THE FINNISH ENVIRONMENT 12 | 2007

ENVIRONMENTAL PROTECTION

Continuum - Rethinking BAT Emissions of the Pulp and Paper Industry in the European Union

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Helsinki 2007

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Finnish Environment Institute
Expert Services Department

Page layout: Pirjo Lehtovaara
Cover photo: Pöyry

The publication is available only on the internet: www.environment.fi/publications:

ISBN 978-952-11-2642-0 (PDF)
ISSN 1796-1637 (verkkoj.)

SUMMARY

This report is the Finnish contribution to the second exchange of information defined in the Council Directive 96/61/EC and to the preparation of the second Reference Document of the European Commission on Best Available Techniques in the Pulp and Paper Industry. The report is the work of Pöyry Forest Industry Consulting Oy on behalf of the Finnish Forest Industries Federation and Finnish Environment Institute.

In this report, a series of suggestions for categorised improvements to the BREF are given. The reasoning behind all suggestions is given. Among key messages in this document we find:

Uphold and emphasise the key principles of the BAT BREF

It is important that the key principles of BAT and the purpose of the BREF document can be easily located and that they are followed consistently throughout the whole document. However, the practical experience from the first BREF shows that it is not enough to describe the key principles applied briefly in the Preface or the Introduction of the BREF. Among the key principles of the BREF, the ones that especially need to be further emphasised and repeated are:

1. BAT levels are not permit limits
   The BAT levels presented in the BREF are not permit limits. This has been mentioned in the BREF, but the message seems to disappear in a long document. The use of BAT levels as permit limits is wrong for several reasons, which are gone into in this document.
2. A balanced view of the full circumstances of a mill is needed in any consideration.
3. Prioritisation does matter
   Choices made delimit later choices.
4. Comprehensive utilisation of all raw materials
   The BREF has to be neutral as to raw materials; where raw material choice leads to different profiles, the BREF has to take this into account.

Furthermore, the readability of the BREF can be pointed out as the fifth general item that needs more attention.

For improved understanding and finding the main issues, the key principles and chapter summaries presented in executive summary should be mentioned at the beginning of every BAT chapter before the listing of the BAT techniques.

Take note of smooth running and cross-media effects

Among issues of special importance for Chapters 2.3 - 6.3 Techniques to Consider in the Determination of BAT and Chapters 2.4 - 6.4 Best Available Techniques of the first BREF, we have

- The need for ensuring smooth running and minimising accidental releases should be emphasised in the BREF. One way to ensure smoother running is to use simpler processes.
- Cross-media effects should be further emphasised in the BREF. Lack of cross-media information and integrated views in decision making can result in wrong decisions.

From emerging techniques to emergent trends
The chapters dealing with new techniques could be improved by making them to be a readable, clear and concise analysis of the current technology trends and selected techniques, not forgetting key principles of the BREF.

Rectifying distorted BAT levels
Based on the information on both Finnish and international mills, it seems that not all the BAT ranges are on same level of stringency. NO_x and TSS emission values presented in the BREF are not in line with the other values and should be revised. For mechanical pulp based papers, both TSS and COD seem to need revision. In addition, the energy consumption figures should be updated. Due to geographical reasons and considering the biogenic origins of the emissions, releases of VOC from pulp and paper mills cannot be considered as a general environmental problem especially in all places.

A final thing to remember
BAT techniques do not necessarily go hand in hand with BAT emissions levels.

CONTENTS

1 Introduction

This report is the Finnish contribution to the second exchange of information defined in the Council Directive 96/61/EC concerning Integrated Pollution Prevention and Control, article 16, and to the preparation of the second Reference Document of the European Commission on Best Available Techniques in the Pulp and Paper Industry.

This document should be read together with the European Commission's *Integrated Pollution Prevention and Control (IPPC) Reference Document on Best Available Techniques in the Pulp and Paper Industry (December 2001).*

The report is the work of Pöyry Forest Industry Consulting Oy on behalf of the Finnish Forest Industries Federation and Finnish Environment Institute.

2 General principles

A basic understanding of the general principles involved is essential when using any information exchange document. Thus it is important that the key principles of BAT and the purpose of the BREF document can be easily located and that they are followed consistently throughout the whole document. In the first BREF document, the main principles can be found in the Preface and Chapter 1.8.

From the Preface

The purpose is thus to provide **general indications regarding the emission and consumption levels that can be considered as an appropriate reference point to assist in the determination of BAT-based permit conditions** or for the establishment of general binding rules under Article 9(8).

It should be stressed, however, that **this document does not propose emission limit values**.

The determination of appropriate permit conditions will involve taking account **of local, site-specific factors** such as the technical characteristics of the installation concerned, its geographical location and the local environmental conditions.

In the case of **existing installations, the economic and technical viability** of upgrading them also needs to be taken into account.

Even the single objective of ensuring a high level of protection for the environment as a whole will often involve **making trade-off judgements** between different types of environmental impact, and these judgements will often be influenced by **local considerations**.

From Chapter 1.8 .Presentation of BAT:

- There is **no single reference** of best available techniques in pulp and paper industry. In contrast, the list of techniques to consider in the determination of BAT provides **a lot of different options** of an overall BAT for given mills, which **may be combined in different ways**.
- The BAT-concept is **process-related** because the environmental impact is caused on this level i.e. by different manufacturing processes as for instance cooking, bleaching, de-inking, coating etc. The single processes, the raw materials used and the **product properties** to be achieved determine the emissions of a mill. That means when approaching the pulp and paper industry **different types of raw materials used and processes involved have to be distinguished**.
- As pulp and paper products are highly diverse and utilised processes even for one and the same product may vary greatly, many factors of production technology must be taken into account to guarantee a high level of environmental protection. For the pulp and paper **industry the best**

available techniques cannot be defined solely by describing unit processes. Instead, **the whole installations must be examined** and dealt with as entities. BAT in pulp and paper industry is linked to the environmental performance of mills.

- There are different options for suitable combinations of processes depending - besides other things - on the product properties to be achieved. As a consequence, **the process-oriented approach has to be extended by a product-oriented concept** i.e. the BAT approach must be linked to the environmental performance of specific types of mills where specific products are manufactured. Thus, in this document best available techniques are presented for major mill classes separately.

However, the practical experience from the first BREF shows that it is not enough to describe for example the above cited principles shortly in the Preface or Introduction of the BREF. Among the key principles of the BREF, the ones that especially need to be further emphasised and repeated are:

1. BAT levels are not permit limits
2. A balanced view
3. Prioritisation does matter
4. Comprehensive utilisation of all raw materials

Furthermore, *the readability of the BREF* can be pointed out as the fifth general item that needs more attention.

2.1

The difference between permit limits and BAT levels

The BAT levels presented in the BREF are not permit limits. This has been mentioned in the BREF, but the message seems to disappear in a long document. The use of BAT levels as permit limits is wrong for several reasons:

1. Permit limits are based on national legislation.
2. Local environmental and socioeconomic conditions need to be taken into account in permit limits. The local conditions can either tighten or loosen the permit limits.
3. Site-specific factors, for example technical characteristics of a mill and its product portfolio, must be considered in the permitting process and for the permit limits.
4. BAT levels are annual averages, which cannot be used in permit limits.
5. The BAT values presented in BREF are not generated in a systematic way, they are taken from heterogeneous data sources.
6. As stated in the Preface of the BREF: "The purpose is thus to provide general indications regarding the emission and consumption levels that can be considered as an appropriate reference point to assist in the determination of BAT-based permit conditions or for the establishment of general binding rules under Article 9(8). It should be stressed, however, that this document does not propose emission limit values."

The way authorities deal with multiproduct integrated mills can be seen in general as the correct way to use the BREF. Multiproduct integrates are integrated pulp and paper mill complexes which produce several different products. This kind of mills are common for example in Northern Europe. It is not possible or even meaningful

to try to produce a BREF document that would cover all the possible variants of multiproduct integrates.

A multiproduct integrate straddles many BREF areas at the same time. The areas overlap; some are impossible to separate, among them effluents. Thus, it is not possible to use the BREF to find exact numbers for a multiproduct integrated mill. This means that the BREF must be used as one tool among others to find a suitable range of values and technical options.

The situation with multi-product integrates resembles the case of *multi-grade machines or multi-grade pulp mills*. Even brand new multi-grade machines cannot reach the BAT levels defined based on single-grade machines, especially in case of energy consumption. Thus, also multi-grade machines do not fit in the grade based classification used in the BREF.

The BREF is *not* a statute book without any possibilities to interpretation for any mill, and all mills are in a way individual with their own local and technical details. A site is an evolving entity. It is founded as a big or small facility, bound by its physical surroundings, and starts evolving immediately. A pulp production line or a paper mill is always custom-made, and its modification starts straight away. Different companies are good at different things – even smaller scale or older production facilities can be world-top at a single, specific part of the production process. Many different grades are produced on a single machine – and even very standard grades such as basic newsprint have mill-specific variations due to raw material composition, special machine characteristics etc. This is why the relationship between the buyer and seller of paper often develops into something very close: changing paper supplier usually requires a printer to calibrate and adapt his printing process. In addition, the way the machines use common raw material resources is entirely up to the mill.

Message: BAT levels are not permit limits.

2.2

A balanced view

According to the IPPC directive, all environmental parameters - emissions to air and water, solid waste, energy and raw material consumption – should be assessed in an integrated manner. The total level of environmental performance is best when the different sections (air, water, solid waste, energy and raw material consumption etc.) are balanced according to local conditions. A mill must simultaneously master an army of differing techniques to achieve sufficient performance. Still, BAT mills have their strongest and weakest "disciplines", depending on the technology choices made. The metaphor “decathlon trap” has been used to describe this, showing that it is not possible to be the “best” for every parameter. One cannot put together a list of best performances in all emission types and expect a single mill to be able to match that list (Figure 2-1).

As all mills are different, it is particularly important to avoid the “ghost mill” trap, in other words that of constructing a non-existing installation from the best “bits and pieces” available. With the highest probability, such a “ghost mill” would be non-functional.

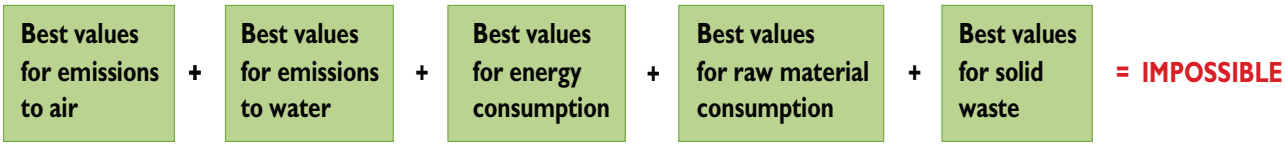


Figure 2-1.
Impossible Combination – It is impossible to have best values in all emission categories and produce a competitive product.

Achieving the lower BAT values is an indication of extremely good performance levels. According to the basic laws of physics matter does not disappear – what is put into the process also comes out in some form. In pulp and paper production, it is not possible that all of the process inputs exit the process with the product, and that is why waste and emissions are generated.

The balanced and integrated view on environmental performance is very closely linked to cross-media issues and local conditions and site specific prioritisations, which are described in the following chapter.

Message: All environmental parameters should be assessed in an integrated manner, while avoiding the "ghost mill" trap.

2.3

Prioritisation does matter

Depending on e.g. the authorities determining the permit limits, local environmental characteristics and facility-specific technical development, mills have to prioritise their environmental operations to best fit their situation. In many cases, for example cross-media effects force mills to make some environmental trade-offs. The goal should be a balanced view on total environmental performance, which is described in Chapter 2.2.

Very often the technological choices made at one point affect the number of the feasible technical options in later stages (Figure 2-2). There is no general pathway or action tree to follow; all are situation-dependent. This is everyday reality, which in a way is in contrast with the spirit of IPPC, where the whole system should be planned and controlled in an integrated manner. But, even when building a greenfield mill, the same realities exist: prioritisation is needed, and choices made in one part of the process affect possibilities in other parts. A well-known, old example illustrates a mill, which has first concentrated on emissions to air and water and then on water consumption, achieving very good performance. When turning to solid waste, its options are already limited by the choices made, and for energy and chemicals the limitations increase even further.

A well-run mill usually makes an investment programme to develop its environmental performance. The investment programme is made for several years. The programme is especially important when process internal changes – not only end-of-pipe techniques - are planned. The process internal environmental investments are mostly done in connection with other investments such as rebuilds and thus follow the same cycles. This is the best solution from a technical, economical and environmental point of view. In some cases, it is not economically or technically feasible to simultaneously invest in several BAT techniques. In this way, it is also possible to take advantage of possible developments in BAT techniques.

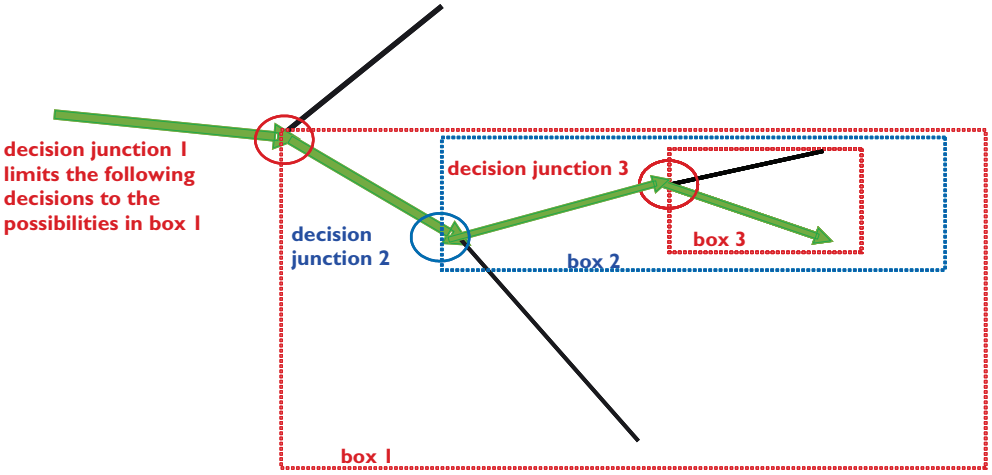


Figure 2-2.
When you make a prioritisation, you limit yourself to one part of the road map or action tree. Further choices cause further limits on your degrees of freedom.

Noise abatement can be used as an example of prioritisation and investment cycles: The starting point for noise abatement is the authorities' requirements depending on the mill location (distance to the neighbourhood, recreational or industrial area etc.) and the national requirements. The reference points can be located at the mill border and/or in several locations in the residential area. The target values in the residential areas must usually be fulfilled and always when new machinery is being delivered. However, also existing noise sources must more and more frequently be attenuated, because the requirements are becoming stricter.

Noise reduction is in most cases relatively expensive. Therefore lay of aspects and the design of noise abatement measures are very important at an early stage of a project. When existing noise sources have to be attenuated the costs for silencers and sound insulation enclosures can become high.

Message: Prioritisation does matter. The technological choices made at one point affect the number of the feasible technical options at later stages.

2.4

Comprehensive utilisation of all raw materials

In the pulp and paper industry, an effective and comprehensive utilisation of all raw materials, not only fibres, should be considered to be BAT. The differentiation of raw materials and end products to "main products" and "waste" does not encourage for this. In addition, the current definition of waste accentuates this even further. It can in some cases force the industry to classify perfectly good products, which are used as raw materials, fuels or by-products, as waste. Therefore, an inappropriate definition should not hinder the application of the IPPC principles and limit the industry's ability to act in a sustainable way.

As stated in the BREF, the BAT for waste recovery, recycling and re-use varies across Europe. The reasons for the variation are often independent of the pulp and paper industry. As an example, in countries or areas with low population density it can be impossible to find sensible recycling and re-use applications for waste. Thus, as in many other situations, local conditions need to be taken into account when the best alternatives for waste recovery, recycling and re-use are sought out.

Options for recycling and reuse of solid waste are for example:

- fibre clay (paper mill sludge) is utilised as a hydraulic barrier material for landfills and in landscaping as well as in road and sports field construction
- scrap metals, waste paper and board are recycled
- ash is utilised as a fertiliser in the forests, as a hardener in filling mine cavities and in road construction
- waste is incinerated with energy recovery
- green liquor dregs of a pulp mill can in some cases be used as a neutralization agent of acidic wastewater

Below, two examples of reuse are discussed in more detail.

Case 1: Fibre clay

Fibre clay is an important by-product of paper and board production. The Finnish paper and board industry produces annually approximately 430 000 dry tonnes of fibre clay. It consists of wood fibres, mineral fillers and other coating material, which cannot be recycled back into the production process. Due to its environmental and technical properties, fibre clay is suitable for reuse e.g. in landfill sites, in landscaping, and in road and sports field construction.

Research and development of fibre clay utilisation was started in the mid 1990s and has created a solid basis for its reuse today. As a result, since the year 2000, 1.5 million tonnes of fibre clay has been reused in industrial and communal environmental construction work in Finland.

Advantages

Fibre clay has many advantages compared to its substitute products. It is an economical and easy-to-use material for environmental construction. 20 paper and board mills in Finland produce fibre clay.

Compared to mineral-based materials, fibre clay is significantly lighter. This is why it can be competitively supplied and transported up to a distance of 150 kilometres.

The fibres in fibre clay provide a very good transformation resistance for constructions. The significance of transformation resistance is especially critical in structures which are exposed to large contraction deviations, as is the case for the surface structures of landfills.

The water permeability of fibre clay is between 10-8 – 10-10 m/s. Compared to other natural materials only clay, which is rather scarce in many areas, can reach similar permeability figures.

Fibre clay is a very safe material for the environment. Environmental feasibility studies have proven that fibre clay is fully suitable for earthwork.

Unlike many natural materials, fibre clay is not sensitive to erosion and does not silt up. Therefore, construction can take place during rainy periods as well. Today's earth moving equipment is also suitable for working with fibre clay.

End-uses

For several years, fibre clay has been used in the landscaping of old landfills. Its usefulness in landfill surface structures has already been proven in over 40 different landfill sites around Finland.

Fibre clay has also been used both in the foundations of cross country skiing trails and in the shaping of ski slope profiles. It also has the potential to replace mineral-based materials in sports ground renovations and in building golf course foundations.

Mixtures of fibre clay and fly ash have been successfully used in the maintenance of smaller roads at various locations in Finland

Case 2: Fly ash

The Finnish Ministry of the Environment has completed a statute by the Council of State regarding the use of industrial by-products in road, ground, street, and sports ground structures. The new statute enables the use of industrial fly and bottom ashes in earthwork without a previously required environmental permit.

In the future, fly ash may attain an important role in repairing and improving smaller roads and in other earthwork, due to its very favourable anti-frost and carrying capacity properties. In some cases, it is possible to reduce by 50 % the number of required structural layers compared to when building with traditional materials. This will lead to very significant cost savings in the building and maintenance of roads and i.e. sports fields.

In the near future, production plants will provide fly ash and fibre clay for the building and maintenance of industrial areas, landfill sites, roads, sports grounds, and various landscaping structures. For many such projects, plans already exist at various localities. Fly ash has already been used in forest road building and maintenance, where it has replaced gravel and crushed stone in the bearing layer of the road due to the aforementioned favourable properties.

Message: Effective and comprehensive utilisation of all raw materials should be considered to be BAT.

2.5

Readability

The purpose of the BREF document is information exchange. Thus, the document should be easy to use. This does not mean that the technical details described should be easy to understand also for a layman but that the key principles should be easily accessible, and that the information is presented in a logic and consistent way. However, this is not the case in all parts of the first BREF. For the sake of the readability of the BREF document, the important principles should be repeated and unnecessary information, e.g. old data, too detailed data, and information covered in other BREFs, should be cut out.

Annex 1 contains a list of the BREF's chapters which contain old or unnecessary information.

3 Best available techniques

The general principles of the BREF, for example the ones, which have been pointed out in this report – the difference between permit limits and BAT levels, a balanced view, prioritisation and comprehensive utilisation of all raw materials – should apply to all BREF chapters dealing with BAT techniques. For improved understanding and for ease in locating the main issues, *the key principles and chapter summaries presented in the executive summary should be mentioned at the beginning of every BAT chapter* before listing the BAT techniques. In the following, other issues especially important for *Chapters 2.3 - 6.3 Techniques to Consider in the Determination of BAT and Chapters 2.4 - 6.4 Best Available Techniques* of the first BREF are discussed.

3.1

Smooth running and simple processes

In the connection of the *Chapters 2.3 - 6.3 Techniques to Consider in the Determination of BAT* of the first BREF, the need for ensuring smooth running and minimising accidental releases should be emphasised. It is a well known fact that a smooth run improves material efficiency, cuts pollution, decreases energy consumption and cuts costs. On the other hand, repetitive production breaks, technical shut-downs and incidental releases increase emissions and cause wasteful processes. Smooth and safe running of machines and processes guarantees low emission levels without further end-of-pipe investments. However, there are periods in the pulp and paper business when the utilisation rates of pulp and paper mills are rather low – this can be the case for market reasons or labour market unrest or other disturbance beyond mill control. This increases specific consumption and emission figures. Thus, from an environmental point of view, it is best to run continuous series without interruptions. However, *different market conditions demand changes in furnish content and products*. This means that there *is no best practice on what to produce but* only on *how to produce*: you can do grade changes well or poorly using best practices and measures.

Figure 3-1 shows the correlations between smooth and bumpy running and emissions. A smooth running avoids production peaks/valleys and starts/ends and extraordinary high/low loads resulting in reduced emissions and decreased energy consumption. This also affects product quality.

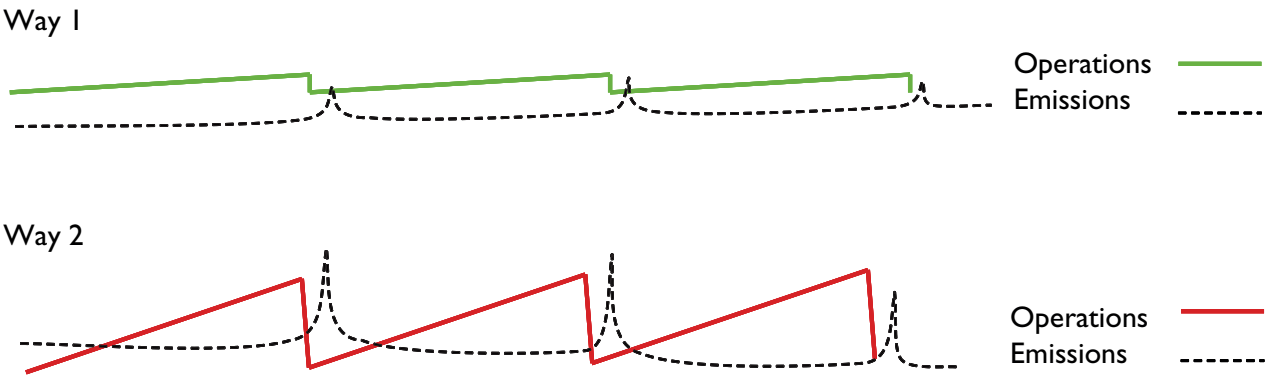


Figure 3-1
Smooth running ensures low emissions

One way to ensure smoother running is to use simpler processes and to have as few components in the system as possible (Figure 3-2). It is easier to control a simple system well and the process simplification has several other benefits:

- A simpler pulp and paper making process reduces investment costs. As its design becomes simpler, the production facility including its emissions control works better and the process is easier to operate and maintain.
- If additional equipment, e.g. for lowering emissions, is installed in a system, it has an effect on the process as a whole by e.g. increasing energy consumption. Thus, instead of adding pieces of equipment one by one, it would make more sense to try to optimise and control the entire system in order to make it simpler and more functional.
- Traditionally, papermakers have tended to add controls when increasing production. However, the process could be optimised and simplified, which should be the ultimate goal in process design aided by simulation. As a result, a reduced number of controls would be required.
- Simplification can be expected from combining process stages. Currently, there are attempts to combine the forming section with the press section. Another example is the development of impulse technology which seeks to merge the press section with the first stages of drying.
- In addition to considerable potential in large-scale papermaking, a simplified process would benefit small-scale production economics.

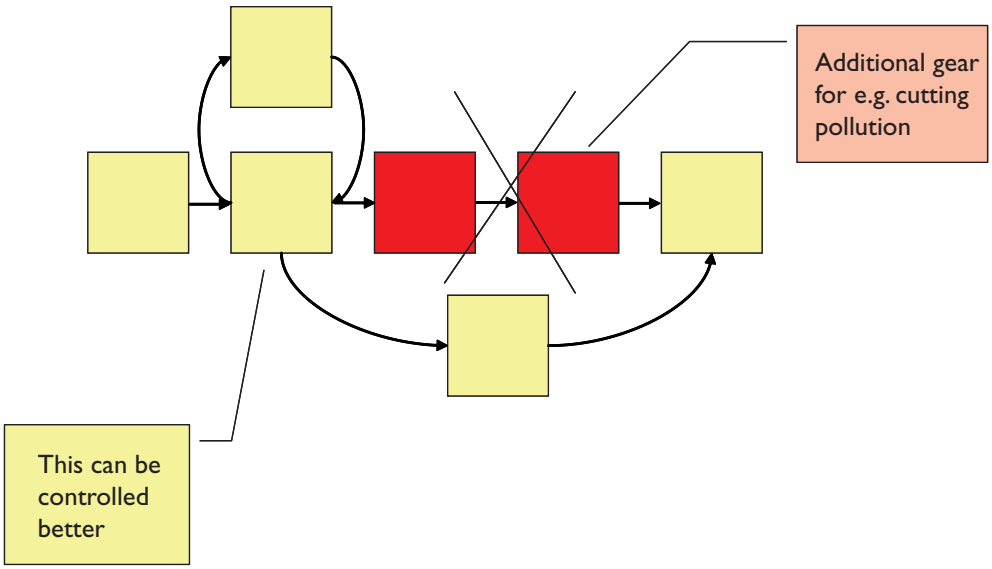


Figure 3-2
Simple systems for smooth running - it is easier to control a simple system well.

Message: The need for ensuring smooth running and minimising accidental releases should be emphasised in the BREF. One way to ensure smoother running is to use simpler processes.

3.2

Cross-media effects

In the first BREF document, the possible cross-media effects are included in the presentation of techniques to consider in the determination of BAT techniques. However, these effects should be further emphasised in the Chapters 2.3-6.3 of the first BREF, or in the corresponding chapters of the new document. Lack of cross-media information and integrated views in decision making can result in wrong decisions. As examples of cross-media effects, the following cases are discussed below:

- Closed water cycles
- Tertiary treatment of waste water

Closed water cycles

More closed water cycles with in-line process water treatment reduce the effluent volume but at the same time complicate the process, increase energy demand and the generation of solid waste. The runnability of the paper machines suffers from a high degree of closure of water circuits. This leads to unplanned breaks and washing so that the load to the environment can in some cases increase.

In addition to technical problems, closed water loops also create a trade-off problem: production of high value added, high quality papers with fast machines require more open water loops. In other words, some paper qualities demanded by the market cannot be produced in mills with closed water loops, at least not in the near future.

This is also relevant for smaller mills producing e.g. special foodboard with high microbiological requirements for the production process.

It has been speculated that in total closure of the water circulation, traditional chemicals may need to be converted to new substances. For example, new kinds of polymers are under development. According to some sources closure of the water circulation could in some cases bring with it benefits by stabilizing the papermaking process with minimal changes in chemicals concentration in the steady state. In addition, there would not be temperature fluctuations associated with the introduction of raw water. However, there is no full scale evidence of general validity.

Implementation of new water treatment methods should not lead to environmental loads elsewhere or to increased consumption of primary energy. Even though closed water cycles with in-line process water treatment (mentioned for example in *Chapter 5.3.4* of the first BREF) have some positive environmental effects, there are also several problems associated with them. In addition, there is not enough real full scale experience about them and thus they can not be considered as BAT.

Tertiary treatment of waste water

The cross-media effects of tertiary treatment are illustrated with two real mill cases:

Case: Mill 1

Mill 1 in is a Finnish mill producing newsprint and directory papers, coated and uncoated fine papers, coreboard and sawn whitewood products. In addition, it produces chemical pulp, thermomechanical pulp and recycled pulp. The total annual output of the fibre-based products is over 600 000 tonnes.

The wastewaters of Mill 1 are treated biologically in the aerated lagoon (secondary treatment) and chemically in the flotation plant (tertiary treatment). At the beginning of 2002 the flotation plant started up to *improve the efficiency of wastewater treatment. One reason for the construction of the tertiary treatment was a low efficiency of the aerated lagoon to reduce COD and phosphorus loads in wintertime*. The tertiary treatment after the aerated lagoon is quite effective and its investment cost was lower compared with the upgrading of the aerated lagoon to the activated sludge plant. *Disadvantages are chemical costs and a rather high amount of chemical sludge. Chemical sludge is difficult to handle and its treatment is comparable to biosludge*. At Mill 1 all sludges are mixed before the treatment of a screw press and the dried sludge is incinerated at the Mill's own power plant.

The tertiary treatment was reasonable in the case of Mill 1 where *the wastewater load changed significantly during different seasons and the performance of the aerated lagoon was clearly on a lower level compared with the activated sludge plant.*

Case: Mill 2

Mill 2 produces semi-chemical pulp for the board machine which manufactures high quality semi-chemical fluting. This Finnish mill has an annual production capacity of 280 000 tonnes of fluting and is one of the most modern and efficient fluting mills in the world.

After mechanical pre-clarification the wastewaters of the Mill are fed to the two-stage biological treatment plant. The first biological treatment stage is the Minimum Biosludge Process (MBP) plant and the second biological stage is the activated sludge process. The biologically treated wastewater is pumped to post-flotation (tertiary treatment) which started at the end of 2002. *The suspended solids and total phosphorus loads reached exceptionally high levels* in 2001 and the Mill *failed to meet the discharge limits* set by the relevant authorities for phosphorus and suspended solids. *The existing wastewater treatment plant was too small to effectively treat the incoming load. In case of Mill 2 it was reasonable to build the flotation plant (tertiary treatment)* because the wastewater

flow was exceptionally small (about 3000 m^3/d) and the *acute wastewater problem had to be solved quickly*. The investment cost of the flotation plant was also lower compared with the enlargement of the activated sludge plant.

The flotation plant has proved to be *efficient for suspended solids and phosphorus but expensive to use. The chemical sludge is difficult to handle and it lowers the dry content of the total sludge (dry content < 20 %)*. The primary sludge, biosludge and chemical sludge are mixed and dewatered on a belt filter press. The dried sludge is incinerated at the Mill 2's power plant.

Message: Cross-media effects should be further emphasised in the BREF. Lack of cross-media information and integrated views in decision making can result in wrong decisions.

3.3

A new BAT technique to be added

A new pulp bleaching stage, *removal of hexenuronic acids by mild acidic hydrolysis* (Hex), should be added to the BREF. This method is suitable for hardwood pulp and, in particular, to pulp produced from eucalyptus. The method is becoming a standard feature at bleaching plants using the latter as a raw material. The main advantages of the technique include the reduction in the consumption of bleaching chemicals and better permanent brightness stability in the end-product.

Hexenuronic acids (HexA) react with several bleaching chemicals thus consuming them without a bleaching effect. The acid stage is used to remove HexA from the pulp prior to the chlorine dioxide stage. HexA cannot be removed in the oxygen delignification stage, but they do consume e.g. chlorine dioxide if not first removed in an acid stage prior to the first chlorine dioxide stage. When the consumption of chemicals is lower, there are fewer detrimental effects on the environment.

For more information, please see the articles of Tapani Vuorinen, Johanna Buchert et al., for example Vuorinen et al: *"Effect of cooking and bleaching on the structure of xylan in conventional pine kraft pulp"* Tappi Journal 78(1995):11, 125–130. and Vuorinen et al: *"Characterization of 4-deoxy- -L-threo-hex-4-enopyranosyluronic acid attached to xylan in piXne kraft pulp and pulping liquor by 1H and 13C NMR spectroscopy"* Carbohydrate Research 272(1995):1, 55–71.

Message: The removal of hexenuronic acids by mild acidic hydrolysis should be added both *in Chapter 2.3 Techniques to consider in the determination of BAT and Chapter 2.4. Best Available Techniques* of the first BREF or the corresponding chapters of the new BREF.

3.4

Solid fuels including peat

In the first BREF document, emission levels associated with the use of BAT for different fuels in auxiliary boilers are given. However, the listed fuel categories do not respond entirely to the current status of pulp and paper industry fuel use. Therefore, a fuel category *"other solid fuels"* in the BREF should be added. This new category would include e.g. peat, which is in some countries an important fuel for the pulp and paper industry. Hence, there should be reference values for "other solid fuels" in the Pulp and Paper BREF (Table 2.44 on page 109).

It should be noted that in case of peat, the quality and amount of peat used has an effect on emissions. Peat is seldom used as the only fuel and the share of peat in the fuel mix has an effect on the emissions. Moreover, the natural nitrogen content of peat (up to 3%) is higher than the nitrogen content of other biomass based fuels e.g. wood and the same situation is with the sulphur content of peat (up to 0.2%). The nitrogen in peat is organically bound and reactive. This means that the nitrogen in peat is easily oxidised to NO_x. The high combusting temperature of peat increases further the formation of NO_x

Message: A new fuel category *"other solid fuels"*, including for example peat should be included in the new BREF.

3.5

Best available techniques

The *Chapters 2.4. – 6.4, "Best available techniques"* are probably the most read chapters in the whole BREF document. Thus, it is very important that the key principles of the BREF and the chapter summaries presented in the Executive summary are also presented in every chapter before the listing of the BAT techniques. Therefore, for example the above mentioned difference between permit limits and BAT levels, the importance of local conditions, the need for ensuring smooth running and minimising accidental releases, investment cycles and timing, concepts such as balanced view and prioritisation and cross-media effects should be shortly repeated at the beginning of *Chapters 2.4. – 6.4, "Best available techniques"*.

Message: Because the *Chapters "Best available techniques"* are the most read chapters in the BREF, it is very important that the key principles of the BREF are also presented in every chapter before the listing of the BAT techniques.

4 Promising new techniques (emerging techniques)

The chapters dealing with development of new techniques *(Chapters 2.5-6.5. "Emerging techniques")* are important, showing that today's BAT is not definitive. However, it takes often several years or even decades before a technique tested in laboratory scale can be used in production scale and thus possibly considered as BAT. Therefore, it is important to recognise that not all emerging techniques move automatically into the BAT–category, following the revision cycles of the BREF documents. In other words, the process is not an automaton, where emerging technologies in one BAT BREF always flow into the next BREF's BAT section. Instead, one can see the promising new techniques as a "boiling kettle"(Figure 4-1): if there is enough market demand and investment/R&D heat, some techniques boil over, and flow into a tube leading to the BAT section. Most of the techniques exit the kettle as process rejects – they never become a large scale technique or product that reaches the BAT section. However, some techniques become BAT directly without the "emerging technique" stage.

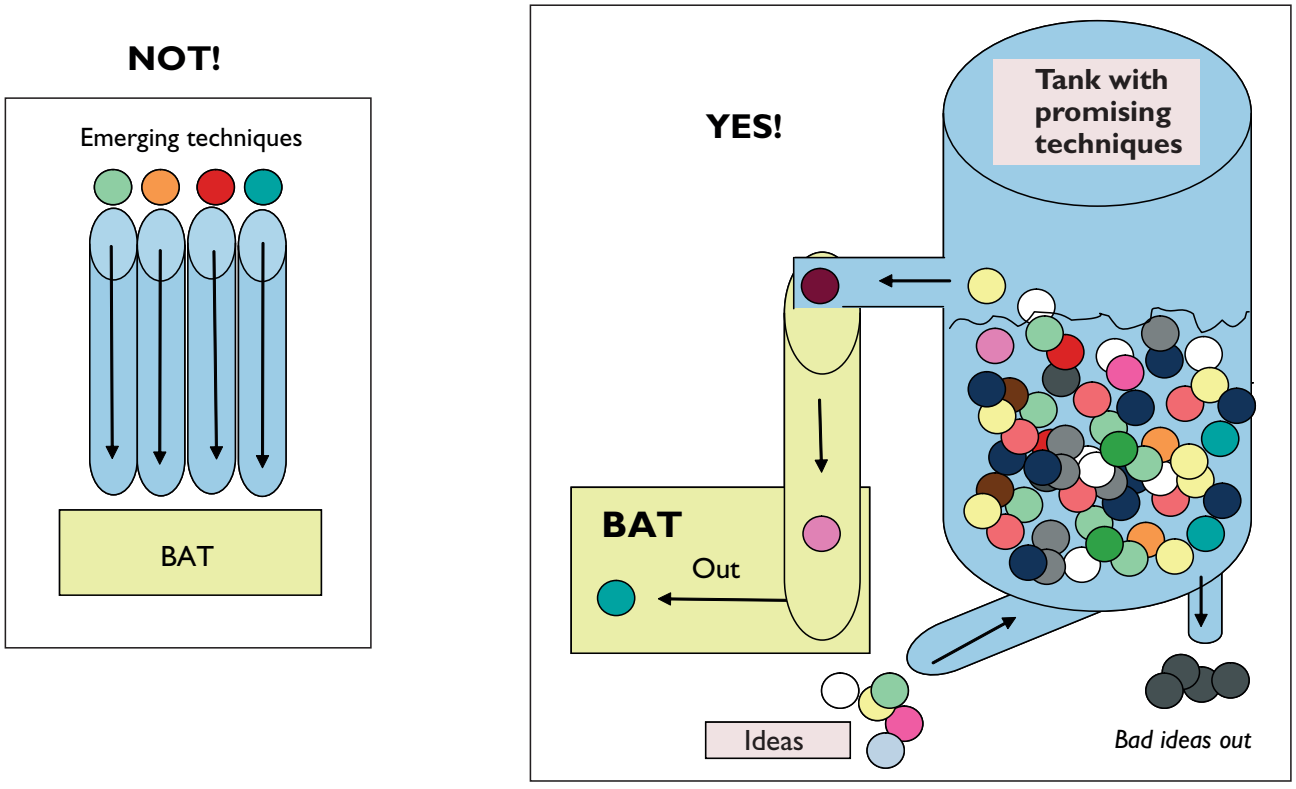


Figure 4-1
The development of new promising techniques is a kettle, from which the best ones run into the BAT tube.

Because of the facts mentioned above, the *Chapters 2.5 – 6.5 Emerging Techniques* of the first BREF could be improved by making it into a readable, clear and concise analysis of current technology trends and selected techniques, not forgetting key facts such as the need for ensuring smooth running and minimising accidental releases and cross-media effects. Some of the current trends are discussed below.

The pulp and paper industry is seeking better cost efficiency and improved product quality (e.g. higher brightness). More specifically, these two major trends result in the need for e.g.

- energy efficiency
- decreased water consumption (and possibly resulting lower process water quality)
- decreased raw materials consumption (e.g. lower paper grammages)
- process simplification
- lower investment costs / shorter payback period
- more durable interchangeable/wearing parts
- increased time efficiency
- better control, i.e. automation and ICT

Furthermore, the development in the paper industry is often directed towards increased machine speed and width, as well as faster grade changes. In addition, the industry is looking for completely new product features (including different by-products) in order to improve its business outlook. While some of these trends have direct positive environmental effects, others are likely to introduce trade-offs in terms of environmental impacts.

Some general, potential new techniques could be presented together with the trends. However, the techniques should be presented without supplier-related information. The newest developments of one supplier cannot automatically be considered as the most promising ones. The differences between the suppliers are in many cases small and the best technique depends on what is done in the next stages of the process, according to the "Prioritisation"-principle presented in chapter 2.3. In addition, only the final result of the environmental actions and techniques should count, not the intermediate process phases.

Message: The chapters dealing with new techniques could be improved by making them into a readable, clear and concise analysis of current technology trends and selected techniques, not forgetting the key principles of the BAT.

5 Emissions values and techniques

5.1

Data production and evaluation to ensure comparability

It is obvious that the comparability of the values presented as source information in the current pulp and paper-BREF (as well as in other BREFs, too) is vague. The weakness can be seen in two main areas:

1. i.e. what does the value of the parameters represent (such as daily, monthly or annual average or BOD5 / BOD_7) and
2. in the variation and documentation of the measurement methods and conditions.

To improve the comparability of the values and to make them easier to interpret, the data production of the source data (European mill data) should be more transparent. This means that a figure could be regarded as truly credible only when it is accompanied by documentation of how it was produced. This documentation enables a comparison between the values that have been produced by applying the same outlines in both data production and in reporting (Figure 5-1).

When producing emission data from IPPC installations the data needs to undergo the following two phases:

1. The operator needs to follow the principles in production of emission data which are presented in Monitoring BREF
2. The authority needs to evaluate and rate the reported data for various purposes:
   - Supervision: guidelines in Monitoring BREF, IMPEL documents and national legislation
   - BAT reference data presented in the BREF documents
   - Emission data presented in the EPER/E-PRTR registers

Presentation of BAT reference data in the BREF documents

The following procedure is proposed as a solution to the problem presented in the first paragraph. The authority needs to receive enough information to enable understanding of emission data, i.e. how complete and accurate the data is

- Complete = all relevant emission sources and conditions included
  - The background information needs to be transparent enough to reveal which of the relevant emission sources (point and diffuse) and process conditions (normal and exceptional) during the reporting year were included in the reported data

- Accurate = no systematic over or under estimation of emissions
  - Information of the measurement/calculation method accuracy and uncertainty

The data to be presented as BAT reference value needs to be transparent, i.e. the above listed information needs to be reliably documented.

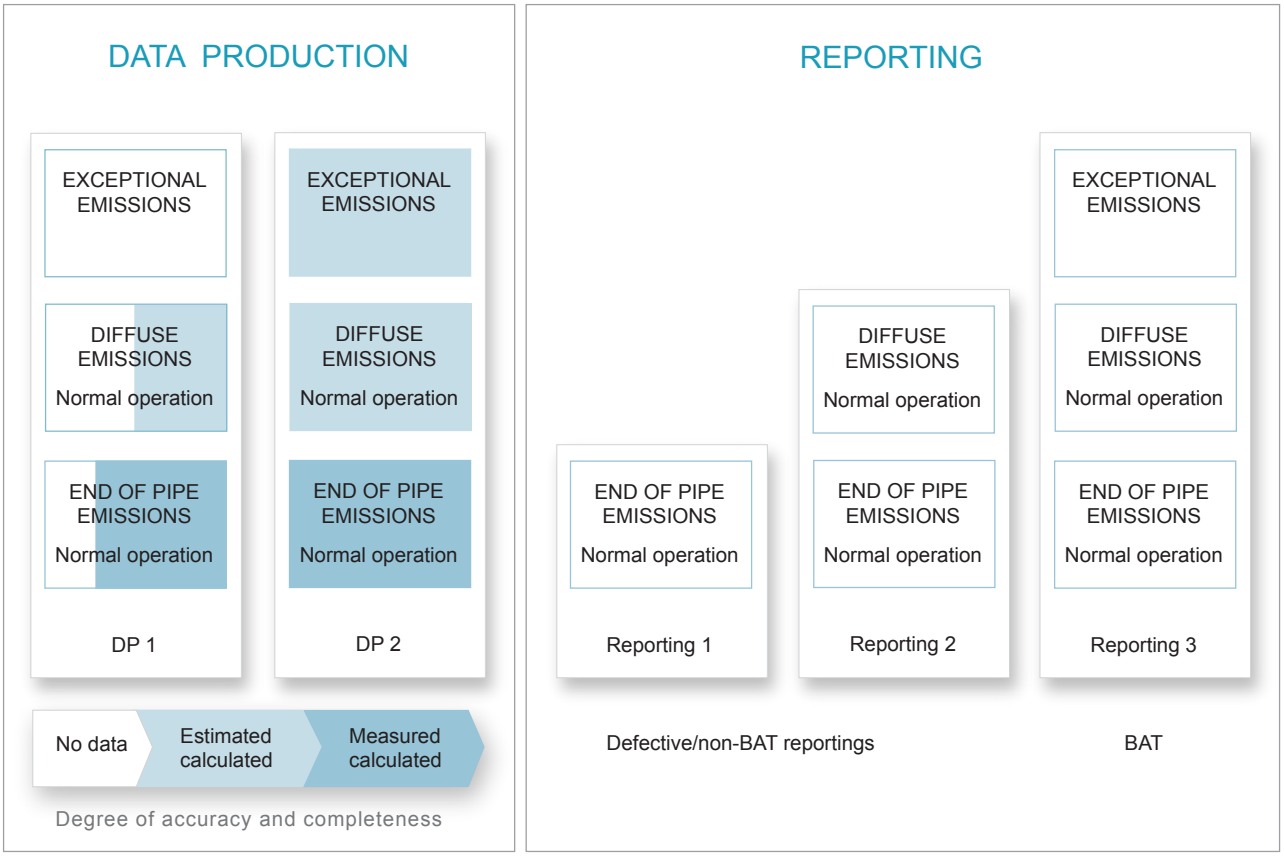


Figure 5-1
Different manners in production and reporting of emission data

Note that calculated emission data can be as accurate and complete as measured data for instance in cases it is based on e.g. on-line follow up of fuel consumption as well as on frequent determination of specific emission factors. However, the accuracy of emission data based on mass balance calculations can not generally be comparable to that based on direct emission measurements.

Rating of BAT background data in the BREF

In case the information needed to understand the completeness and accuracy of the emission data, as listed above, is available, European mill data presented as source data[1] for BAT reference values can be rated. Based on this information each figure presented in the BREF can be indexed to show the level of completeness and accuracy. It is recommendable that the rating is simple, e.g. three level as A = complete and accurate B = moderately complete and accurate C = poorly complete and accurate.

[1] Data sent to BREF author

This enables presenting of incomplete/inaccurate data as background material for BAT reference values when the background is known, and gives the BREF reader an indication of whether the data is representative to the real world emissions. The use of such comparability indices clearly improves the value of well documented source data in the definition of BAT references.

Message: Improve comparability of emission data.

5.2

Emission values

Numerous parameters have an effect on the emissions of a pulp or paper mill: product portfolio and quality, raw materials, techniques used, the way the machinery is operated and maintained - just to mention some of them. As all mills are individuals, a higher value in one emission category does not necessary mean poor overall environmental performance. This should be kept in mind also when studying the emissions of the Finnish pulp and paper mills, which are shown and analysed in Chapters 5.2.1 and 5.2.2 below.

When comparing the emissions in 2001 to those in 2004, it should be kept in mind that year 2001 was an excellent year for the Finnish paper industry (meaning also smooth running), whereas 2004 was not particularly good. On the technical side, there have not been any large technology jumps during this period. However, when it comes to emissions to air, measurement technology has made great advances. This also has an influence on the emission values.

5.2.1

Kraft Pulp

In Table 5-1 the emissions of Finnish non-integrated and integrated kraft pulp mills are shown. In waste water discharges, the average emissions of year 2004 have gone down in almost all categories compared to year 2001 whereas in atmospheric emissions the situation is about the same as in 2001. In general the Finnish mills represent a high technical standard and are well run. The averages of the Finnish emissions are inside the BAT range in all emission categories except in NO_x emissions. In some categories single mills reach emission values below the lower BAT level, even though the year 2004 was not a good year for the Finnish pulp and paper industry – thus no "smooth running".

In Figure 5-2, the Finnish bleached kraft pulp mills, both integrated and non-integrated, are shown together with a group of international, non-integrated bleached kraft pulp mills. The analysed non-Finnish mills represent competitive, well-known large international companies. However, due to the reasons mentioned in the Chapter 5.1 of this report, the emission values are still not completely comparable. The mills in the picture use hardwood and/or softwood as their raw material. The black lines show the current BAT range. As can be seen from Figure 5-2 below, a large number of mills are outside the BAT range especially in case of NO_x and SO_2 emissions. Please note the different scale for COD emissions in the figure.

Table 5-1
Ranges of emissions in the studied Finnish plants in comparison with BREF BAT emission ranges – non-integrated and integrated kraft pulp. Please note that the selection of mills in 2001 and 2004 were not completely identical.

Waste water discharges	BREF[1]	FIN range [2] 2001	FIN average [3] 2001	FIN range [2] 2004	FIN average [3] 2004
BOD_7 (kg/ADt)	0,3-1,5	0,3-6,8	1,0	0,2-4,9	0,7
COD_{Cr} (kg/ADt)	8-23	8-40	18	4-34	17
TSS (kg/ADt)	0,6-1,5	0,3-3,0	1,0	0,2-2,9	0,9
AOX (kg/ADt)	0-0,25	0-0,30	0,14	0-0,27	0,16
P (kg/ADt)	0,01-0,03	0,003-0,06	0,02	0,003-0,04	0,01
N (kg/ADt)	0,10-0,25	0,06-0,63	0,21	0,05-0,52	0,15
Flow (m^3/ADt)	30-50	22-100	52	20-95	39
Atmospheric emissions [4]					
TSP (kg/ADt)	0,2-0,5	0,1-1,1	0,5	0,1-3,0	0,5
SO_2 (kg S/ADt)	0,2-0,4	0,04-0,8	0,3	0,01-0,8	0,2
TRS (kgS/ADt)	0,1-0,2	0,03-0,5	0,1	0,04-0,5	0,1
NO_x (kg/ADt)	1,0-1,5	1,2-2,4	1,5	1,1-2,1	1,6

[1] BAT ranges in the Pulp and Paper BREF
[2] Emission ranges of the plants in this study (data from 2001 and 2004)
[3] Average emission values weighted by production
[4] Emissions related to Kraft process including recovery boilers, lime kilns, fugitive emissions and separate furnaces (e.g. for TRS incineration), if any

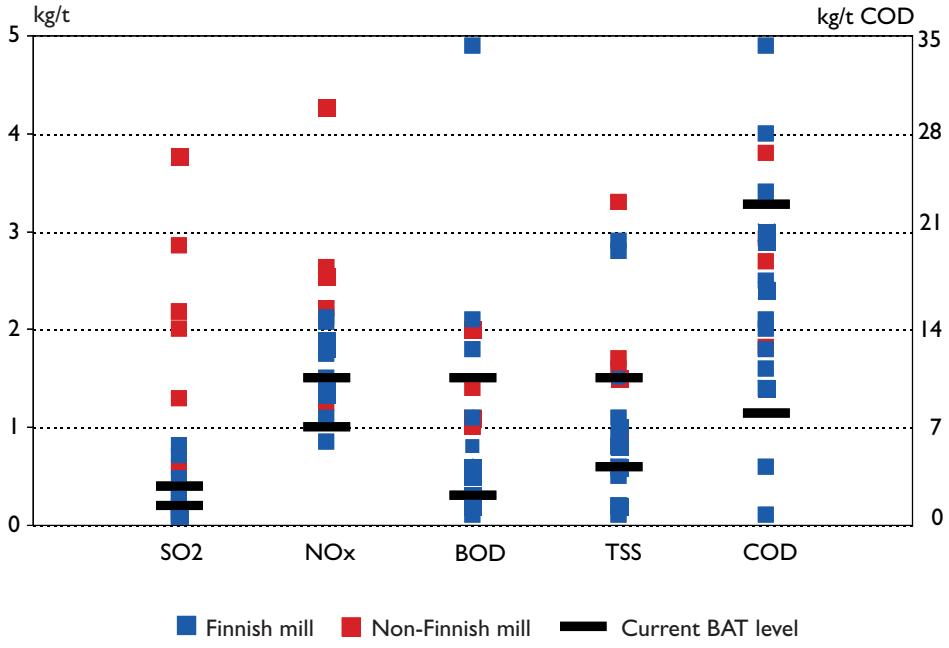


Figure 5-2
Selected Emissions from Bleached Kraft Pulp Mills (integrated and non-integrated mills). Please note the different scale for COD emissions.

NO_x emissions

As Finlad has commented before, the presented NO_x emissions values from kraft pulp mills are not in line with the other values for emissions to air. There are several reasons for this.

1. NO_x emissions from recovery boilers are highly dependent on the type of wood used in kraft pulping. Softwood (e.g. pine) contains less nitrogen than hardwood (e.g. birch and eucalyptus). However, due to other differences in softwood and hardwood properties, the amount of black liquor generated from softwood pulping is so much higher that the different nitrogen content of the wood species cannot compensate for this. The NO_x levels presented in the BREF are thus tighter for mills using only softwood as raw material. The BAT cannot be valid for one raw material only - or otherwise different BAT technologies should be described for softwood and hardwood. All raw materials (and end products) should be treated in an equal manner.
2. Process conditions have a significant impact on the NO_x values: It was noticed in late 1980's / early 1990's that in cases where the sampling lines (sondes) were not properly warmed up, in other words the measurements were made "too early", very low NO_x emission values could be measured.
3. Combustion conditions have a significant impact on the NO_x values: In cases where the combustion system is "suboptimised" just for NO_x emissions and for example the levels of CO and SO_2 emissions are neglected, low NO_x values can be reached. This can happen for example if the combustion is incomplete. Thus,
   - The NO_x values presented e.g. in table 2.12. at page 40 of the BAT BREF (reference from year 1992) should be rechecked against this information.
   - As stated in the BAT BREF, there is a need to harmonise future data by using further European standard methods and by investigating the real differences and important factors influencing the reported results harmonisation.
   - According to the spirit of the IPPC directive, there is a need for holistic view, not for sub optimisation of one specific emission.

Below, a summary of the NO_x emissions from Finnish bleached kraft pulp mills can be found (Table 5-1). Even though all but one mill have all the listed NO_x related BAT techniques in use, only half of the mills reach the BAT range.

The share of mills above the BAT-range is much higher, if the non-Finnish mills are taken into account, Figure 5-2.

More information on NO_x emissions can be found in the articles of Vakkilainen et al.: *Nitrogen Oxide Emissions from Recovery Boilers/Pulp Mills – Scandinavian Perspective, and Hupa: Nitrogen oxide emissions from pulp mills and the factors affecting them – a summary of the current knowledge*.

Table 5-2
Process based NO_x emissions from Finnish bleached kraft pulp mills. Please note that the selection of mills in 2001 and 2004 were not completely identical.

Atmospheric emissions	BREF	FIN range 2001	FIN average 2001	FIN range 2004	FIN average 2004
NO_x (kg/ADt)	1,0-1,5	1,2-2,4	1,5	1,1-2,1	1,6

TSS level from kraft pulp production

It has been noticed that the BAT TSS levels from kraft pulp production presented in the first BREF are not in line with the list of BAT techniques or with other emissions to water: there are several examples of modern kraft pulp mills which have a well performing biological effluent treatment plant and COD load clearly below the BAT level, but which still are not in the BAT range of TSS emissions

For some mills, the TSS levels are exceptionally small. This is at least partly explained by the fact that the biological effluent treatment plant of some mills has been connected with a so-called natural pond before leading the effluent into the waterway. This kind of waste water treatment system decreases TSS levels and gives too low result compared with the measurements after the biological effluent treatment plant (after the secondary sedimentation basin).

This difference in the waste water treatment systems should be taken up in the BAT clarifications and the TSS emission values should be reviewed.

Message: NO_x and TSS emission values presented in the BREF are not in line with the other values and should be revised or clarified.

5.2.2

Mechanical Pulp and Wood Containing Paper Mills

In the following table, Table 5-3, waste water discharges of integrated mechanical pulp and wood containing paper mills in Finland are shown. No clear trend between 2001 and 2004 can be found – in some of the emission categories the average has gone up, in others down. However, as in case of bleached kraft pulp, the Finnish mills represent a high technical standard and are well operated. The mechanical pulp mills have the majority of the listed BAT techniques in use and in paper production all the listed BAT measures are in use at the mills. Despite this, the TSS and COD ranges cannot be reached in all mills.

The averages of the Finnish emissions are inside the BAT range in all emission categories except TSS. In several categories single mills even reach emission values below the lower BAT level. The increase in COD emissions is an indication of the growing demand for high brightness products, discussed in more detail in the following. In addition the uneven or "non-smooth" running in year 2004 can be seen in the values.

The same comparison between Finnish and international integrated mechanical pulp based paper mills is shown in the Figure 5-3. Again, the non-Finnish mills represent competitive, well-known international companies. As in the Figure 5-2, despite the effort to put the presented emission values on the same starting point, the values are still not 100% comparable. The black lines show the current BAT range. It can be seen that the international situation is the same as with the Finnish mills - the TSS and COD ranges are challenging.

Table 5-3
Ranges of emissions in the studied Finnish plants in comparison with BREF BAT emission ranges - Integrated mechanical pulp and wood containing paper and board. Please note that the selection of mills in 2001 and 2004 were not completely identical.

Waste water discharges	BREF[1]	FIN range [2] 2001	FIN average [3] 2001	FIN range [2] 2004	FIN average [3] 2004
BOD_7 (kg/ADt)	0,2-0,5	0,1-2,0	0,2	0,1-1,0	0,3
COD_{Cr} (kg/ADt)	2-5	2-6	3	2-9	4
TSS (kg/ADt)	0,2-0,5	0,3-1,0	0,5	0,1-4,0	0,9
AOX[4] (kg/ADt)	0-0,01	-	-	-	-
P (kg/ADt)	0,004-0,01	0,002-0,01	0,006	0,002-0,01	0,006
N (kg/ADt)	0,04-0,1	0,05-0,1	0,1	0,04-0,3	0,1
Flow (m^3/ADt)	12-20	10-35	19	8-32	15

[1] BAT ranges in the Pulp and Paper BREF
[2] Emission ranges of the plants in this study (data from 2001 and 2004)
[3] Average emission values weighted by production
[4] Monitoring of waste water discharges does not cover AOX from paper mills

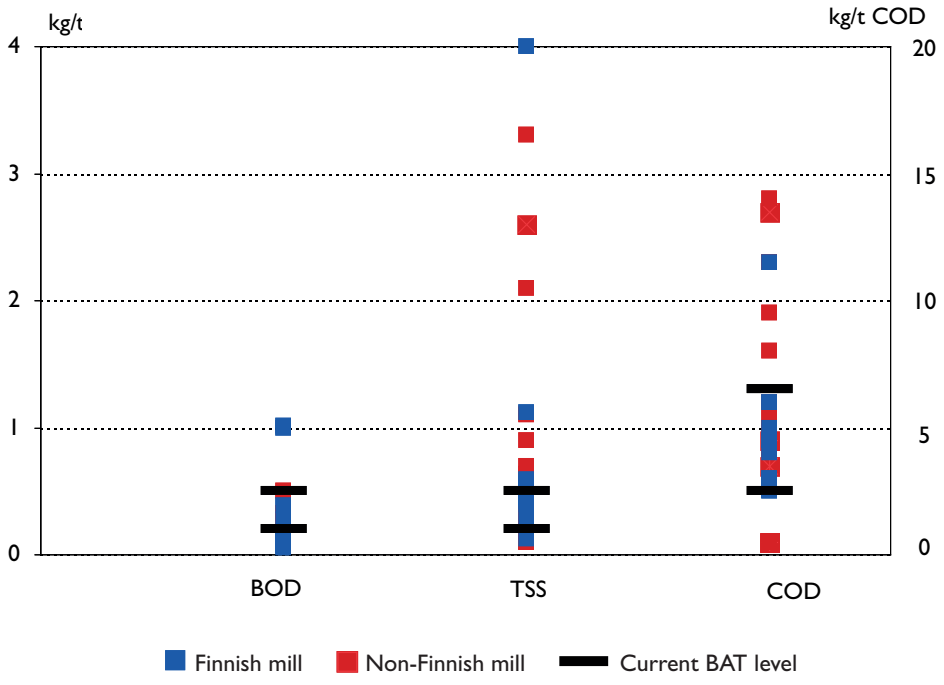


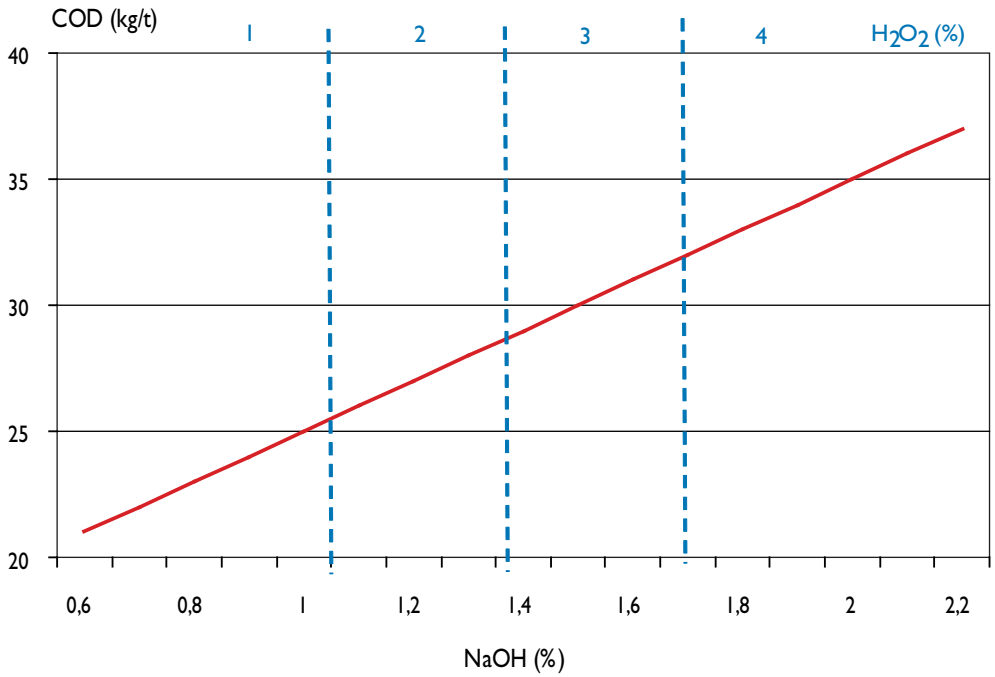
Figure 5-3
Selected emissions from integrated, mechanical pulp -based paper mills. Please note the different scale for COD emissions.

Peroxide bleaching and COD emissions

Production lines producing high brightness printing grades mainly based on peroxide bleached mechanical pulp generate more COD than indicated in the first BREF document. According to Suess et al: *Options for Bleaching mechanical pulp with lower COD load*, peroxide bleaching requires alkaline conditions. In mechanical pulp bleaching, this results in an increase of the effluent COD. Because of bleaching to a very high brightness requires a high input of caustic soda for the activation, the resulting COD load becomes very high. The correlation between chemical addition and COD emissions is shown in the Figure 5-4.

For more information, please see for example Suess et al: *"Options for Bleaching Mechanical Pulp with a Lower COD Load"*, Proceedings of the 2001 APPITA Conference, 2001:419.

The COD values for mechanical pulp -based papers presented in the first BREF document should be revised to also match the high brightness paper grades.



Modified from Suess et all.

Figure 5-4
The correlation between COD emissions, alkali addition and peroxide amount

Energy consumption

Due to reasons originating from market demand and reflected in paper furnishes, certain printing paper grades require more mechanical pulp and thus electricity than papers based on conventional furnishes. Advantages of increasing use of mechanical pulp in LWC/MFC papers include:

- opacity increases, making it possible to produce lighter paper grades (lower basis weights)
- TMP has a high fibre yield and virgin fibre is needed to feed the fibre cycle in Europe
- less chemical pulp is needed, therefore less effluent load

Production technology has been developing so that mechanical pulp -based paper grades are produced with a decreasing content of chemical pulp. In case recycled fibre is the main pulp component, increasingly often the share of mechanical pulp is substantial. The higher the content of mechanical pulp, the higher the consumption of electricity per ton of paper.

This means that the energy consumption range presented in *Chapter 4.4.2, Table 4.20 and Chapter 5.4.2. Table 5.34* of the first BREF does not fit the current "best available furnish" for printing papers. This is illustrated in the example below:

Example - Calculation of LWC/MFC electricity consumption:
Furnish of LWC/MFC paper

Pulp Grade	Conventional furnish (%)	Best currently known furnish (%)	Possible extreme furnish (%)
Chemical pulp	33	10	0
TMP	34	57	67
Filling and coating agents	33	33	33

Electricity consumption for different furnishes

	Conventional furnish (%)	Best currently known furnish (%)	Possible extreme furnish (%)
TMP	3 600 kWh/t TMP pulp	3 600 kWh/t TMP pulp	3 600 kWh/t TMP pulp
Paper machine	800 kWh/ t paper	800 kWh/ t paper	800 kWh/ t paper
TMP and paper machine*	2 000 kWh/ t paper	2 900 kWh/ t paper	3 200 kWh/ t paper
Current BAT range	1 700-2 600 kWh/ t paper	1 700-2 600 kWh/ t paper	1 700-2 600 kWh/ t paper

*Simplified calculation. In reality also other mill subprocesses than mechanical pulping and paper machine use electricity.

So far, when improvements in the energy efficiency of the mechanical pulping process have been achieved, *the energy savings have been used to decrease the freeness values of the pulps, and thus total energy consumption per ton of mechanical pulp has been kept fairly constant*. In other words, *quality requirements have increased at the same time due to market demand*. This pattern is expected to continue in the future. The need for more smooth and non-roughening paper grades tends to increase energy consumption exponentially, while the processes become more complicated. Simultaneously, the trend towards lower basis weight will lead to increased demands on bulk and opacity for the mechanical pulp.

Another energy issue to be considered in the revision of the first BREF is the large amount of other regulations directly or indirectly influencing energy consumption. For example the EU emission trading and increasing cost of energy guarantee that paper producers have a keen interest to do their utmost in decreasing energy consumption. However, market demand – e.g. indirectly in form of requirements on paper furnishes and the level of capacity utilisation - dictates the actual level of energy consumption. It should be noted that furnishes are usually confidential information. However, the general trend in LWC papers has been that furnishes with deinked pulp and mechanical pulp no longer include kraft pulp – this is a change from 2001.

VOC emissions

Most of the VOC emissions in the Nordic countries are from biogenic sources. The biomass density of the boreal forest is typically very high, resulting in large amounts of biogenic VOCs being emitted especially during the warm summer months. It has been estimated that the biogenic VOC emissions in Finland in June-August are about 250 000 tonnes. The estimated annual anthropogenic VOC emissions in Finland are around

200 000 tonnes. During the summer months the biogenic VOC emissions are thus 5.5-fold compared to the anthropogenic emissions.

VOC emissions from the pulp and paper industry are released mainly from the storage and handling of wood, and therefore originate from biogenic sources. Storage of woodchips and production of mechanical pulp are the most notable points of emissions. Paper machines, production of chemical pulp and effluent treatment are minor emission sources. VOC compounds released from pulp and paper mills consist mainly of methanol and terpenes. The annual total release of VOC from pulp and paper mills in Finland is estimated to be around 30 000 t/a.

Harmful effects of VOC emissions are based on their reactions with atmospheric NO_x compounds in the presence of solar radiation (UV), which produces ozone in the troposphere. Another problem sometimes connected with VOC emissions from industrial plants is odours, which, however, is relevant only in a very limited number of mills. In the Nordic Countries the net ozone production rates are typically low because the main driving forces of the ozone production - anthropogenic NO_x emissions and noontime solar radiation intensity - are low. The most significant source of tropospheric ozone is the long-distance pollution drift from Central-Europe. Local ozone production rates are significant only in the summer months in densely populated areas with heavy traffic. However, pulp and paper mills in Finland, Sweden and Norway are mostly located in sparsely populated areas, where traffic is limited and the amount of NO_x compounds low.

Due to geographical reasons and considering the biogenic origins of the emissions, releases of VOC from pulp and paper mills cannot be considered as a general environmental problem. This is especially true for the Nordic countries. In Central Europe the location of the mills, amount of NO_x emissions and amount of solar radiation differs considerably and may therefore require a different approach. However, there is no justification for any general EU BAT regulation for the abatement of VOC emissions from the pulp and paper making processes. Any decisions on the handling of VOC emissions should be made individually for each mill taking into consideration local conditions, and can therefore be handled most efficiently in national environmental permitting processes.

Message: Based on the information on both Finnish and international mills, it seems that not all the BAT ranges are on same level of stringency. In mechanical pulp based papers both TSS and COD seem to be stricter. In addition, the energy consumption figures should be updated. Due to geographical reasons and considering the biogenic origins of the emissions, releases of VOC from pulp and paper mills cannot be considered as a general environmental problem – at least not in all geographic regions.

5.3

Cases on emissions and techniques

In mill comparisons, there are vast amounts of possible combinations of techniques and emission profiles. However, the combinations can be simplified into four cases:

1. *Similar technology, similar emissions* Mills with the same or similar technology profiles have the same or similar emission value profiles

2. *Similar technology, different emissions*. Mills with the same or similar technology profiles have different emission value profiles (described in the following Case 1)
3. *Different technology, same emissions*. Mills have different technology profiles but the same or similar emission value profiles (described in the following Case 2)
4. *Different technology and different emissions*. Mills have different technology profiles and different emission values profiles

If it were the case that emission levels are solely determined by the list of technology at the mill, one would only have mills in case categories 1 and 4: if mills have similar technology profiles, they have the same emissions, otherwise there is a difference. As has been stated before, this is of course not true. In practice, the most interesting cases are bullet points 2 and 3 or quadrants "Case 1" and "Case 2" in the Figure 5-5, which demonstrate the broken link between technology and emissions. Case 3 shows the possible difference between absolute and net emissions.

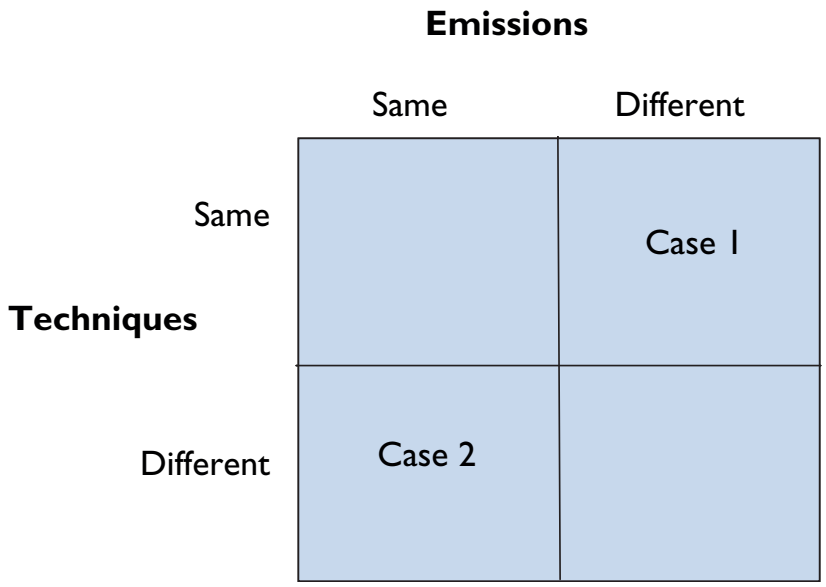


Figure 5-5
Techniques and emissions. Two example cases are shown according to the Case 1 and Case 2 described in the following paragraphs.

Case 1 - Same or similar technology profiles but different emission values

In this case, two Finnish mills were chosen to demonstrate the fact that mills can have the same BAT techniques installed and yet be different in terms of their environmental performance (Figure 5-5, Figure 5-6). The selected mills both have 100 % of the available BAT techniques, whereas, in general, the BAT utilisation rate varies between 90-100 % in the Finnish integrated kraft pulp mills with an average of 95 %. Both mills are relatively large, modern mills, with Mill 2 having a production capacity about 30 % smaller than Mill 1.

As shown in Figure 5-6, the emission values for the two mills are different, as mill 1 has notably lower emissions than mill 2. As background information for the case comparison, overall minimum and maximum values for the entire Finnish kraft pulp production are shown in Figure 5-7 together with the BAT ranges.

Case 2 - Different technology profiles but same or similar emissions values

In this case, three Finnish integrated mills were chosen to show that mills with different technology profiles can have relatively similar values for some emissions (Figure 5-5). Mill 1 has installed 85 % of the available BAT techniques, while the same figure for Mill 2 is 70 %. In general, the BAT utilisation rate varies between 70 % and 85 % in the Finnish integrated wood containing printing paper mills, with a national average of 70 %. The production capacity of the mills studied here varies between 500 000 and 700 000 t/a, Mill 2 having the lowest and Mill 1 the highest production figure.

As shown in Figure 5-7, the emission values for the three mills are relatively similar, when compared to the overall minimum and maximum values for the Finnish mechanical pulp based paper industry, also shown in the same figure together with the BAT ranges.

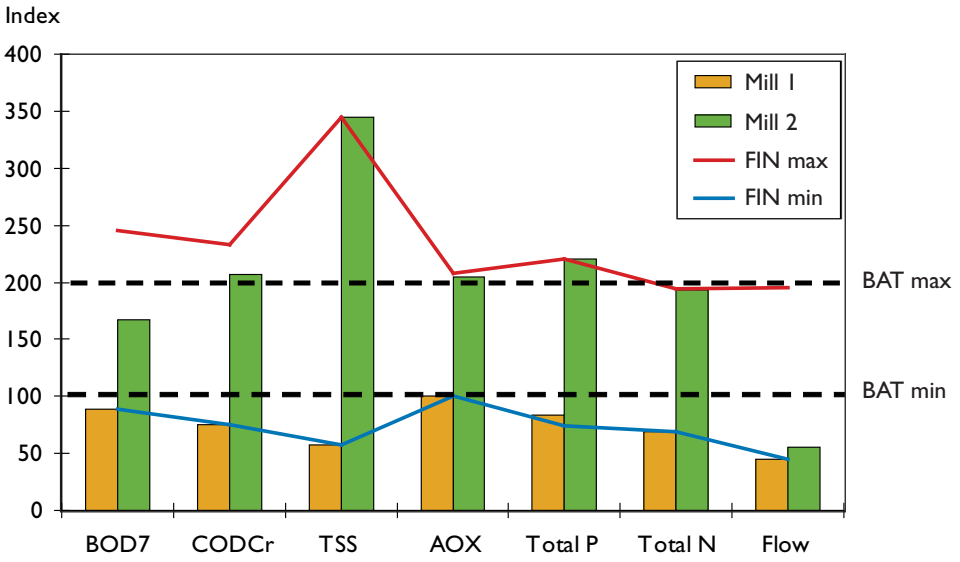


Figure 5-6
Same or similar technology profiles but different emissions for the two example mill cases

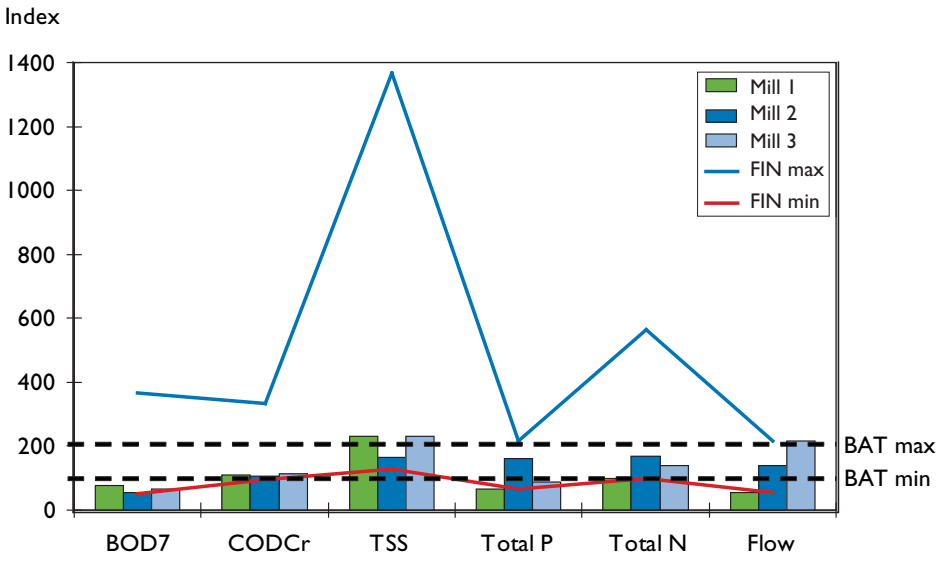


Figure 5-7
Different technology profiles but same or similar emissions for the two example mill cases

Message: Case 1 and Case 2 further demonstrate the well-known truth that BAT techniques and BAT emission values do not necessarily go together.

Case 3 – The significance of initial conditions: Net emissions shown using one Finnish mill as a case

In medicine, the phenomenon of one substance masking another in e.g. blood tests is familiar. For mills, an analogous phenomenon occurs when e.g. the initial quality of the raw water taken in masks or distorts the actual emissions caused by the mill. The impact: absolute emissions values can be much higher than the net figures. This is illustrated using one Finnish mill as a case (Figure 5-8). In calculating the net emissions values, the quality of the raw water used has been taken into account. If we standardise all emissions to 100, and show the net emissions in relation to this index, a completely different net, "true" emission profile appears. As can be seen, the net emissions are in most cases notably lower – and furthermore, the changes vary greatly, from 8 % to 50 % (Figure 5-8). The difference between absolute and net emissions should be taken into account when considering emission limits of mills where the initial quality of for example the raw water intake is an issue.

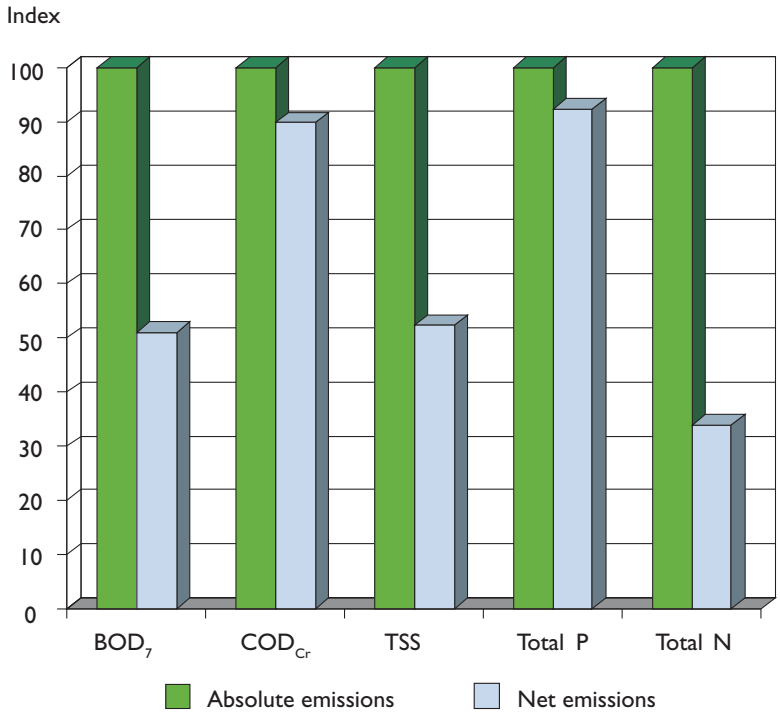


Figure 5-8
Absolute vs. net emissions shown using one Finnish mill as a case

Message: In cases where a mill's initial intake of e.g. raw water contains significant pollution, the emphasis should be on net emissions.

6 Conclusions

The EU BREF apparatus is heavy machinery: it takes a long and heavy process to produce a BREF, and the series of BREF revisions is a long and heavy process by itself.

The first attempt is always the first attempt: errors occur, and things can be improved. Continuous improvement is in this case about making the BREF more informative, free of errors, consistent, usable and readable. It is in this constructive spirit that this Finnish contribution to the second exchange of information defined in the Council Directive 96/61/EC concerning Integrated Pollution Prevention and Control, article 16, and to the preparation of the second Reference Document of the European Commission on Best Available Techniques in the Pulp and Paper Industry is given.

With a genuine desire for understanding the paper industry, and a genuine desire to make the BREF a fair and informed document, the paper industry's progress in environmental issues will be matched by the BREF's progress in becoming a key, reliable item for information about the industry.

ABBREVIATIONS

a	annum; year. For design purposes, 350 operating days/a are estimated for the mill
ADt	air dry ton of pulp; pulp at 90 % dryness
AOX	adsorbable organic halogen; adsorbable halogenated organic compounds Organic halogens expresses the amount of organic chlorine compounds in waste water
BOD	biochemical oxygen demand (5 or 7 days)
COD	chemical oxygen demand
CTMP	chemi-thermomechanical pulp
kg	kilogram
LWC	light weight coated (paper grade)
m^3	cubic metres
MFC	light weight coated matt paper
N	nitrogen
NO_x	notation for a combination of nitrogen oxides formed in combustion units; usually measured as NO_2 (nitrogen dioxide)
P	phosphor
SO_2	sulphur dioxide (gas)
TSS	total suspended solids (in effluent water)

SOURCES

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DOCUMENTATION PAGE

<table>
<tr><td>Publisher</td><td colspan="3">Finnish Environment Institute (SYKE)</td><td>Date
March 2007</td></tr>
<tr><td>Author(s)</td><td colspan="4">Pia Nilsson, Karina Puurunen, Petri Vasara and Timo Jouttijärvi</td></tr>
<tr><td>Title of publication</td><td colspan="4">Continuum - Rethinking BAT Emissions of the Pulp and Paper Industry in the European Union</td></tr>
<tr><td>Publication series and number</td><td colspan="4">The Finnish Environment 12/2007</td></tr>
<tr><td>Theme of publication</td><td colspan="4">Environmental protection</td></tr>
<tr><td>Parts of publication/ other project publications</td><td colspan="4">The publication is only available on the internet: www. environment.fi/publications</td></tr>
<tr><td>Abstract</td><td colspan="4">This report is the Finnish contribution to the second exchange of information defined in the Council Directive 96/61/EC and to the preparation of the second Reference Document of the European Commission on Best Available Techniques in the Pulp and Paper Industry (BREF). The report is the work of Pöyry Forest Industry Consulting Oy on behalf of the Finnish Forest Industries Federation and Finnish Environment Institute.

In this report, a series of suggestions for improvements to the BREF are given. The suggestions are shored up with reasoning and examples behind them. Among key messages in this document we find:
• Uphold and emphasise the key principles of the BAT BREF, and increase the readability of the BREF.
• The need for ensuring smooth running and minimising accidental releases should be emphasised in the BREF. One way to ensure smoother running is to use simpler processes.
• Cross-media effects should be further emphasised in the BREF. Lack of cross-media information and integrated views in decision making can result in wrong measures taken.
• The chapters dealing with new techniques could be improved by reshaping them into a readable, clear and concise analysis of the current technology trends and selected techniques, not forgetting key principles of the BREF.
• Based on information on both Finnish and international mills, it seems that not all the BAT ranges are on same level of stringency. In addition, BAT techniques do not necessarily go hand in hand with BAT emissions levels.

It is recommended that this report is read together with the first pulp and paper BREF.</td></tr>
<tr><td>Keywords</td><td colspan="4">BAT, reference document, BREF, IPPC, pulp and paper industry</td></tr>
<tr><td>Financier/ commissioner</td><td colspan="4"></td></tr>
<tr><td rowspan="2"></td><td>ISBN
(pbk.)</td><td>ISBN
978-952-11-2642-0 (PDF)</td><td>ISSN
(print)</td><td>ISSN
1796-1637 (online)</td></tr>
<tr><td>No. of pages
41</td><td>Language
English</td><td>Restrictions
Public</td><td>Price (incl. tax 8 %)
-</td></tr>
<tr><td>For sale at/ distributor</td><td colspan="4"></td></tr>
<tr><td>Financier of publication</td><td colspan="4">Finnish Environment Institute, P.O. Box 140, FIN-00251 Helsinki, Finland</td></tr>
<tr><td>Printing place and year</td><td colspan="4"></td></tr>
</table>

KUVAILULEHTI

<table>
<tr><td>Julkaisija</td><td colspan="3">Suomen ympäristökeskus (SYKE)</td><td>Julkaisuaika
Maaliskuu 2007</td></tr>
<tr><td>Tekijä(t)</td><td colspan="4">Pia Nilsson, Karina Puurunen, Petri Vasara ja Timo Jouttijärvi</td></tr>
<tr><td>Julkaisun nimi</td><td colspan="4">Continuum - Rethinking BAT Emissions of the Pulp and Paper Industry in the European Union

(Continuum - Euroopan Unionin massa- ja paperiteollisuuden BAT-päästöjen uudelleenarviointi)</td></tr>
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<tr><td>Julkaisun osat/ muut saman projektin tuottamat julkaisut</td><td colspan="4">Julkaisu on saatavana vain internetistä: www.environment.fi/publications</td></tr>
<tr><td>Tiivistelmä</td><td colspan="4">Tämä raportti on osa suomalaisten panosta Direktiivin 96/61/EC edellyttämään tiedonvaihtoon sekä Euroopan Komission järjestyksessään toisen massa- ja paperiteollisuuden referenssidokumentin (BREF) valmisteluun. Pöyry Forest Industry Consulting on tehnyt tämän raportin yhteistyössä Metsäteollisuus ry:n ja Suomen Ympäristökeskuksen kanssa.

Raportti puuttuu ensimmäisen BREF:in ongelmiin ja käy läpi joukon parannusehdotuksia uutta versiota varten. Ehdotukset on perusteltu joukolla käytännön esimerkkejä. Raportin pääviestejä ovat mm.:
• BREF:in pääperiaatteita tulisi noudattaa ja korostaa läpi koko dokumentin ja sen luettavuutta tulisi lisätä.
• Prosessien tasaista ajoa ja satunnaispäästöjen minimointia tulisi painottaa BREF:issä. Tasainen ajo on helpompi saada aikaan yksinkertaisemmilla prosesseilla.
• Ympäristötoimenpiteiden mahdollisia ristikkäisvaikutuksia eri medioihin tulisi myös korostaa BREF:issä. Tiedonpuute näistä vaikutuksista sekä kokonaisnäkemyksen puute päätöksenteossa voivat johtaa vääriin toimenpiteisiin.
• Ensimmäisen BREF- dokumentin kappaleet jotka käsittelevät uusia tekniikoita tulisi muuttaa. Esityksessä tulisi keskittyä nykyisten teknologiatrendien analyysiin sekä mahdollisesti nostaa esiin tiettyjä avaintekniikoita. Näin kappaleet olisivat helppolukuisia, selkeitä ja linjassa BREF:in avainperiaatteiden kanssa.
• BREF:issä esitetyt BAT-tasot eivät kohtele kaikkia massa- ja paperilajeja yhdenmukaisesti. Tämä on nähtävissä kun BAT-tasoja verrataan suomalaisten ja ulkomaisten tehtaiden päästöihin. Lisäksi tulisi muistaa, että BAT-tekniikoiden käyttö ei välttämättä johda BAT-tasojen saavuttamiseen – on myös osattava ajaa kokonaisuutta.

Tätä raporttia tulisi lukea rinnan ensimmäisen massa- ja paperiteollisuuden BREF-dokumentin kanssa maksimaalisen hyödyn saavuttamiseksi.</td></tr>
<tr><td>Asiasanat</td><td colspan="4">BAT, vertailuasiakirja, BREF, IPPC, massa- ja paperiteollisuus</td></tr>
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<tr><td rowspan="2"></td><td>ISBN
(nid.)</td><td>ISBN
978-952-11-2642-0 (PDF)</td><td>ISSN
(pain.)</td><td>ISSN
1796-1637 (verkkoj.)</td></tr>
<tr><td>Sivuja
41</td><td>Kieli
englanti</td><td>Luottamuksellisuus
julkinen</td><td>Hinta (sis.alv 8 %)</td></tr>
<tr><td>Julkaisun myynti/ jakaja</td><td colspan="4"></td></tr>
<tr><td>Julkaisun kustantaja</td><td colspan="4">Suomen ympäristökeskus, PL 140, 00251 Helsinki</td></tr>
<tr><td>Painopaikka ja -aika</td><td colspan="4"></td></tr>
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PRESENTATIONSBLAD

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<tr><td>Utgivare</td><td colspan="3">Finlands miljöcentral (SYKE)</td><td>Datum
Mars 2007</td></tr>
<tr><td>Författare</td><td colspan="4">Pia Nilsson, Karina Puurunen, Petri Vasara och Timo Jouttijärvi</td></tr>
<tr><td>Publikationens titel</td><td colspan="4">Continuum - Rethinking BAT Emissions of the Pulp and Paper Industry in the European Union

(Continuum - Omvärdering av Europeiska unionens massa- och pappersindustrins BAT emissioner)</td></tr>
<tr><td>Publikationsserie och nummer</td><td colspan="4">Miljön i Finland 12/2007</td></tr>
<tr><td>Publikationens tema</td><td colspan="4">Miljövård</td></tr>
<tr><td>Publikationens delar/ andra publikationer inom samma projekt</td><td colspan="4">Publikationen finns tillgänglig endast på internet: www.environment.fi/publications</td></tr>
<tr><td>Sammandrag</td><td colspan="4">Denna rapport utgör en del av det finländska bidraget till det informationsutbyte som stadgas i kommissionens Direktiv 96/61/EC samt förberedelsen av Kommissionens andra referensdokument gällande ”bästa tillgängliga teknik” inom massa- och pappersindustrin (BREF). Rapporten är gjord av Pöyry Forest Industry Consulting Oy i samarbete med Metsäteollisuus r.y. samt Finlands Miljöcentral.

Rapporten innehåller förbättringsförslag till det nuvarande BREF-dokumentet. Dessa förslag stöds av logik, förklaringar och konkreta exempel. Bland centrala slutsatser i rapporten kan nämnas:
• Huvudprinciperna för hela BAT BREF-arbetet borde klarare framhävas genom hela dokumentet – som därtill borde göras avsevärt mera lättläst.
• Nödvändigheten och nyttan av att köra processerna så jämnt som möjligt och av att minska diffusa utsläpp bör betonas i BREF-dokumentet. En jämn körning av processer uppnås lättast genom förenklade processer.
• BREF-dokumentet borde i större utsträckning ta fasta på olikriktade effekter (d.v.s”cross-media”-effekter). Bristfällig information om dessa effekter samt brist på helhetssyn i beslutsfattande kan leda till felaktiga åtgärder.
• De kapitel som innehåller information om nya teknologier kunde förbättras genom att förvandla dem till en lättläst, klar och koncis analys över teknologitrender och utvalda tekniker. Allt detta bör naturligtvis ske inom ramen för de fastslagna BAT BREF-principerna.
• Det är uppenbart att alla BAT-nivåer inte är jämlika. En jämförelse med material från finländska och internationella fabriker och deras utsläpp ger starkt stöd för detta utlåtande. Därtill bör man komma ihåg följande tumregel: att uppnå BAT-nivåer är inte en automatisk följd av att ha BAT-utrustning. Man måste också behärska sin process.

Denna rapport har maximal nytta för läsaren om den avnjuts parallellt med det första BREF-dokumentet.</td></tr>
<tr><td>Nyckelord</td><td colspan="4">BAT, referensdokument, BREF, IPPC, massa- och pappersindustri</td></tr>
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<tr><td rowspan="2"></td><td>ISBN
(hft.)</td><td>ISBN
978-952-11-2642-0 (PDF)</td><td>ISSN
(print)</td><td>ISSN
1796-1637 (online)</td></tr>
<tr><td>Sidantal
41</td><td>Språk
Engelska</td><td>Offentlighet
Offentlig</td><td>Pris (inneh. moms 8 %)</td></tr>
<tr><td>Beställningar/ distribution</td><td colspan="4"></td></tr>
<tr><td>Förläggare</td><td colspan="4">Finlands miljöcentral, PB 140, FIN-00251 Helsingfors, Finland</td></tr>
<tr><td>Tryckeri/tryckningsort och -år</td><td colspan="4"></td></tr>
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SYKE

ISBN 978-952-11-2642-0 (PDF)
ISSN 1796-1637 (online)

CONTINUUM - RETHINKING BAT EMISSIONS OF THE PULP AND PAPER INDUSTRY IN THE EUROPEAN UNION

THE FINNISH ENVIRONMENT 12 | 2007