissions from bleached pulp mills are below the upper level of 0,25 kg/Adt. The specific AOX emissions are higher from older plants and at lower level from new plants.



Source: Finnish Forest Industries Federation
Specific_Emissions2004.ppt

Picture 3. Specific AOX-emission (organic chlorine compounds), Bleached Pulp, Kraft Pulp Mills in Finland 1990-2004.



Source: Finnish Forest Industries Federation
Specific_Emissions2004.ppt

Picture 4. Specific AOX-emission (organic chlorine compounds), Bleached Pulp, Kraft Pulp Mills in Finland 2004.

Problems within BAT Bref document

Processes and mills are different and it is sometimes very hard to compare them. There are different ways to monitor and report emission levels in different countries and therefore poor comparability of data is obvious. It is very important that harmonized measurement techniques are used. Emissions should take into account diffuse, fugitive and exceptional emissions and this was not done when BAT Bref was done and is still not known very well. It might be that when the knowledge of e.g. diffuse emissions increases the upper levels in Bref seem too low and the data between years is no longer comparable. The background information in general which has been available for the Brefs has been partly confusing and in some cases very far from scientific facts – high expectations for technical development are easily mixed with reality. The first version of the Bref for Pulp and Paper can be regarded pretty successful even if there still is some inaccuracy in it.

In practical terms there is always the need for balancing any cross media effects and taking account of costs, benefits, technical and economic viability. No mill can be 'the best' in every parameter, there is always the need to make trade-offs between different parameters. Cross-media effects should be taken into account even if it is complicated and not always very well known. In real life there are mills that have all the techniques listed in Bref document in use but still their specific emissions are above the upper levels mentioned in Bref. Often this is a question of training and how the mill is run.

Quite little information was available on some issues like solid waste issues and energy efficiency when Bref was done. Because of how Bref-document is constructed it does not work very well for integrated pulp and paper mills and some product types are very poorly described in the document.

BAT and Bref in the future

The revision of the BAT reference document for pulp and paper industry will probably start in 2006 and will take around two years. In this process there is a chance to correct the mistakes (e.g. NO_x levels for kraft pulp production) in the present Bref-document. In the revision process the technical working group is trying to gather new information on areas that very little information was available when pulp and paper Bref-document was done. These new areas might be for example waste treatment, energy efficiency, the use of chemicals, cross media effects etc. Also the list of emerging techniques will be considered whether they can be regarded as BAT and the range of emission limits will be re-examined. Very little information is available on how BAT is implemented in environmental permits so far.

Conclusions

BREFs are the results of the information exchange. They are compiled as technical reference documents from information submitted by EU member states, industry and environmental NGO's. They are not either standards or techniques which must be used but they give information how to meet different emission ranges with different packages of techniques and they give information for those who have to make decisions on BAT. Very little experience has been gathered on how BAT is considered in the environmental permits or on how BREF-documents have been used in the environmental permit process so far.

The specific emission from Finnish kraft pulp mills have gone down radically during past 15 years. The specific emissions between different mills vary because of the age and technical solutions of the mill.

Bibliography

Environmental report 2005, Pulp and Paper Industry, Wood Products Industry, Statistics for 2004, Finnish Forest Industries Federation, 28 pages.
European Commission, Reference Document on Best Available Techniques in the Pulp and Paper, Industry Integrated Pollution Prevention and Control (IPPC), December 2001, 475 pages.
<http://eippcb.jrc.es/>
<http://europa.eu.int/comm/environment/ippc/index.htm>
<http://www.ymparisto.fi/default.asp?contentid=100933&lan=EN>