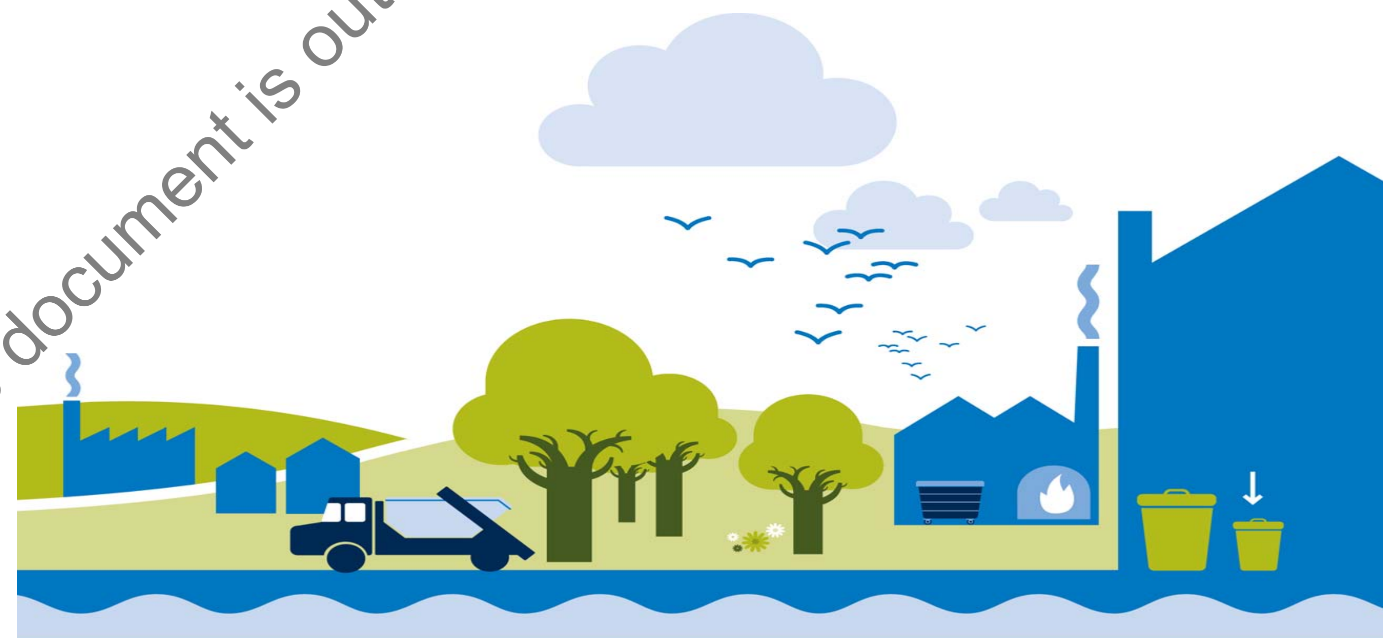
How to comply with your environmental permit
Additional guidance for:

Paper and Pulp (EPR 6.01)



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Introduction

In *"Getting the basics right – how to comply with your environmental permit"* (GTBR) we described the standards and measures that we expect businesses to take in order to control the risk of pollution from the most frequent situations in the waste management and process industries.

This sector guidance note (SGN) is one of a series of additional guidance for Part A(1) activities listed in Schedule 1 of the Environmental Permitting Regulations (the Regulations). We expect you to use the standards and measures in this note **in addition** to those in GTBR to meet the objectives in your permit.

Sometimes, particularly difficult issues arise such as problems with odour or noise. You may then need to consult the "horizontal" guidance that gives in depth information on particular topics. Annex 1 of GTBR lists these.

The IPPC Directive requires that the Best Available Techniques (BAT) are used. When making an application, explain how you will comply with each of the indicative BATs in this sector guidance note. Where indicative BAT is not included, where you propose to use an alternative measure or where there is a choice of options you should explain your choice on the basis of costs and benefits. Part 2 of Horizontal Guidance Note H1 Environmental Risk Assessment (see GTBR Annex 1) gives a formal method of assessing options which you should use where major decisions are to be made.

We will consider the relevance and relative importance of the information to the installation concerned when making technical judgments about the installation and when setting conditions in the permit.

Modern permits describe the objectives (or outcomes) that we want you to achieve. They do not normally tell you how to achieve them. They give you a degree of flexibility.

Where a condition requires you to take appropriate measures to secure a particular objective, we will expect you to use, at least, the measures described which are appropriate for meeting the objective. You may have described the measures you propose in your application or in a relevant management plan but further measures will be necessary if the objectives are not met.

The measures set out in this note may not all be appropriate for a particular circumstance and you may implement equivalent measures that achieve the

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same objective. In cases where the measures are mandatory this is stated.

In response to the application form question on Operating Techniques, you should address each of the measures described as indicative BAT in this note as well as the key issues identified in GTBR.

Unless otherwise specified, the measures and benchmarks described in this note reflect those of the previous Sector Guidance Note. They will be reviewed in the light of future BREF note revisions. In the meantime we will take account of advances in BAT when considering any changes to your process.

Installations covered

This note applies to activities regulated under the following section of schedule 1 of the Regulations:

Section 6.1, Part A(1) Pulp and Paper Manufacturing Activities:

a) Producing, in industrial plant, pulp from timber or other fibrous materials.
b) Producing, in industrial plant, paper and board where the plant has a production capacity of more than 20 tonnes per day.
c) Any activity associated with the making paper pulp or paper, including activities connected with the recycling of paper such as de-inking, if the activity may result in the release into water of any substance described in paragraph 7 of Part 1 in a quantity which, in any 12 month period, is greater than the background quantity by more than the amount specified in that paragraph in relation to that substance.

In paragraph c), 'paper pulp' includes pulp made from wood, grass, straw and similar materials and references to the making of paper are to the making of any product using paper pulp.

Directly Associated Activities

As well as the main activities described above, the installation will also include directly associated activities which have a direct technical connection with the main activities and which may have an effect on emissions and pollution. These may involve activities such as:

- storage and handling of raw materials
- water abstraction and treatment plant
- debarking and chipping
- pulping or repulping
- de-inking
- washing
- bleaching
- stock preparation
- papermaking
- reeling and cutting
- storage and despatch of finished products, waste and other materials

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- the control and abatement systems for emissions to all media
- on and off machine coating plants;
- the power plant
- a waste to energy plant
- waste handling and recycling facilities.

Key issues

The key issues are:

Accident prevention and control

Apart from the normal process and spillage risks, older sites may have poor drainage systems that will need attention.

Process selection and raw materials

As far as practicable, you should use the least harmful metals and chemicals. You should also use techniques that aim for near-zero emissions to water and the minimum amount of waste.

Bleaching

A major problem has been the use of chlorine compounds in bleaching. This affects both the pulp mills and the paper mills that use their pulp. This is now much reduced by the use of ECF and TCF pulp and you must have a strong justification for using chlorine-bleached pulps.

Minimising the use of water

Water use is a major issue, not only from the point of view of water conservation, since actual loss to the environment is low, but from the knock-on effects of high water use in terms of increased emissions. A large mill with the best conventional Effluent Treatment Plant (ETP) may still release 2-5 tonnes/day of largely unidentified substances with poor biodegradability (COD) into the watercourse.

Emissions to sewer and controlled waters

Most mills discharge via either their own or a municipal treatment works. In either case, confirmation that the more persistent substances are broken down remains an issue, as does the minimisation of BOD. Significant detail is required in assessing rinsing and metal recovery systems used within the installation and you should provide a full justification for current techniques and planned improvements based on the use of Best Available Techniques (BAT). Note also that you should take care to prevent or minimise the release of persistent organic substances that may be present in some of the materials or chemicals you use.

Releases associated with energy use

The industry is a major energy user. There remain significant opportunities for reduction of emissions caused by energy use and choice of energy source (CO2, SO*x*, NO*x*, etc. contributing in particular to global warming and acidification). You may enter into a Climate Change Levy Agreement with the Government.

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Noise

There are major noise sources on pulp and paper mills that should be addressed.

Monitoring

The residual organic constituents of the effluent are generally not known in detail, so it is hard to monitor. Analysis of the constituents of the effluent will be a key issue and you will need to consider direct toxicity testing.

Solid waste recovery, recycling and disposal

Sludge to land is a major issue. The Agencies' policy on this is reflected in this document. An assessment of the options for the recovery or disposal of fibre and filler from sludge is likely to be needed. You should also carry out an assessment of the recovery of fibre within the process.

Site restoration

Many paper mills will have been operating on the same site for many years. There may well be ground contamination that could be confused with potential future contamination from the activities. In such cases you will need to assess the degree of contamination as a baseline for future operations.

1

Managing your activities

Energy efficiency

1. Managing your activities

1.1 Energy efficiency

Indicative BAT

You should use the following where appropriate:

1. Partial heat recovery from the hot humid air leaving the machine drying section.
2. Press section designs (e.g. better materials, higher pressures and extended press nips) to maximise water removal from the web and thereby reduce drying energy requirements.
3. Heat recovery from refiners in mechanical pulping plants.
4. High efficiency mechanical de-watering at all stages particularly before pulp and paper drying.
5. Minimisation of water use and closed circulating water systems.
6. Plant layout to reduce pumping distances.
7. Phase optimisation of electronic control motors.
8. Make use of spent cooling water (which is raised in temperature) in order to recover the heat.
9. Belt conveying instead of pneumatic.
10. Optimised efficiency measures for combustion plant e.g. air/feedwater preheating or excess air.
11. For mills based on non-de-inked recycled fibre, particularly liner and fluting mills, optimize stock preparation plant in terms of:
    - fractionation prior to disperging (and possible refining) of the long fibre fraction
    - improved cleaning to remove particulate contaminants
    - washing to remove dissolved materials.
12. For chemical pulping use:
    - continuous pulping instead of batch
    - indirect rather than direct evaporator heating
    - increased liquor strength to the furnace
    - high-consistency pulp washing
    - converting batch processes to cold blow systems
    - high-consistency bleaching and washing.

Efficient use of raw materials and water

1.2 Efficient use of raw materials and water

In many applications the best conventional effluent treatment produces a good water quality that may be usable in the process directly or in a mixture with fresh water.

Indicative BAT

You should where appropriate:

1. Carry out dry debarking.
2. Fresh water should not be used for dry debarking or for make-up where wet debarking is still used and the water should be recycled.
3. Only use fresh water for:
   - dilution of chemicals (some such as fillers can be diluted with clarified water)
   - vacuum pump sealing (this can be much reduced or even eliminated)
   - to make up for evaporative losses (this can be reduced by heat recovery on the machine)
   - high pressure showers
   - wire section - the HP wire cleaning shower, the couch suction box, trimming and headbox
   - press section - felt conditioning, lubricating showers for felt and press roll and suction boxes.
4. Separate cooling waters from contaminated process waters and re-use, possibly after some form of treatment, e.g. re-cooling and screening.
5. Control accidental discharges particularly on web breaks by:
   - designing the broke and backwater tanks with sufficient capacity for such events
   - computer control of the system which takes into account the levels not only of the whitewater tower but also the broke and pulp towers
   - broke and whitewater systems which are separate for each machine.
6. For integrated papermaking, maximise water recirculation. Recycling is enhanced by maintaining or improving the quality of the clarified and unclarified whitewater to enable it to be used in as many places as possible.
7. Maximise unclarified whitewater recycling by the following techniques where possible:
   - use unclarified whitewater from the paper machine for broke re-pulping and bleaching
   - use water from the bleaching stage and further unclarified whitewater for dilution of fibres in the pulping stages

Efficient use of raw materials and water

- use white water from dry suction boxes, shower trays, press section or vacuum pump pit, (i.e. low fibre positions) on the subsequent low pressure showers following a fibre guard (e.g. a bow screen) to filter out long fibres or felt hairs
- ensure adequate whitewater storage capacity in order to preclude use of fresh water for process make-up
- use techniques to prevent deterioration in water quality on storage.

8. Maximise the recycling of clarified whitewater by the following techniques where possible:
   - generate clarified whitewater (as well as recovering fibre) by filtration of the whitewater in a save-all or equivalent device. Available techniques include membrane technology (typically ultrafiltration), precoated disc filter conditioned with raw pulp, other disc or drum filters, flotation devices or sedimentation
   - provide save-alls on each machine or on a multi-ply machine, each ply may have its own water system with its own save-all
   - in de-inking/bleaching produce clarified water internally by flotation; remove colour from fibre substantive dyes by a simple save-all, but if there are a lot of coloured fines then consider DAF or membrane technology.
9. Prevent inhibiting factors by:
   - careful selection of materials to minimise the introduction of interfering materials that will otherwise build up on water closure
   - selecting papermaking chemicals for optimal operation under closed conditions
   - taking all reasonable steps to control the build-up of temperature and substances that could limit the degree of water closure achievable
   - including features such as smooth surfaces, sufficient flow velocities, larger nozzles, synthetic wires and felts and optimum storage volumes, in process design
   - making use of chemicals such as chelants to complex metal ions, dispersing agents and retention aids where appropriate
   - considering microbiological control by biocides, increased temperatures (>45°C) and adding air at critical positions to prevent anaerobic conditions and adding barium salts to bind sulphate ions where these conditions are limiting closure.

Avoidance, recovery and disposal of wastes

1.3 Avoidance, recovery and disposal of wastes

Indicative BAT

You should where appropriate:

1. Consider all avenues for bark and sawdust recovery such as composting, ground cover or animal bedding (sawdust).
2. Consider all avenues for recovery of fibre and filler from de-inking and wastewater treatment such as:
   - use in insulating building blocks
   - recycling within the process or, at least, within the industry, to a wastepaper machine
   - filler recovery (directly from sludge or from waste-to-energy ash)
   - other commercial uses (effective fillers for plastics and rubber products, high-performance, drilling muds for the oil industry, industrial adsorbents (from sludge or ash), and a particular absorbent able selectively to absorb oil from contaminated water)
   - landspreading where it represents a genuine agricultural benefit or ecological improvement and the ultimate fate of pollutants present pose no environmental harm.
3. Where energy recovery is the chosen option for bark or sludge (where the fibre:filler ratio is high):
   - the sludge should be dewatered to the greatest practicable extent to maximize heating value for example by airless dryers or screw presses followed by heating utilizing waste process heat
   - residual ash from the energy recovery boiler should also be re-used
   - the plant should meet the standards in the appropriate combustion guidance.
4. Where energy recovery is not appropriate you should:
   - assess the amount of wastes generated by nearby mills or other industrial/commercial enterprises and consider the possibility for a central, collective incineration plant
   - consider energy recovery via an off-site plant such as a cement kiln.
5. Where landfill is the only option, pre-treatment may be necessary to dewater waste particularly when high in fillers.

2 Operations

2.1 Raw material selection
2.2 Preparing fibre
2.3 Pulping
2.4 Bleaching
2.5 Papermaking
2.6 Coating

Raw material selection

2. Operations

2.1 Raw material selection

A proportion of virtually all of the raw materials and chemicals used will end up as a waste or in the final effluent, even if much reduced by treatment. Because of the wide variety of chemicals used there will always be a risk of harmful effects that may not be expected or immediately apparent. A good example of this has been where the combination of resin acids from some UK paper mills, in specific combination with petroleum products from other industries, has led to pigmented salmon syndrome.

The key areas of control are:

- control of point source emissions to water
- minimizing the environmental impact of fugitive releases to air and water
- minimizing the environmental impact of wastes produced
- minimizing the use of raw materials with adverse environmental impact.

Indicative BAT

You should as appropriate:

1. Only use chemicals with high biodegradability and known degradation products (e.g. guanidine and isothiazolones used as biocides).
2. Only use "low mercury" NaOH.
3. Consider the contribution of pulps to other significant environmental aspects, such as wastewater COD or toxicity.
4. Consider the content and routing of harmful substances from recovered paper (e.g. cadmium and other heavy metals and PCP).
5. Only use ECF or TCF grades of pulp.
6. Select wet strength agent resins with the lowest practicable contents of free formaldehyde (available at <0.5%) and chlorinated organic byproducts, notably dichloropropanol
7. Use the most retentive type of optical brighteners, preferably added at the size press.
8. Avoid alkylphenolethoxylates .
9. Ensure that elemental chlorine is not used.
10. Use DTPA as a chelant in preference to EDTA or NTA because of its superior degradability.
11. Replace coatings using organic solvents wherever possible with aqueous versions.

Raw material selection
Preparing fibre

12.	Ensure that timber, wood chips, hemp etc. have not been sprayed with harmful substances, e.g. lindane and pentachlorophenol (PCP).
13.	Avoid the use of chlorine-bleached pulps or chlorine-containing bleaches other than in the short term when you should consider the impact of chlorinated organics (particularly dioxins/furans and the higher chlorinated phenolics, e.g. PCP).
14.	Where compatible with the paper specification, use calcium carbonate in preference to clay; this should maximize retention and minimize wastewater residues.
15.	Minimize the use of fresh water disinfectants and for high organic loads use ClO_2 or equivalent instead of halogenated disinfectants.
16.	Only use dyes with solid pigments where they can be abated by clarification.

2.2 Preparing fibre

Preparing virgin fibre - debarking

Debarking is carried out by the mechanical action between logs in a rotating drum and can be either wet with added water or dry. The wastewater is usually clarified and recycled and the bark is removed for either disposal or energy recovery – in the wet process the bark has to be dewatered before burning to recover energy. The issues relate primarily to recycling of water, control of final effluent discharges and the recovery and use of large quantities of waste bark. There are also potential problems with dust and odour from the log and bark stores and potentially from surface water run-off from the log and bark stores containing pesticides

The main control measures are:

- the use of water efficiency techniques
- control of fugitive releases to air from bark storage
- control of surface water run-off with potential pesticide contamination
- control of point source emissions to water
- control of localized odour from fugitive releases to air from bark storage
- recovery of wastes produced
- clarification and recycling of water.

Indicative BAT

1. Bark is a significant waste arising and should be recovered for example by burning to recover energy.

Preparing fibre

Preparing virgin fibre - chipping

Before pressurised refining or chemical pulping the logs are chipped and washed. The primary issue relates to noise from the chipping operation and there is a more minor risk of duct and localised odour from outdoor stores and run-off of resin acids from stores.

The main control measures are:

- control of fugitive emissions to air
- control of noise
- control of surface water run-off

Indicative BAT

You should where appropriate:

1. Evaluate potential for surface water runoff of resin acids from the stores, and control as necessary.

Preparing recovered fibre - including de-inking

Wastepaper or packaging (depending on the required product) is re-pulped in a hydropulper, followed by stages of mechanical cleaning and de-inking. Typically fibre is de-inked for newsprint and printings/writings but not for packaging. The quality of the waste used for tissue (waste printings/writings) means that it too can sometimes be used without de-inking.

De-inking is a chemi-mechanical process for removing ink and other materials. The mechanisms are removal (e.g. of stickies, ink, filler, dyes in screens, flotation cells and bleaching), change of physical characteristics of the materials (e.g. disperging disperses remaining ink particles) and change of chemistry (e.g. reductive bleaching of lignin/dyes).

Two basic approaches are taken:

- **Wash de-inking** involves diluting the waste paper suspension and dispersing the inks, by chemical or mechanical means, so they are removed with the water phase after dewatering. Chemicals used are surfactants such as alkylphenolethoxylate. Washing is effective at removing smaller ink particles (less than 10µm).
- **Flotation de-inking** typically uses fatty acid soaps with calcium, or synthetic alternatives, to bind to the ink, and allow it to be floated off as a scum. This is effective with the larger particles (greater than 50 µm). In some cases a combination of techniques has been used although the flotation techniques are most common in UK de-inking plants.

Preparing fibre
Pulping

Large quantities of water are used in de-inking, but are largely recycled in a thickener followed by further cleaning and washing and a disperging stage to avoid any visible spots. Water is supplied from the papermaking machine to the later de-inking stages and then recycled, countercurrent, through the stages. Water from an integrated system would leave the circuit with the scum from the flotation cell and with the cleanings/screenings, i.e. from the dirtiest parts of the circuit. The remainder of the water passes forward again, with the pulp, to the paper machine.

The de-inked wastewaters have high concentrations of BOD/COD and contaminants and will require treatment. The sludge from de-inking contains mainly fibre and filler and may also contain heavy metals from the inks and dyes and organics and trace organics such as PCBs and PCP. The sludges are usually handled along with wastewater treatment sludges and the large quantity of sludge make on-site energy recovery a viable option.

The key areas of control are:

- control of fugitive releases to air of dust and loose paper
- control of point source emissions to water
- control of localized odour from fugitive releases to air from starch in warm effluent
- recovery and disposal of wastes produced
- water efficiency issues
- There are significant wastewater loads with elevated COD/BOD and the potential presence of organics and trace organics requiring treatment before discharge
- There is a large quantity of sludge from de-inking, separated trash and potentially metals from the inks requiring treatment before disposal.

2.3 Pulping

Mechanical pulping

Mechanical pulps are used to make wood-containing papers (newsprint and light-weight coated [LWC] papers) and wood-containing boards (folding boxboard). The process separates the individual fibre bundles by applied physical force aided by the elevated pressure and temperature achieved naturally or by the addition of steam. There are two types of mechanical pulping process:

- groundwood processes in which the logs are pressed against a large rotating grindstone
- refiner processes in which chips are forced against barred rotating discs.

Pulping

Indicative BAT

You should where appropriate:

1. Minimise the small quantities of unseparated fibres (which are usually recycled for further pulping) through optimisation of pulp screening and cleaning operations.
2. Use alkaline peroxide process rather than neutral/alkaline sulphite in order to minimise emissions of SO_2.
3. Abate the VOC and steam plume from the refiners.
4. Control wood-derived aquatic toxicity by minimising water use and abate by biological treatment of the wastewater.
5. Control other soluble materials in the wastewater (e.g. COD/colour from lignins and BOD/COD from hemi-cellulose) by minimising water use.

Chemical pulping

The fibres are broken down chemically in pressure vessels, called digesters, which are heated, traditionally spherical, pressure vessels, usually arranged to rotate to unload the contents. There are a number of different chemical pulping methods:

- **sulphate Kraft** uses sulphates under alkaline conditions to dissolve the lignin (none in the UK)
- **sulphite** process uses sulphites, under a range of pH, to dissolve the lignins (none in the UK)
- **NSSC** process combines both chemical and mechanical pulping
- **other** chemicals:
  - hydrogen peroxide for various non-wood fibres
  - sodium hydroxide, alone or with sodium carbonate, with a catalyst such as anthraquinone

- others, developed mainly on alcohol as a solvent.

Indicative BAT

You should where appropriate:

1. Use processes involving peroxide, carbonate, hydroxide or alcohols in preference to sulphite/sulphate processes where possible.
2. Choose the cooking method and any associated recovery plant, not only to minimise releases to air and water, but also to be amenable to environmentally acceptable bleaching regimes. Any new process using sulphate or sulphite would be expected to

Pulping

incinerate the liquor and recover the cooking chemicals and any other substances in the spent liquor wherever possible.

3. The most likely candidate for a new chemical mill in the UK would be based on straw. The pulping of straw should be achieved without the use of sulphates or sulphites - sodium hydroxide/sodium carbonate has, for example, been used successfully.
4. Mills with batch digesters should displace the hot black liquor at the end of the batch with cooler liquor from the filtrate tank. This lower temperature reduces the emissions of sulphides and mercaptans and as the displaced hot liquor is used to heat incoming white liquor and the energy requirements are also reduced.
5. Use magnesium or sodium bases in sulphite mills in preference to calcium to make recovery possible.
6. For NSSC or sodium sulphite pulping, consider the use of alternatives such as sodium carbonate and sodium hydroxide. This avoids sulphide and sulphate releases but is only applicable where the weaker and darker resulting pulp would be acceptable.Other possibilities for alternative pulping chemicals are solvent pulping with alcohols such as using sulphite with 9,10-anthraquinone (AQ) and methanol that provides a bright pulp requiring little extra bleaching.
7. Use high consistency refining where possible as it can eliminate the need for subsequent screening and reduce BOD loads.
8. Where the pulp is to be subsequently bleached there are pulping techniques which increase delignification to minimise the bleaching needed. Use extended cooking where possible as this can reduce the bleaching chemical requirement by 25%, and catalysts e.g. polysulphide or AQ, should be employed. The use of AQ also decreases the generation of sulphurous compounds. The use of AQ on the NSSC process has not, however, been evaluated.
9. Control wood-derived aquatic toxicity by minimising water use and abate by biological treatment of the wastewater.
10. Limit other soluble materials in the wastewater (e.g. COD/colour from lignins and BOD/COD from hemi-cellulose) by minimising water use.

(NSSC) pulping and chemical recovery

In semi-chemical pulping, chemical and mechanical methods are combined. The chips are partially softened with chemicals after which they are refined. Compared with chemical pulping, yields are higher (~80%) because more lignin is left in the product pulp and the chemical usage is lower. The main semi-chemical process is

Pulping

the neutral sulphite semi-chemical (NSSC) process that produces a pulp from hardwoods and is used primarily for high quality, strong fluting for packing cases. NSSC mills do not necessarily de-bark the wood before the chipper. The main control issues for NSSC are associated with the handling of the black liquor. The black liquor is of lower concentration than for full chemical processes and therefore recovery is not often practised but the liquor has a very high BOD and has high toxicity and is unacceptable for long-term release into the environment.

The recovery of NSSC liquor would be a net consumer of energy (resulting in increased pollution loads to the atmosphere) and may not represent BAT because of its low calorific value.

The liquor contains substances, particularly ligno-sulphonates, which are potentially saleable. Lignosulphonates have been used as binders in oil drilling muds, dispersants, emulsifiers, sequestrants(chelating agents) and fluting additives and can be oxidised to vanillin (used widely as a flavouring and perfuming material). In order to do this the ligno-sulphonates need to be concentrated to around 25%.

Ligno-sulphonates in a more dilute form have also found applications in road building and animal feedstuffs.

As part of the process of concentrating the ligno-sulphonates much of the more degradable BOD can be removed by fermentation to produce either alcohol or yeast protein.

The most likely option to represent BAT, however, would be anaerobic/aerobic biodegradation with energy recovery that would give a positive energy balance. The strength of the liquor is such that a number of stages of biological treatment are likely to be required.

Indicative BAT

You should where appropriate:

1. Consider the options for recovery and recycling of the black liquor and justify your choice of technique.

Bleaching

2.4 Bleaching

Bleaching uses chemicals to brighten the pulp. The cellulose and hemi-cellulose are inherently white and it is the lignin that is primarily responsible for the colour. In mechanical pulp which has a large lignin content, it is impracticable to remove the lignin in order to brighten the pulp, thus certain chemicals are used which change its structure in a temporary way (newsprint fades).

Emissions to water from chemical bleaching contain a considerable BOD/COD load and chlorine bleaching results in halogenated VOCs such as chlorophenols, dioxins, furans. For mechanical pulps emissions to water include sulphates from hydrosulphite bleaching and more organics from peroxide bleaching. There are also significant emissions to air comprising:

- particulates from flash-drying when pulp is exported
- chlorine, chlorine dioxide, dioxins and furans from chlorine bleaching
- sulphur dioxide from on-site manufacturing of chlorine dioxide
- chloroform from hypochlorite bleaching
- sulphur dioxide from hydrosulphite bleaching.

Bleaching

Indicative BAT

You should where appropriate:

1. Elemental chlorine should not be used. Ozone bleaching is expensive but can give completely chlorine-free bleaching for any brightness.
2. For bleaching mechanical or recovered mechanical pulp, use brightening techniques that do not dissolve the lignin as they minimise the COD releases to water; e.g. sodium hydrosulphite, sodium bisulphite, sodium chlorite, sodium permanganate, sodium chlorate, dithionite or sodium perborate. Use techniques that do not use sulphur compounds to minimise sulphur releases to air. For bleaching chemical or recovered chemical pulp TCF techniques that also do not use sulphur compounds are preferred.
3. Use hydrogen peroxide or oxygen/peroxide for bleaching wood or non-wood sulphite fibres.
4. Where TCF techniques will not provide the quality of product required, ECF bleaching may be used. However, chlorate residues from on-site chlorine dioxide production can be toxic and water system closure may be restricted. Unless appropriate measures are taken ECF would not be the preferred system.
5. Use techniques to minimise the use of chlorine dioxide and justify where these are not used. Options include:
    a. Oxygen de-lignification, especially when used with extended cooking, has been shown to produce significant reductions in COD, BOD and AOX:
    b. Enzymatic pre-treatment.
    c. Sodium hypochlorite can be suitable for sulphite pulps, coloured broke or broke with wet strength agents and produces less highly substituted chlorinated organics than when using chlorine, but far more chloroform. It does not require the use of chelants.
    d. Oxygen and hydrogen peroxide will reduce further the formation of chlorinated compounds. In particular, replacing hypochlorite with hydrogen peroxide will reduce chloroform releases to air.
6. Cover bleaching tanks to suppress releases of chlorine, chlorine compounds or sulphur dioxide to air. While the concentration of such substances may be high, unless direct contact steam heating is employed, the mass flow from the cover vents will normally be low. The use of deliberate extraction, may reduce concentration levels but can lead to an increased mass flow. Where releases are significant, they can be abated by alkaline scrubbing (chloroform by adsorption).
7. Where flash drying is used, appropriate dust abatement should be employed.

Papermaking

2.5 Papermaking

The main environmental release from papermaking is wastewater containing a range of substances in dissolved and particulate form. The solids are a mixture of fibre, filler and chemicals such as sizes and starches. The dissolved solids comprise BOD/COD from biodegradable organics largely from pulp and broke, low levels of PCP and other chlorinated organics, non-retained wet end additives such as resins and dyes and inorganics such as chlorides. There may also be small quantities of heavy metals from inks and mercury from caustic soda and these may be adsorbed on particulate solids.

There are a number of sources of emissions to air including formaldehyde from resins, ammonia from urea breakdown, odours from microbiological action in the wastewater (anaerobic conversion of sulphate to sulphide and starches to volatile organic acids), particulates during finishing and converting, chloroform from bleaching to decolorise broke and other VOCs.

Sludges are produced during wastewater treatment and can contain most substances present in the water circuit including PCPs, persistent biocides, heavy metals, dyes and chlorinated species.

The main control issues are:

- selection of materials - in particular that only ECF or TCF imported pulp is used
- water efficiency
- abatement of releases to water
- releases to atmosphere of VOCs and steam
- control of noise
- energy consumption which is mainly determined by the pulping method
- recovery and disposal of wastes produced
- prevention of fugitive emissions to water
- prevention of fugitive emissions from finishing operations
- minimisation of waste, the load on the ETP and emissions to air from the bleaching of broke.

Papermaking

Indicative BAT

The following will minimize waste, the load on the ETP and emissions to air from the bleaching of broke, and you should where appropriate:

1. Use save-alls for the recovery of both particulate solids and clarified water.
2. Optimise use of retention aids, to improve particulate wire retention without causing any unacceptable deterioration in paper quality, e.g. formation. This includes:
   i. raw material selection
   ii. neutralisation of interfering substances that would otherwise reduce the efficiency of retention aids
   iii. monitoring, preferably on-line rather than manual, of wire retentions for fibre and, where present, filler.
3. With regard to broke, quantify the levels for each grade and take the appropriate steps to minimise the production of broke or limit its effect, in particular:
   - uprating of machine control systems (computer control, on-line sensors for grammage, ash content, colour, drive speed, supply of fibre, dosing of additives and wet end retentions and related chemical parameters)
   - wherever practicable, coloured or brightened broke should be re-used in compatible grades rather than bleached or quenched for use in any grade
   - adequate storage capacity for broke and whitewaters should be provided along with level monitoring in broke/whitewater tanks in order to minimise overflows.
4. Minimise particulate losses during screening; rejects at integrated pulp mills should be returned to the pulp mill wherever possible.
5. Optimise operation of pulp refiners to minimise generation of fines and dissolution of pulp/broke solubles, noting that there is a law of diminishing returns requiring increasing amounts of energy for diminishing recovery of solids.
6. Monitor machine drains for flow and solids content (turbidity) so that total particulate losses can be calculated.
7. Select materials, where possible, so as not to inhibit recycling. Starches, adhesives, some dyes and wet strength resins are examples of materials that can be difficult to recycle.

Coating

2.6 Coating

The main impact of coating (assuming that the coating is aqueous and there are no VOC emissions) is the generation of wastewater for treatment in an ETP. Some dyes are potentially harmful and can have poor biodegradability and others may contain metal ions. Many degradation products will adhere to the sludge and this is often sent for land disposal as it has a high ash content and is unattractive for combustion.

The main control issues are:

- treatment of coating wastewaters
- substitution of solvents by aqueous alternatives, dyes and carriers by less harmful alternatives or those which do not inhibit the recycling of coated broke
- abatement of VOCs, where they still exist.

Indicative BAT

You should where appropriate:

1. Minimise the loss of coating materials by:
   - optimising the preparation/inventory of coating mixes using normal efficient system design/working practices and good housekeeping
   - monitoring coating losses with a view to minimisation.
2. Re-pulp coated broke and recycle to the wet end, where the coating pigment is used to raise the ash content of the base paper. However note that the coating binder can cause deposits (white pitch) and the dispersants present in the pigment slurry can interfere with the action of wet end additives.
3. Where the dyes (and/or coatings) have been applied at the coating station (i.e. not in the stock), the concentration of these materials in the broke will be high. Wash the re-pulped broke, before returning to stock preparation, and treat separately the concentrated washwater.
4. Where dyes are applied with coatings, collect separately the coating filter backwash, and the shower water and washout drains in the coating area, and use membrane technology to recover the coating colour. The permeate should also be recycled.

3

Emissions and monitoring

Emissions to water

3. Emissions and monitoring

3.1 Emissions to water

Water is predominantly used for transportation of the wood and pulp. There is a high degree of recycling benefiting particularly from the integration of other activities with papermaking.

In addition to the substances which give rise to the BOD of mill effluent, the wood contains organics, some of which are poorly biodegradable, and which can be particularly toxic. A wide variety of chemicals are also used in the papermaking process and the effluent will be a complex mixture of substances. The impact of these both individually and synergistically needs to be assessed.

While most pesticides and other persistent substances have been detected in releases from UK paper mills in recent years, those most frequently recorded in significant amounts are PCP, lindane, mercury and cadmium. Although concentrations tend to be low the very significant volumes of water involved mean that loadings can be high. The use of pulps which have been bleached with chlorine can lead to releases of PCP, dioxins, furans and other chlorinated organics.

Wastewater treatment changes the nature and distribution of these substances, with some (fibre, filler, some carbon from biodegradable organics, some adsorbed organic and ions) ending up in a sludge form, others being emitted to atmosphere (some carbon from biodegradable organics, sulphur from reduced sulphates) and some remaining in the wastewater discharge (non-degraded and nonadsorbed organics, non-adsorbed and non-precipitated ions).

Wastewater can arise from the process activity, from storm water, from cooling water, from accidental emissions of raw materials, products or waste materials and from fire-fighting. Most paper mills have some form of treatment plant prior to direct or indirect discharge. After initial screening to remove gross solids, the wastewater may be treated in two or sometimes three stages.

Options for specific mill types

Chemical pulping wastewaters are generally more concentrated and toxic than papermaking effluents. Anaerobic treatment can be used for pre-treatment of evaporator condensates on recovery systems or pre-treatment of the whole wastewater at NSSC mills without liquor burning.

Emissions to water

Non-biodegradable, coloured lignin compounds, can be removed by chemical adsorption/precipitation with lime, alum and polymers. (note high sludge production).

Where chemical pulp making is combined with paper making, the weaker white water from the papermaking can be treated to a very low level in a separate "aerobic only" plant prior to mixing with the ex-black liquor, after it has been treated as far as reasonably practicable, for discharge.

Mechanical pulping wastewaters are always handled with those from papermaking.

For non de-inked recycled mills, where the raw wastewater is of adequate quality anaerobic followed by aerobic bio-treatment rather than full aerobic biotreatment would be normally be considered to be the BAT. Where this is not used in existing mills, but the wastewater is either treated aerobically or discharged for collective treatment off-site, the environmental disbenefits in terms of energy use, sludge production, discharge quality and operational stability should be quantified as part of the BAT issues.

For other de-inking/bleaching activities full biological (normally aerobic) treatment would be needed before direct discharge in view of the high COD/BOD loads from recovered paper.

Coating wastewaters should be minimized. Where they occur they should be dealt with by pre-treatment by suitable means to remove the residues of solid pigments (e.g. chemical coagulation followed by settlement) with the sludge solids being dewatered prior to disposal/re-use and the liquor handled in admixture with the paper machine wastewater.

Emulsified polyvinyl alcohol, can cause foaming and disruption of the sludge layer in the biological plant and can be treated with calcium chloride and a retention aid, in a primary settlement tank, in order to break down the emulsion and coagulate it. Although even with subsequent use of bentonite and polyacrylamide in the main settlement area, the large quantities of the material can still be a problem to the biological plant. Operators should describe how these problems are or will be overcome.

Where coloured coatings (dyes) are used, the coloured wastewaters should be separately collected and the coating materials recovered for re-use through the use of membrane technology. Where dye-related toxicity problems persist, you should consider washing the broke to dissolve dye followed by separate treatment of the thickened broke filtrate and/or tertiary wastewater treatment.

Emissions to water
Emissions to air

Indicative BAT

You should where appropriate:

Design and management

1. For paper machines and on-line coating, control accidental and unnecessary discharges, particularly on web breaks, by:
   - on-line monitoring of key machine functions for forewarning
   - on-line monitoring or manual sampling/analysis of drain flows/suspended solids to establish baseline for normal losses
   - designing the broke system with sufficient capacity to avoid overflow and loss of water and fibre to the ETP
   - designing the whitewater tanks with sufficient capacity for repulping this quantity of broke
   - computer control of the system taking into account the production schedule and the levels of the white water, broke and pulp towers (i.e. the system inventories)
   - separate broke and white water systems for each machine, especially where machines are producing different, incompatible grades
   - interlocking of chemical dosing pumps with machine operation in order to prevent continued dosing after machine stoppage.
2. Have systems in place to ensure that effluent cannot bypass the ETP. Where storm overflows are likely ensure releases do not go to sewer.
3. Provide adequate effluent buffer storage to prevent spills reaching the ETP or controlled water.

Handling

4. Provide buffer storage or balancing tanks to release stronger or alkaline wastewaters gradually or to provide corrective treatment, (e.g. pH control) and to cope with the general variability in flow and composition. If no balancing is provided you will need to demonstrate how peak loads are handled without overloading the ETP.

3.2 Emissions to air

Emissions to air arise from the following sources

- SOx, NOx and COx from the combustion plant or liquor burning
- particulates from these sources, or paper and timber handling
- formaldehyde and ammonia from wet strength resins
- other VOCs from:

  - the timber during mechanical pulping

Emissions to air

- solvents from wire cleaning or carriers in formulated chemicals (e.g. biocides)
- solvents from the coating processes.

- chloroform from the use of chlorine compounds in bleaching
- odorous compounds from wet pulping areas and certain types of effluent treatment plants.

Indicative BAT

You should where appropriate:

1. Consider the release potential for VOCs from mechanical pulping, measure the emissions and assess the eventual fate of any condensed VOCs.
2. Remove the fines released after pulping with the steam by a cyclone or similar.
3. In chemical pulping, alkaline scrub the vented gases from the digester and the digester house atmosphere for NSSC and sulphite pulping in order to capture sulphur dioxide where problems exist.
4. Minimise emissions of bleaching chemicals and chloroform or capture and abate.
5. Consider the quantities of formaldehyde, ammonia and other VOCs from the drying section and from re-pulping wet strength broke in papermaking. Where heat recovery has yet to be installed, assess the impact of the various heat recovery options on VOC reduction. Wherever possible, the first option should be substitution of VOCs used with less harmful alternatives.
6. Collect and abate VOCs from any solvent-based coating.
7. There may also be other sources of combustion gases such as direct gas fired drying equipment. In such cases use low-NOx burners.
8. Where there is an on-site combustion plant other guidance on combustion is also relevant. (For plants greater than 50 MW consult S1.03 and for plants of 20-50 MW consult the Local Authority Air Pollution Control guidance. For incineration plant consult S5.01.)

Noise

3.3 Noise

Most installations in this sector have the potential for noise problems and you should therefore prepare a Noise Management Plan.

Indicative BAT

You should where appropriate:

Debarking and chipping

1. Deal with debarking noise by the careful location of plant or by relatively simple shielding.
2. The chipping operations are extremely noisy and if placed indoors, acoustic design of the building structure and doors will be needed. An alternative is to place both the chipper and the conveyors underground, thereby also solving the dust problems.

Refiners

3. Refiners in mechanical pulping are also inherently noisy. Site these indoors and apply the comments under papermaking.

Paper making

4. The main external noise sources are vacuum pump exhaust (typically 100 dB(A) at 1m) and process and machine room ventilation. Optimise siting and location to minimize noise but where this is insufficient to meet local needs, use silencing. For fans this is likely to be broad band absorptive silencing whereas reactive silencing, e.g. pipe resonators, may be more appropriate for vacuum pump noise which is more likely to have specific peak frequencies. Noise attenuation often increases system pressure drop and hence energy use but where the noise is likely to cause nuisance, the energy demands are unlikely to be significant.
5. The paper machine itself is inherently noisy because of the large number of moving parts. Use primary control - acoustic hooding, good plant maintenance and good design of machine hall building structure.
6. There is also considerable noise from the ancillary equipment because of the high transport rates of water, air and solid materials and this is best controlled by local hooding (mainly for personnel protection) and building design.
7. All such plant should preferably be indoors with particular attention to acoustic building design, minimising openings and ensuring that doors have automatic closing.

Boiler plant

8. Fit silencers to safety relief valves for new plants over 50 MW(t).

Noise
Odour

9. Consider other sources of noise such as fans and waste or fuel feeding.
10. Gas turbine noise is normally controlled by acoustic cladding, acoustic air intakes and stack attenuators.

3.4 Odour

Point source odour emissions are only expected where pulping incorporates the use of chemical recovery systems. Fugitive odorous sulphur compounds, mercaptans and sulphides are released from anaerobic plant offgases or anaerobic conditions in water circuits, primary sedimentation or sludge. The microbial action converts sulphites and sulphates, from a wide variety of sources in the water circuit.

Indicative BAT

The following should be used where appropriate in this sector:

1. Where fugitive odours are released from anaerobic conditions, control by:
   - reducing sulphates and sulphites
   - the control of slime
   - maintaining the system pH above neutral (except machines purposely running under acid conditions)
   - providing alternative sources of oxygen, e.g. nitrate in the ETP
   - addition of iron salts to render residual sulphides non-volatile.

Monitoring

3.5 Monitoring and reporting of emissions to air and water

There is a suite of Environment Agency guidance on monitoring, known as the M series, which is included in the list of references in Annex 1 of GTBR.

Indicative BAT

You should where appropriate:

1. Carry out an analysis covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. The need to repeat such a test will depend upon the potential variability in the process and, for example, the potential for contamination of raw materials. Where there is such potential, tests may be appropriate.
2. Monitor more regularly any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact. This would particularly apply to the common pesticides and heavy metals. Using composite samples is the technique most likely to be appropriate where the concentration does not vary excessively.
3. If there are releases of substances that are more difficult to measure and whose capacity for harm is uncertain, particularly when combined with other substances, then "whole effluent toxicity" monitoring techniques can be appropriate to provide direct measurements of harm, for example, direct toxicity assessment.

Monitoring and reporting of waste emissions

Indicative BAT

You should where appropriate:

1. Monitor and record:

   the physical and chemical composition of the waste

   its hazard characteristics

   handling precautions and substances with which it cannot be mixed.

Monitoring

Environmental monitoring (beyond installation)

Indicative BAT

You should where environmental monitoring is needed:

1 Consider the following in drawing up proposals:

- determinands to be monitored, standard reference methods, sampling protocols
- monitoring strategy, selection of monitoring points, optimisation of monitoring approach
- determination of background levels contributed by other sources
- uncertainty for the employed methodologies and the resultant overall uncertainty of measurement
- quality assurance (QA) and quality control (QC) protocols, equipment calibration and maintenance, sample storage and chain of custody/audit trail
- reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information.

4 Annexes

Annex 1 Emission benchmarks

Annex 2 Other relevant guidance and abbreviations

Annex 1-Emission benchmarks

4. Annexes

Annex 1- Emission benchmarks

The emission benchmarks in this Annex focus on the main paper and pulp activities and there are other benchmarks in the following guidance that may be appropriate for certain operations carried out at paper and pulp activities:

- European Community (EC) 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations ("the Solvent Directive").
- European Community (EC) Directive 2001/80/EC on large combustion plant with a net rated thermal input in excess of 50 $MW_{(th)}$ and associated guidance S1.01 on combustion.
- European Community (EC) Directive 2000/76/EC on the incineration of waste ("the Waste Incineration Directive") and associated guidance S5.01 on combustion.

Emissions to air

Benchmarks or limits are most frequently expressed as daily averages or typically 95% of hourly averages. BREF figures are generally yearly averages.

Reference conditions for releases to air

The reference conditions of substances in releases to air from point-sources are:

- temperature 0 °C (273K)
- pressure 101.3 kPa
- no correction for water vapour or oxygen.

The reference conditions for combustion or incineration processes are as given in the appropriate guidance note.

To convert measured values to reference conditions, see the **Monitoring Guidance**[1] for more information.

[1] Environment Agency Technical Guidance Notes M1 and M2 provide extensive guidance on the monitoring of stack emissions to air. The conversion referred to is given in TGN M2

Annex 1-Emission benchmarks

Table 1 Indicative BAT standards for emissions to air

Emission	Benchmark Level	Activity	Techniques which may be considered to be BAT	Comment
Chloroform	5 mg/m^3	Bleaching/ broke recovery		Parity with UK chemical Sector
Chorine	5 mg/m^3			
Chlorine dioxide	1 mg/m^3			
HCl and HF	See appropriate guidance	Combustion / incineration		See S1.01 or S5.01
Heavy metals	See appropriate guidance			
Oxides of nitrogen	60-80 mgNO_x/MJ fuel input 200 mg/m^3 (as NO_2 at 11% oxygen dry gas) where Waste Incineration Directive applies.	from energy recovery of bark or sludge	Will require the use of good combustion chamber design and low NO_x burners	Mass value is a BREF value - calculated, with no control. Value reduces to 40-60 with SNCR. Concentration is based on Waste Incineration Directive. For other combustion processes see the relevant guidance note.
Particulate matter	"no visible dust" criteria may normally be appropriate	Fugitive from storage yards and materials handling		Parity with other UK industrial sector benchmarks for fugitive or low level, relatively benign, nuisance dusts.
Particulate matter	50 mg/m^3	Point release from paper finishing activities		
Particulate matter		Point release from liquor burning	Will require bag filters or precipitators	
Particulate matter	50 mg/m^3	Point release from mechanical pulping	Assumes cyclone separation of fibre fines	

Annex 1-Emission benchmarks

Particulate matter	See appropriate guidance	Point release from combustion/incineration		See S1.01 or S5.01. Based on parity with other sectors
Oxides of sulphur (as SO_2)	5 – 10 mgS/MJ fuel input	From energy recovery of bark or sludge		Mass value is a BREF value - calculated, with no control.
Oxides of sulphur (as SO_2)	See appropriate guidance	Point release from combustion/incineration	Include the use of low sulphur fuel or sulphur emission control	See S1.01 or S5.01.
Formaldehyde	Where emissions >100g/h limit of 20 mg/m^3 as formaldehyde	Papermaking wet strength agents		Parity with other UK industrial sector benchmarks for a Class A VOC
Solvents from wire cleaning/chemicals eg biocides	Where emissions >5 te/yr limit of 80 mg/m^3 as toluene	Papermaking		Parity with other UK industrial sector benchmarks
Volatile wood compounds (acetic acid, fatty acids, formic acid, resin acids, turpentine. Ethanol, methanol	Where emissions >1kg in 24-hours limit of 50 mg/m^3	Mechanical pulping		

Annex 1-Emission benchmarks

Table 1 Indicative BAT standards for emissions to air (continued)

Emission	Benchmark Level	Activity	Techniques which may be considered to be BAT	Comment
Dioxins	1 ng/m^3	Liquor burning		Parity with other UK industrial sector benchmarks
PAHs	0.1 mg/m^3			
VOCs	20 mg/m^3			
Dioxins and VOCs		Point release from combustion/incineration		See S1.01 or S5.01.
Solvents	Where emissions >5 te/yr limit of 80 mg/m^3 as toluene Solvent use between 5-15 te/yr limit of 100mg/m^3 as carbon Solvent use more than 15 te/yr limit of 50mg/m^3 as carbon from drying operations and 75mg/m^3 as carbon from coating application	Coating		The lower of these limits should be used to ensure meeting the SED and parity with other sector benchmarks

Emissions to water and sewer

UK benchmarks or limits are most frequently 95 percentile concentrations or absolute concentrations, (with flow limited on a daily average or maximum basis). BREF figures are generally yearly averages.

Where automatic sampling systems are employed, limits may be defined such that not more than 5% of samples shall exceed the limit. Where spot samples are taken no individual spot sample in a range of samples, shall exceed the limit by more than 50%.

In addition to the limits in Table 2 below there are water emission and quality standards that may be appropriate to the emissions to water as follows:-

- UK water quality objectives for BOD
- Designated freshwater standards for fishlife SI1991/1331

Annex 1-Emission benchmarks

Table 2 Indicative BAT standards for emissions to water and sewer

Emission	Benchmark Level	Activity	Techniques which may be considered to be BAT	Comment
BOD[1]	10 – 20 g/l (flow weighted monthly average)	New Plant to controlled water	Biological treatment	See also Table 3
COD	See Table.4 below			Only set as a limit where the impact of COD is significant as a toxicity surrogate
Suspended solids	See Table 4 below			Reductions in suspended solids are likely to be driven by the need to reduce BOD/COD due to pollutants adhering to the solids
Phosphates and nitrates	See Table 4 below			Most N and P comes from dosing in the ETP – the aim is to ensure minimum residual nutrients whilst maintaining ETP operation
Pentachlorophenol[2]	1 µg/l	Bleaching or incoming recovered paper	Use effective ETP – minimise by reducing use of hypochlorite	IPC standard
AOX (absorbable organic halogen)	10g/Adt 1 mg/l @ 10m^3/Adt 0.4mg/l @ 25m^3/ADt	Mills using wet strength agents		Not normally necessary to set AOX levels except where there is a programme to reduce them by in-process techniques
Mercury[2] Cadmium[2]	0.1 µg/l 0.6 µg/l	Timber, inks and dyes and most significant in de-inking		Parity with other UK industrial sector benchmarks
Heavy metals	See appropriate guidance	Point release from combustion/incineration		See EPR1.01 or EPR5.01. Based on parity with other sectors

Notes:-

1. See Table 3 existing plant should strive for this standard but should meet the larger range values in Table 3.
2. You should note that mercury, cadmium and pentachlorophenol are List I substances.

Annex 1-Emission benchmarks

Table 3 Indicative BAT standards for BOD emissions to water and sewer

Activity	BREF Benchmark Values BOD (Yearly averages)			
	Pre-treatment	Post-treatment		
	kg/ADt	kg/ADt	Water flow m^3/ADt	mg/l calc.
Mechanical pulp integrated with newsprint LWC or supercalendered or 50% RCF/50% mechanical pulp	8 – 12	0.2 –0.5	12 – 20	10 – 40
RCF not de-inked i/g cartonboard, testliner etc.		0.05 – 0.15	<7	7 – 21
RCF de-inked i/g newsprint or printings / writings covered fibre. De-inked	8 – 12	0.04 – 0.2	8 – 15	2.5 – 25
RCF tissue	8 – 12	0.05 – 0.4	8 – 25	2 – 50
Fine paper coated or uncoated not integrated	1 – 2.5	0.15 – 0.25	10 – 15	10 – 25
Tissue non-integrated		0.15 – 0.4	10 – 25	6 – 40
Integrated NSSC			2.5 – 5	
Other speciality integrated pulping mills and speciality papers		0.15 – 1.3	15 – 50[1]	
Sulphate pulp unbleached for comparison	6 – 9	0.2 – 0.7	15 – 25	8 - 47
Sulphate pulp bleached for comparison	13 - 19	0.3 – 1.5	30 - 50	

Note 1: the specific water consumption sometimes exceeds 100m^3/ADt

Annex 1-Emission benchmarks

Table 4 Indicative BAT standards for COD, Nutrients and suspended solids emissions to water and sewer

Activity	BREF Benchmark Values (Yearly averages)				
	Water flow m^3/ADt	COD mg/l calc.	N Total kg/ADt	P Total kg/Adt	Suspended solids mg/l calc.
Mechanical pulp integrated with newsprint LWC or supercalendered or 50% RCF/50% mechanical pulp	12 – 20	100 – 400	0.04 – 0.1	0.004 – 0.01	10 – 40
RCF not de-inked i/g cartonboard, testliner etc.	<7	70 – 210	0.02 – 0.05	0.002–0.005	7 – 20
RCF de-inked i/g newsprint or printings / writings covered fibre. De-inked	8 – 15	130 – 500	0.05 – 0.1	0.005 - 0.01	14 – 37
RCF tissue	8 – 25	80 – 500	0.05 – 0.25	0.005–0.015	4 – 50
Fine paper coated or uncoated not integrated	10 – 15	40 – 200	0.05 – 0.2	0.003-0.01	13 – 40
Tissue non-integrated	10 – 25	20 - 200	0.05 – 0.25	0.003-0.015	8 – 40
Integrated NSSC	2.5 – 5				
Other speciality integrated pulping mills and speciality papers	15 - 50[1]		0.15 – 0.4	0.01 – 0.04	6 – 75
Sulphate pulp unbleached for comparison	15 – 25	200 - 630	0.1 – 0.2	0.005-0.2	12 – 75
Sulphate pulp bleached for comparison	30 - 50		0.1 - 0.25	0.01 – 0.03	12 - 50

Note 1: the specific water consumption sometimes exceeds 100m^3/ADt

Annex 2- Other relevant guidance and abbreviations

Annex 2- Other relevant guidance and abbreviations

For a full list of available Technical Guidance and other relevant guidance see Appendix A of GTBR (see http://publications.environment-agency.gov.uk/pdf/GEHO0908BOTD-e-e.pdf?lang=_e).

In addition to the guidance in GTBR the following guidance is relevant to this sector:

1. IPPC Reference Document on Best Available Techniques in the Pulp and Paper Industry, (BREF) European Commission. http://eippcb.jrc.es.

The guidance in this note focuses on the main paper and pulp activities. Directives that may apply to certain operations carried out at paper and pulp activities include:

- European Community (EC) 1999/13/EC on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations ("the Solvent Directive"),
- European Community (EC) Directive 2001/80/EC on large combustion plant with a net rated thermal input in excess of 50 $MW_{(th)}$ and associated guidance S1.01 on combustion.
- European Community (EC) Directive 2000/76/EC on the incineration of waste ("the Waste Incineration Directive") and associated guidance S5.01 on combustion.

There is also additional cross-sectoral guidance on abatement techniques for point source emissions to air and water in the BREF for Waste Water and Waste Gas treatment.

Abbreviations

ADt *Air dried tonne of paper (paper contains around 7% water under ambient conditions)*

AOX *Adsorbable Organic Halogen*

APP *Alkaline peroxide process*

BAT *Best Available Techniques*

BOD *Biochemical Oxygen Demand*

Broke *Paper made on the machine and returned to the process for a variety of reasons but usually because of web breaks*

CHP *Combined heat and paper plant*

Closed-water *The water is repeatedly recycled with the minimum of losses)*

COD *Chemical Oxygen Demand*

Couch-pit *Under and at the end of the wire this collects the deckle trim and wire broke*

CMC *Carboxymethycellulose*

CTMP *Chemi-thermo-mechanical-pulping processes (using sulphite or APP)*

DAF *Dissolved air flotation*

Deckle *The edge of the paper continuously trimmed off the web and returned to the stock*

DTPA *Diethylene triamino pentaacetic acid*

Annex 2- Other relevant guidance and abbreviations

ECF *Elemental chlorine free (pulp bleached without elemental chlorine)*

EDTA *Ethylene diamine tetra-acetic acid*

ETP *Effluent treatment plant*

Fibrillate *Raising small hairs on the fibres which increase their bonding strength*

Fourdrinier *The most common design of paper-making machine comprising a wire forming section, a press section and a drying section*

Furnish *The diluted pulp, fillers and other additives fed to the machine*

Integrated-mill *A mill in which both pulping and paper-making take place*

ITEQ *International Toxicity Equivalents*

MF *Melamine formaldehyde*

MLSS *Mixed Liquor Suspended Solids*

NTA *Nitrilo triacetic acid*

PAE *Polyamidoamine-epichlorhydrin resins*

PAM *Polyacrylamides*

PCDD *Poly chlorinated dibenzo dioxins*

PCDF *Poly chlorinated dibenzo furans*

PCP *Pentachlorophenol*

PEI *Polyethyleneimines*

PGW *Pressurised ground wood pulping*

RCF *Recycled fibre*

Retention *The percentage of substances, both solids and solubles retained in the paper rather than passing to effluent*

RMP *Refiner mechanical pulping*

Save-all *The fibre recovery unit, filtration, flotation or settlement. Also produces clarified water*

SGW *Stone ground wood pulping*

Size-press *The area of the machine where size is applied. Within the drying section of the machine*

Stock *The suspension of fibres being prepared for the machine. Thick stock is 3-5% solids, thin stock generally less than 1% solids*

SS *Suspended solids*

TCF *Totally chlorine free (pulp bleached without any chlorine compounds)*

TMP *Thermo-mechanical pulping*

TOC *Total Organic Carbon*

TRS *Total reduced sulphur*

UF *Urea formaldehyde*

VOC *Volatile organic compounds*

Web *The continuous sheet of paper once formed on the wire*

Wet-end *Wet end chemistry or plant is that associated with the stock as opposed to that at the coating or size press areas*

Wire *On a paper machine, the continuous loop of porous mesh onto which the suspension of fibres is poured and on which the web is formed by drainage of the water through the wire*

Wood-free *Paper made from pulp from which the lignin has been largely dissolved by chemical means*

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