Til
Miljødirektoratet
Postboks 5672,
Sluppen,
7485 Trondheim

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Deres referanse og saksbehandler:
2013/1236, Olaug Bjertnæs

Vår referanse:
Elisabeth Berli / Trond Mageli

BAT-konklusjoner for treforedling er vedtatt – pålegg om å gi opplysninger

Vi viser til brev fra Miljødirektoratet datert 19.09.2015, der det gis pålegg om at Norske Skog Saugbrugs AS skal sende inn opplysninger om virksomheten innen 30.04.2016. Det aktuelle pålegget er vist i rammen under:

Pålegg om å gi opplysninger
Vi pålegger bedriften å opplyse om følgende:

- Redegjøre punktvis for egen virksomhet i forhold til BAT-konklusjonen, og avklare hvilke punkter som er relevante. Vurdere om utslippene fra virksomheten oppfyller BAT-AEL. Gjelder både med de generelle BAT-konklusjonene i kapittel 1.1 (punktene 1.1.1 – 1.1.10) og de spesifikke i kapitlene 1.2 – 1.7.

- Beskrive eventuelle tiltak som må gjennomføres for å oppfylle BAT-AEL. Kostnader ved eventuelle tiltak skal oppgis.

- For BAT-konklusjoner der det beskrives teknikker, skal bedriften oppgi om teknikken er i bruk ved virksomheten eller om eventuelle alternative teknikker benyttes. Dersom dere benytter alternative teknikker, skal det redegjøres for hvilke effekter det har på utslippet og om de overholder utslippsnivåene i BAT-konklusjonene.

- Redegjøre for om virksomheten omfattes av horisontale BREF-er og om disse overholdes.

- Vurdere om dere er omfattet av kravet om tilstandsrapport om mulig forurensning av grunn og grunnvann. Dere må opplyse om hvilke stoffer eller stoffblandinger i CLP-forordningen dere bruker, fremstiller eller slipper ut som utløser kravet.

Kort om Norske Skog Saugbrugs AS i Halden
Saugbrugs er en av verdens største og mest moderne produsenter av superkalandrert (SC) magasinpapir. Fabrikken har en samlet årskapasitet på 510.000 tonn SC-magasinpapir fordelt på tre papirmaskiner. Utslipp til vann går gjennom et 4-trinns biologisk renseanlegg før det går til elva Tista.

Papir fra fabrikken blir brukt til å formidle hendelser og annonser i publikasjoner (magasiner, kataloger og bilag) hele verden over. Papirruller på opptil 6 tonn må derfor behandles varsomt og funksjonell logistikk er avgjørende for å være "on-time" (når trykkpressene er klare) hos kundene.

Saugbrugs ble grunnlagt i 1859 og har siden 1989 være en del av Norske Skog-konsernet. Det viktigste råstoffet i Saugbrugs sin produksjon er granvirke (minst 75% fra sertifiserte skoger), innkjøpt sulfatcellulose og clay (leire). Fra granvirke lages det mekanisk tilvirket fiber-masse (TMP) som er hovedingrediens i papirproduksjonen. Fabrikken er sertifisert i henhold til ISO 9001, ISO 14001, ISO 50001, CoC-PEFC, CoC-FSC og EU Ecolabel. Omsetningen er i underkant av 2,5 milliarder kroner og antall ansatte er rundt 470.

Saugbrugs lager produkter fra fornybare råvarer som skog og vannkraft. Produktene er bærekraftige og har et meget lavt CO_2-fotavtrykk. Råstoffet er fornybart, produktene er svært gjenvinnbare og både råvarer og produkter lagrer karbon og vil derfor være viktige bidragsytere i lavutslippssamfunnet. På slutten av sin livssyklus kan de skogbaserte produktene brukes til å produsere bioenergi, som er nøytralt i forhold til klimaendringer. En strammere global klimapolitikk som løfter frem bærekraftige produkter vil gi mulighet for ekspansjon, gitt gode rammebetingelser i Norge.

Aktuelle BAT-konklusjoner for Saugbrugs og om BAT-AEL oppfylles (påleggets første og tredje punkt)
De BAT-konklusjoner som omfatter produksjonen ved Saugbrugs finner man i kapitlene 8.1 (GENERAL BAT CONCLUSIONS FOR PULP AND PAPER INDUSTRY), 8.4 (BAT CONCLUSIONS FOR MECHANICAL PULPING) og 8.6 (BAT CONCLUSIONS FOR PAPERMAKING AND RELATED PROCESSES). I vedlegg 1 redegjør vi punktvis for egen virksomhet i forhold til disse BAT-konklusjonene, inkludert beskrivelse av teknikker, og vurderer om utslippene fra virksomheten oppfyller BAT-AEL.

Redegjørelsen i vedlegg 1 viser at Saugbrugs oppfyller de fleste BAT og BAT-AEL.

Diskusjon og beskrivelse av eventuelle tiltak som må til for å oppfylle BAT-AEL (påleggets andre punkt)
Usikker oppnåelse av BAT-AEL diskuteres under.

BAT 40; BAT-AEL for utslipp til vann fra integrert produksjon av papir fra mekanisk masse (se tabell 8.16):

Saugbrugs produserer SC-papir med høy andel peroksidblekte mekaniske fibre (highly bleached mechanical pulp) i det ferdige papirproduktet. Følgelig omfattes produksjonen av fotnote 1 i Tabell 8.16. Fotnote 1 tillater utslippsnivå inntil 8 kg/tonn for integrerte bruk dersom andelen høybleket mekanisk masse overstiger 70%. På Saugbrugs utgjør andelen høybleket egenprodusert mekanisk masse omlag 90% av det totale fibermaterialet i SC papiret. Over de siste 5 årene har produkter med stadig høyere andel TMP fibre blitt utviklet. KOF-genereringen øker proporsjonalt med mengden egenprodusert masse hvilket betyr at spesifikk KOF i avløp kan øke på tross av uendret eller synkende papirproduksjon.

Saugbrugs nåværende spesifikke kjemisk oksygen forbruk (COD) utslippsgrense er 5 kg/tonn (årlig gjennomsnitt). Målte og rapporterte verdier fra Saugbrugs har periodevis vært høyere enn 5 kg/tonn, spesielt etter siste økning i andel egenprodusert høybleket mekanisk masse.

Saugbrugs kan overholde en utslippsgrense på 8 kg/tonn, også om andelen egenprodusert masse i papiret økes.

Sett siste 2,5 år oppfyller ikke Saugbrugs en BAT-AEL på opp til 0,45 kg totalt suspendert materiale (TSS)/tonn (tabell 8.16). Utslippsnivået av TSS ut fra BAT-AEL er på rundt halvparten av dagens utslippsgrense.

Den foreslåtte BAT-AEL for totalt nitrogen utslipp er rundt 30% lavere enn Saugbrugs nåværende utslippsgrense og den foreslåtte BAT-AEL for totalt fosfor utslipp er rundt 20% lavere enn nåværende utslippsgrense. I dagens situasjon oppfyller ikke Saugbrugs total nitrogen og fosfor BAT-AEL (tabell 8.16), men dette kan trolig oppnås i den eksisterende ETP-prosessen gitt en COD utslippsgrense på 8 kg/tonn.
Høy lyshet medfører bruk av EDTA. Bruken av EDTA gir en noe forhøyet total nitrogen. I dag finnes ingen alternativer med bedre miljøprofil og samtidig tilfredsstillende effektivitet tilgjengelig. Det henvises derfor til fotnote 2 i Tabell 8.16. Fotnote 2 tillater en noe høyere utslipp av total nitrogen «and should be assessed on a case-by-case basis".

En ny anaerobisk reaktor (biogass reaktor) vil være igangsatt på fabrikken i 2017. «Worst case» scenario etter dette er ingen vesentlige endringer i utslippsparameterne etter implementering av nytt anaerobisk rensetrinn for, i grove trekk, alt avløp av prosessvann. Konsesjon etter BAT-AEL-verdier kan da gi problemer med overholdelse av spesifikke krav med hensyn på total nitrogen og total fosfor.

Overholdelse av BAT-AEL for total fosfor kan da medføre at det må investeres i anlegg for kjemisk felling. Litteraturdata antyder at nødvendige investeringer for dosering av fellingskjemikalier vil beløpe seg til 1-2 millioner NOK. Årlig kjemikaliekostnad estimeres til ~1 million NOK og øvrige driftskostnader kan være 100 kNOK. I tillegg kommer kostnader for ekstra slambelastning og håndtering av denne.

Kemira antyder investering på 1,3 millioner NOK for tank og doseringsutstyr og pris for fellingskjemikalie (AVR) i overkant av 200 EUR/tonn. Forbruksestimat kan ikke gis grunnet for stor usikkerhet.

Eventuell reduksjon av total nitrogen kan gjøres i eksisterende aktiv-slamanlegg med visse modifikasjoner, men vil kunne redusere rensegrad med hensyn til kjemisk oksygenforbruk (COD).

Tilsetninger av næringsstoffene (urea og fosforsyre) for å justere C: N: P-forhold er viktig for å oppnå stabil drift av ETP (det biologiske renseanlegget) og derved kunne overholde utslippstillatelsens grenseverdier. Vår erfaring er at vi får det laveste COD og TSS utslipp når vi tillater utslipp av total nitrogen og total fosfor i nærheten av våre nåværende konsesjonsgrenser. Å flytte utenfor dette drifts-vinduet medfører at vi ikke klarer å etterleve nåværende utslippskrav med hensyn til COD og TSS. Siden de suspenderte faste stoffer består hovedsakelig av rester fra den aktive slam behandlingen (biologisk materiale inneholdende i henhold til litteratur ~ 12% N og 2% P), bidrar det til å øke også utslippene av total fosfor og total nitrogen.
Derfor vil strengere utslippskrav for total nitrogen og total fosfor gjøre det vanskeligere å overholde alle utslippsgrenser, inkludert total nitrogen og total fosfor.

Redegjørelse vedrørende om virksomheten omfattes av horisontale BREF-er og om disse overholdes (påleggets fjerde punkt)

Av de BREF-BAT-konklusjoner som er vedtatt faller Saugbrugs kun inn under PP (Pulp and Paper) BREF.

Vi har også vurdert de BREF-BAT som er «på trappene» og om Saugbrugs faller inn under disse. Mer informasjon finnes i vedlegg 2.

1) LCP (Large Combustion Plants) BREF. Denne BREF omhandler forbrenningsanlegg med en nominell termisk effekt over 50MW. Anlegget til Saugbrugs ble ved bygging dimensjonert for 70 MW. Dersom Saugbrugs blir omfattet av BREF for LCP så blir følgende konklusjon gjeldende: Utslippsgrenser knyttet til HCl og SO2 vil medføre store investeringer i størrelsesorden 50 millioner kroner og økte driftskostnader i området 4 MNOK/år for Saugbrugs. Papirmarkedet er global og forslagene vil sette Saugbrugs i en uakseptabel kostnadsposisjon og forverre kostnadsposisjonen betraktelig. De andre parameterne vil Saugbrugs overholde.

Hvis derimot CEPI sitt innspill på utslippsgrenser blir gjeldende så vil Saugbrugs være innenfor disse grensene.

2) WT (Waste Treatment) BREF. Saugbrugs sitt biologiske renseanlegg for avløpsvann faller ikke inn under WT (Waste Treatment) BREF, siden mengden som håndteres er langt under den kapasitet som oppgis i forutsetningen til WT BREF. Denne BREF omhandler heller ikke deponier eller forbrenningsanlegg.

3) WI (Waste Incineration) BREF. Denne BREF dekker anlegg for forbrenning av farlig og kommunalt avfall. Saugbrugs er ikke omfattet av denne BREF siden fabrikken ikke forbrenner farlig avfall.

Vurdering av om Saugbrugs er omfattet av kravet om tilstandsrapport om mulig forurensing av grunn og grunnvann (påleggets femte punkt)

Området Tyska/Hollenderen

Områdene nord og vest for utløpet av Tista, kalt Tyska og Hollenderen, er tidligere benyttet til impregnering og lagring av trevirke. Her er det i tidligere undersøkelser påvist forurensede masser i grunnen. Ref. Scandiaconsults rapport, oppdrag 600440 "Miljøteknisk undersøkelse og risikovurdering av tidligere impregneringsverk" datert 26.01.2001.

Siden den gang er dette området solgt til Halden kommune, og Cowi AS utarbeidet i 2010 en rapport på oppdrag fra Halden kommune
"Tiltaksplan for graving i forurenset grunn. Området Tyska/Hollenderen" datert 23.09.2010.

Miljødirektoratet er godt kjent med denne problemstillingen. Dette området er etter salget i sin helhet Halden kommunes ansvar.

Øberg deponi

Øberg deponi ligger i et nedlagt grustak. Deponiet var i bruk i perioden 1992 – 2009. Fraksjoner som har vært deponert her er aske og bedsand fra multibrenselkjelen, barkholdig sand fra vaskeprosessen i tømmerrenseriet, slam fra vårt biologiske renseanlegg, bark og restavfall. Deponiet er avsluttet og følges opp av Norske Skog Saugbrugs i. h. t. kravene fra myndighetene. Miljødirektoratet er vår myndighetskontakt i denne oppfølgingen.

Brattli deponi

Norske Skog Saugbrugs ble i brev av 18.02.2005 fra Statens Forurensningstilsyn pålagt å foreta en miljøteknisk grunnundersøkelse av Brattli deponi (gnr/bnr 141/26, Halden kommune) for å avdekke mulig grunnforurensning ved det tidligere deponiet til Saugbrugs. Det refereres derfor til COWIs rapport "Norske Skog Saugbrugs. Undersøkelse av mulig grunnforurensning. Brattli, Gnr/bnr 141/26. Juni 2005». I rapportens sammendragskapittel står det under Tiltaksvurdering følgende:

«Siden det ikke kan påvises at spredning av miljøgifter fra området utgjør en uakseptabel risiko for resipienten, og at forurensning i grunnen heller ikke representerer en helserisiko, er det ikke anbefalt spesielle tiltak.
Det kan være aktuelt å tinglyse heftelse på eiendommen som viser at denne inneholder forurensninger i grunnen.»

For øvrig har Norske Skog Saugbrugs ikke kjennskap eller mistanke til andre områder med forurenset grunn. Om virksomheten er omfattet av kravet om tilstandsrapport om mulig forurensing av grunn og grunnvann, vurderes det ut fra redegjørelsen over, at Saugbrugs ikke er det.

Vedlegg 1

Information about the operation of Norske Skog Saugbrugs AS with respect to the EU BAT conclusions for the pulp and paper industry

Review of the relevant BAT's for Saugbrugs and BAT-AEL conclusions (chapter 8.1-8.7 in the document "Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board")

8.1 GENERAL BAT CONCLUSIONS FOR PULP AND PAPER INDUSTRY

BAT 1 Environmental management system - In order to improve the overall environmental performance of plants for the production of pulp, paper and board, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:

(a) commitment of the management, including senior management;
(b) definition of an environmental policy that includes the continuous improvement of the installation by the management;
(c) planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;
(d) implementation of procedures paying particular attention to:

(i) structure and responsibility
(ii) training, awareness and competence
(iii) communication
(iv) employee involvement
(v) documentation
(vi) efficient process control
(vii) maintenance programmes
(viii) emergency preparedness and response
(ix) safeguarding compliance with environmental legislation;

(e) checking performance and taking corrective action, paying particular attention to:

(i) monitoring and measurement (see also the Reference Document on the General Principles of Monitoring)
(ii) corrective and preventive action
(iii) maintenance of records
(iv) independent (where practicable) internal and external auditing in order to

determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;

- (f) **review of the EMS and its continuing suitability, adequacy and effectiveness by senior management;**
- (g) **following the development of cleaner technologies;**
- (h) **consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life;**
- (i) **application of sectoral benchmarking on a regular basis.**

<u>BAT conclusion for Saugbrugs</u>

General information: Saugbrugs is certified in accordance with ISO 14001, ISO 9001, ISO 50001, PEFC CoC, FSC CoC and EU Ecolabel.

(a), (b), (c), (d), (e), (f), (g), and (h) applies for Saugbrugs and is carried out. (i), sectorial benchmarking occurs but not on a regular basis.

BAT 2 Materials management and good housekeeping – BAT is to apply the principles of good housekeeping for minimising the environmental impact of the production process by using a combination of the techniques given below

	Technique
a	Careful selection and control of chemicals and additives
b	Input-output analysis with a chemical inventory, including quantities and toxicological properties
c	Minimise the use of chemicals to the minimum level required by the quality specifications of the final product
d	Avoid the use of harmful substances (e.g. nonylphenol ethoxylate-containing dispersion or cleaning agents or surfactants) and substitution by less harmful alternatives
e	Minimise the input of substances into the soil by leakage, aerial deposition and the inappropriate storage of raw materials, products or residues
f	Establish a spill management programme and extend the containment of relevant sources, thus preventing the contamination of soil and groundwater
g	Proper design of the piping and storage systems to keep the surfaces clean and to reduce the need for washing and cleaning

<u>BAT conclusions with respect to techniques (for Saugbrugs)</u>

a) Continuous assessment of chemical replacement possibilities. Summarised annually.
A specific group devoted to approve new chemicals (Kjemikalieutvalget)
b) Not done
c) Continuous surveillance as part of meetings on all levels, from morning meetings up to mill management meeting. Specific working group(s) dealing with mid and long term chemical consumption issues (kjemikaliegruppe / blekestrategigruppe)
d) Not applied, see also point a)
e) Storage, use and effluent does not pose significant risk to soil, or aerial. The BAK documentation is revised annually.
f) See e)
g) Part of plant design involving reputable consultants and best practice

BAT 3 Materials management and good housekeeping – In order to reduce the release of not readily biodegradable organic chelating agents such as EDTA or DTPA from peroxide bleaching, BAT is to use a combination of the techniques given below

	Technique	Applicability
a	Determination of quantity of chelating agents released to the environment through periodic measurements	Not applicable for mills that do not use chelating agents
b	Process optimisation to reduce consumption and emission of not readily biodegradable chelating agents	Not applicable for plants that eliminate 70 % or more of EDTA/DTPA in their waste water treatment plant or process
c	Preferential use of biodegradable or eliminable chelating agents, gradually phasing out non- degradable products	Applicability depends on the availability of appropriate substitutes (biodegradable agents meeting e.g. brightness requirements of pulp)

BAT conclusions with respect to techniques (for Saugbrugs)

a) Not done. Mass balances indicate that we eliminate significant chelating agent in the effluent treatment plant.
b) Used in bleaching of pulp. Dosage under continuous surveillance. Measurements show that 70% of the EDTA is eliminated in the waste water treatment.
c) Not done

BAT 4 Water and waste water management - In order to reduce the generation and the pollution load of waste water from wood storage and preparation, BAT is to use a combination of the techniques given below

	Technique	Applicability
a	Dry debarking (description see Section 8.7.2.1)	Restricted applicability when high purity and brightness is required with TCF bleaching
b	Handling of wood logs in such a way as to avoid the contamination of bark and wood with sand and stones	Generally applicable
c	Paving of the wood yard area and particularly the surfaces used for the storage of chips	Applicability may be restricted due to the size of the wood yard and storage area
d	Controlling the flow of sprinkling water and minimising surface run-off water from the wood yard	Generally applicable
e	Collecting of contaminated run-off water from the wood yard and separating out suspended solids effluent before biological treatment	Applicability may be restricted by the degree of contamination of run-off water (low concentration) and/or the size of the waste water treatment plant (large volumes)

The BAT-associated effluent flow **from dry debarking is 0.5 - 2.5 m^3/ADt**

BAT conclusions with respect to techniques for Saugbrugs

a) Dry debarking applied
b) Done. Wood/chips is not stored on sand/stones
c) Done. Woodyard and chips stored on paved areas
d) Done. Sprinkling is done only during summer
e) Not done. Run-off water from wood yard to recipient

BAT-AEL conclusion for Saugbrugs:
Saugbrugs complies with all techniques except e). Thus, with the combination of techniques applied Saugbrugs should be considered within this BAT. Collection, separation and pumping to effluent treatment will entail a significant investment. Saugbrugs is within the BAT-AEL.

BAT 5 Water and waste water management - In order to reduce fresh water use and generation of waste water, BAT is to close the water system to the degree technically feasible in line with the pulp and paper grade manufactured by using a combination of the techniques given below

	Technique	Applicability
a	Monitoring and optimising water usage	Generally applicable
b	Evaluation of water recirculation options	
c	Balancing the degree of closure of water circuits and potential drawbacks; adding additional equipment if necessary	
d	Separation of less contaminated sealing water from pumps for vacuum generation and reuse	
e	Separation of clean cooling water from contaminated process water and reuse	
f	Reusing process water to substitute for fresh water (water recirculation and closing of water loops)	Applicable to new plants and major refurbishments. Applicability may be limited due to water quality and/or product quality requirements or due to technical constraints (such as precipitation/incrustation in water system) or increase odour nuisance
g	In-line treatment of (parts of) process water to improve water quality to allow for recirculation or reuse	Generally applicable

The BAT-associated waste water flow at the point of discharge after waste water treatment as yearly averages are:

Sector	BAT-associated waste water flow
Bleached kraft	25 - 50 m^3/ADt
Unbleached kraft	15 - 40 m^3/ADt
Bleached sulphite paper grade pulp	25 - 50 m^3/ADt
Magnefite pulp	45 - 70 m^3/ADt
Dissolving pulp	40 - 60 m^3/ADt
NSSC pulp	11 - 20 m^3/ADt
Mechanical	9 - 16 m^3/t
CTMP and CMP	9 - 16 m^3/ADt
RCF paper mills without deinking	1.5 - 10 m^3/t (the higher end of the range is associated with mainly folding boxboard production)
RCF paper mills with deinking	8 - 15 m^3/t
RCF-based tissue paper mills with deinking	10 - 25 m^3/t
Non-integrated paper mills	3.5 - 20 m^3/t

BAT conclusions with respect to techniques for Saugbrugs

a) Done. Continuous follow up of water flow to effluent treatment and follow up of specific water consumption

b) Partially done. Filtrates has replaced fresh water on several positions bringing overall consumption within BAT. Using effluent not considered.
c) See b)
d) Generally not done apart from a few positions.
e) Done
f) NA
g) Done. Highly filtered water reused.

BAT-AEL conclusion for Saugbrugs: Generally Saugbrugs is within BAT effluent flows of 9-16 m3/Adt.

BAT 6 Energy consumption and efficiency - In order to reduce fuel and energy consumption in pulp and paper mills, BAT is to use technique (a) and a combination of the techniques given below

	Technique	Applicability
a	Use an energy management system that includes all of the following features: i. Assessment of the mill's overall energy consumption and production ii. Locating, quantifying and optimising the potentials for energy recovery iii. Monitoring and safeguarding the optimised situation for energy consumption	Generally applicable
b	Recover energy by incinerating those wastes and residues from the production of pulp and paper that have high organic content and calorific value, taking into account BAT 12	Only applicable if the recycling or reuse of wastes and residues from the production of pulp and paper with a high organic content and high calorific value is not possible
c	Cover the steam and power demand of the production processes as far as possible by the cogeneration of heat and power (CHP)	Applicable for all new plants and for major refurbishments of the energy plant. Applicability in existing plants may be limited due to the mill layout and available space
d	Use excess heat for the drying of biomass and sludge, to heat boiler feedwater and process water, to heat buildings, etc.	Applicability of this technique may be limited in cases where the heat sources and locations are far apart
e	Use thermo compressors	Applicable to both new and existing plants for all grades of paper and for coating machines, as long as medium pressure steam is available
f	Insulate steam and condensate pipe fittings	Generally applicable
g	Use energy efficient vacuum systems for dewatering	
h	Use high efficiency electrical motors, pumps and agitators	
i	Use frequency inverters for fans, compressors and pumps	
j	Match steam pressure levels with actual pressure needs	

Description

Technique (c): simultaneous generation of heat energy and electrical and/or mechanical energy in a single process, referred to as a combined heat and power plant (CHP). CHP plants in the pulp and paper industry normally apply steam turbines and/or gas turbines. The economic viability (achievable savings and payback time) will depend mainly on the cost of electricity and fuels.

BAT conclusions with respect to techniques for Saugbrugs
Saugbrugs is in a good position for total energy use.

a) i. Part of KPI's. KPI's for energy use is hierarchical and available from the top level of overall energy performance in terms of kWh/ton paper and to lower levels KPI's for all production departments having significant energy use. ii. plans for energy optimization and saving is part of annual strategy for the mill. iii. Part of KPI and energy plans follow up.
b) Mill generated waste is burnt in the mills LCP bio boiler.
c) The mill does not generate electrical power, but available energy from burning of sludge, bark and internal waste is used for generation of thermal energy of which all is used internally. Acquiring a turbine to generate electricity from steam pressure reduction has been evaluated on several occasions but not found profitable.
d) This is done to some extent. Boiler feed water is pre-heated and fresh water to process consumption is to some extent pre-heated with excess hot water energy.
e) The use of thermo compressors has no reasonable application at the mill. There is no low pressure steam available.
f) Steam and condensate piping is insulated, along with most other piping.
g) Energy efficient vacuum systems is used.
h) The acquisition of electrical motors, pumps and agitators is subject to LCC analysis where energy efficiency is a key criteria.
i) Frequency converters are increasingly used for pumps and compressors. Fans generally do not have frequency converters.
j) Steam pressure is matched to the demand. The by far largest consumption is for PM dryer sections, driving steam network pressure design.

BAT 7 Emissions of odour - In order to prevent and reduce the emission of odorous compounds originating from the waste water system, BAT is to use a combination of the techniques given below

	Technique
I Applicable for odours related to water systems closure	
a	**Design paper mill processes, stock and water storage tanks, pipes and chests in such a way as to avoid prolonged retention times, dead zones or areas with poor mixing in water circuits and related units, in order to avoid uncontrolled deposits and the decay and decomposition of organic and biological matter**
b	**Use biocides, dispersants or of oxidising agents (e.g. catalytic disinfection with hydrogen peroxide) to control odour and decaying bacteria growth**
c	**Install internal treatment processes ('kidneys') to reduce the concentrations of organic matter and consequently possible odour problems in the white water system**
II Applicable for odours related to waste water treatment and sludge handling, in order to avoid conditions where waste water or sludge becomes anaerobic	
a	**Implement closed sewer systems with controlled vents, using chemicals in some cases to reduce the formation of and to oxidise hydrogen sulphide in sewer systems**
b	**Avoid over-aeration in equalisation basins but maintain sufficient mixing**
c	**Ensure sufficient aeration capacity and mixing properties in aeration tanks; revise the aeration system regularly**
d	**Guarantee proper operation of secondary clarifier sludge collection and return sludge pumping**
e	**Limit the retention time of sludge in sludge storages by sending the sludge continuously to the dewatering units**
f	**Avoid the storage of waste water in the spill basin longer than is necessary; keep the spill basin empty**

g	**If sludge dryers are used, treatment of thermal sludge dryer vent gases by scrubbing and/or bio filtration (such as compost filters)**
h	**Avoid air cooling towers for untreated water effluent by applying plate heat exchangers**

<u>BAT conclusions with respect to techniques for Saugbrugs</u>
Apart from very local spots within the mill, Saugbrugs does not have problems with odour. There are rarely any neighbor complaints related to odour.

I a) Prolonged retention times in tanks etc resulting in decay/decomposition and corresponding odour is not a problem at Saugbrugs.
I b) pH, retention time and temperatures makes the use of biocides, dispersants and oxidizing agents for odour control not necessary
I c) NA

II a) NA
II b) No aeration in equalization basins is implemented, hence over-aeration is not a problem
II c) Aeration in aeration basins is under closed loop or operator control. Thus continuously close to design aeration.
II d) Secondary clarifier sludge handling is collection, pumping, dewatering and burning without unnecessary storage.
II e) Sludge is continuously dewatered and burnt under normal circumstances. Storage of dewatered sludge may occur outdoors, creating local odour.
II f) No waste water is stored in spill basins.
II g) NA. Sludge dryers are not used. Sludge is dewatered with presses.
II h) NA. Air cooling towers not in use. Note the recommendation to use plate heat exchangers

BAT 8 Monitoring of key process parameters and of emissions to water and air - BAT is to monitor the key process parameters according to the table given below

I. Monitoring key process parameters relevant for emissions to air	
Parameter	**Monitoring frequency**
Pressure, temperature, oxygen, CO and water vapour content in flue-gas for combustion processes	Continuous
II. Monitoring key process parameters relevant for emissions to water	
Parameter	**Monitoring frequency**
Water flow, temperature and pH	Continuous
P and N content in biomass, sludge volume index, excess ammonia and ortho-phosphate in the effluent, and microscopy checks of the	Periodic
Volume flow and CH_4 content of biogas produced in anaerobic waste water treatment	Continuous
H_2S and CO_2 contents of biogas produced in anaerobic waste water treatment	Periodic

BAT conclusions with respect to techniques for Saugbrugs

I Pressure, temperature, oxygen, CO and water vapour in flue-gas from combustion is monitored with on-line analyzers.

II Water flow, temperature and pH is continuously monitored for emission flows. P and N is monitored on generally daily (sometimes longer) basis in biomass. Also sludge volume index, excess ammonia is monitored similarly. Microscopy of biomass is done less regularly, but still frequent.
Analysis of H_2S and CO_2 contents in biogas produced in anaerobic waste water treatment is not done.

BAT 9 Monitoring of key process parameters and of emissions to water and air - BAT is to carry out the monitoring and measurement of emissions to air, as indicated below, on a regular basis with the frequency indicated and according to EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality

	Parameter	Monitoring frequency	Applicability	Monitoring associated with
a	NO_x and SO_2	Continuous	Recovery boiler	BAT 21 BAT 22 BAT 36 BAT 37
		Periodic or continuous	Lime kiln	BAT 24 BAT 26
		Periodic or continuous	Dedicated TRS burner	BAT 28 BAT 29
b	Dust	Periodic or continuous	Recovery boiler (kraft) and lime kiln	BAT 23 BAT 27
		Periodic	Recovery boiler (sulphite)	BAT 37
c	TRS (including H_2S)	Continuous	Recovery boiler	BAT 21
		Periodic or continuous	Lime kiln and dedicated TRS burner	BAT 24 BAT 25 BAT 28
		Periodic	Diffuse emissions from different sources (e.g. the fibre line, tanks, chip bins, etc.) and residual weak gases	BAT 11 BAT 20
d	NH_3	Periodic	Recovery boiler equipped with SNCR	BAT 36

BAT conclusions with respect to techniques for Saugbrugs
NA. Saugbrugs does not have recovery boilers. TRS is not measured from fibre lines and chip bins etc.

BAT 10 Monitoring of key process parameters and of emissions to water and air - BAT is to carry out the monitoring and measurement of emissions to water, as indicated below, with the frequency indicated and according to EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

<table>
<tr><th></th><th>Parameter</th><th>Monitoring frequency</th><th>Monitoring associated with</th></tr>
<tr><td>a</td><td>Chemical oxygen demand (COD) or Total organic carbon (TOC) (')</td><td>Daily (2)(3)</td><td rowspan="6">BAT 19
BAT 33
BAT 40
BAT 45
BAT 50</td></tr>
<tr><td>b</td><td>BOD_5 or BOD_7</td><td>Weekly (once a week)</td></tr>
<tr><td>c</td><td>Total suspended solids (TSS)</td><td>Daily (2)(3)</td></tr>
<tr><td>d</td><td>Total nitrogen</td><td>Weekly (once a week) (2)</td></tr>
<tr><td>e</td><td>Total phosphorus</td><td>Weekly (once a week) (2)</td></tr>
<tr><td>f</td><td>EDTA, DTPA (4)</td><td>Monthly (once a month)</td></tr>
<tr><td rowspan="2">g</td><td rowspan="2">AOX (according to EN ISO 9562:2004) (5)</td><td>Monthly (once a month)</td><td>BAT 19: bleached kraft</td></tr>
<tr><td>Once every two months</td><td>BAT 33: except TCF and NSSC mills
BAT 40: except CTMP and CMP mills
BAT 45
BAT 50</td></tr>
<tr><td>h</td><td>Relevant metals (e.g. Zn, Cu, Cd, Pb, Ni)</td><td>Once a year</td><td></td></tr>
</table>

(') There is a trend to replace COD by TOC for economic and ecological reasons. If TOC is already measured as a key process parameter, there is no need to measure COD; however, a correlation between the two parameters should be established for the specific emission source and waste water treatment step.

(2) Rapid test methods can also be used. The results of rapid tests should be checked regularly (e.g. monthly) against EN standards or, if EN standards are not available, against ISO, national or other international standards which ensure the provision of data of an equivalent scientific quality.

(3) For mills operating less than seven days a week, the monitoring frequency for COD and TSS may be reduced to cover the days the mill is in operation or to extend the sampling period to 48 or 72 hours.

(4) Applicable where EDTA or DTPA (chelating agents) are used in the process.

(5) Not applicable to plants that provide evidence that no AOX is generated or added via chemical additives and raw materials.

BAT conclusions with respect to techniques for Saugbrugs

a) COD is measured on a daily basis, but not during weekends in which a sample representative for the whole weekend is analyzed. (Standard used: Merch. ISO 15705-2002)
b) BOD5 is measured on a regular basis. From January 2016 samples for BOD5 analysis are taken out once a week. The lab measurement is done every second week. (Standard used: NS EN 1899-1 Mod.)
c) Total suspended solids is measured as for a). (Standard used: NS 4733 2. Edition)
d) Total nitrogen is measured as for a). (Standard used: HACH-Lange LCK 138/238)
e) Total phosphorous is measured as for a). (Standard used: ISO 6878-2004)
f) EDTA and DTPA is not measured. We use 4,5 kg pr tonne produced*0,4 (active). ~70% of this is broken down.
g) NA
h) Measured 4 times a year. (Standard used: NS-EN ISO17294-2)

BAT 11 Monitoring of key process parameters and of emissions to water and air - BAT is to regularly monitor and assess diffuse total reduced sulphur emissions from relevant sources.

Description

The assessment of diffuse total reduced sulphur emissions can be done by periodic measurement and assessment of diffuse emissions that are emitted from different sources (e.g. the fibre line, tanks, chip bins etc.) by direct measurements.

BAT conclusions with respect to techniques for Saugbrugs

Not done

BAT 12 Waste management - In order to reduce the quantities of wastes sent for disposal, BAT is to implement a waste assessment (including waste inventories) and management system, so as to facilitate waste reuse, or failing that, waste recycling, or failing that, 'other recovery', including a combination of the techniques given below

	Technique	Description	Applicability
a	Separate collection of different waste fractions (including separation and classification of hazardous waste)	See Section 8.7.3	Generally applicable
b	Merging of suitable fractions of residues to obtain mixtures that can be better utilized		Generally applicable
c	Pretreatment of process residues before reuse or recycling		Generally applicable
d	Material recovery and recycling of process residues on site		Generally applicable
e	Energy recovery on- or off-site from wastes with high organic content		For off-site utilisation, the applicability depends on the availability of a third party
f	External material utilization		Depending on the availability of a third party
g	Pretreatment of waste before disposal		Generally applicable

BAT conclusions with respect to techniques for Saugbrugs

Saugbrugs applies a waste management programme entailing separate collection of different waste fraction and contracts with third party companies to handle wastes not burnt at site. The programme is subject to ISO certification. The programme is compliant with the 7 techniques listed in the BAT.

BAT 13 Emissions to water - In order to reduce nutrient (nitrogen and phosphorus) emissions into receiving waters, BAT is to substitute chemical additives with high nitrogen and phosphorus contents by additives containing low nitrogen and phosphorus contents.

Applicability

Applicable if the nitrogen in the chemical additives is not bioavailable (i.e. it cannot serve as nutrient in biological treatment) or if the nutrient balance is in surplus.

BAT conclusions with respect to techniques for Saugbrugs

Nutrient emissions is not in surplus, but added to effluent treatment.

BAT 14 Emissions to water - In order to reduce emissions of pollutants into receiving waters, BAT is to use all of the techniques given below

	Technique	Description
a	Primary (physico-chemical) treatment	See Section 8.7.2.2
b	Secondary (biological) treatment (')	
(') Not applicable to plants where the biological load of waste water after the primary treatment is very low, e.g. some paper mills producing speciality paper.		

<u>BAT conclusions with respect to techniques for Saugbrugs</u>
Both techniques are applied.

BAT 15 Emissions to water - When further removal of organic substances, nitrogen or phosphorus is needed, BAT is to use tertiary treatment as described in Section 8.7.2.2.

<u>BAT conclusions with respect to techniques for Saugbrugs</u>
Tertiary treatment in the form of a flotation basin is applied.

BAT 16 Emissions to water - In order to reduce emissions of pollutants into receiving waters from biological waste water treatment plants, BAT is to use all of the techniques given below

	Technique
a	Proper design and operation of the biological treatment plant
b	Regularly controlling the active biomass
c	Adjustment of nutrition supply (nitrogen and phosphorus) to the actual need of the active biomass

<u>BAT conclusions with respect to techniques for Saugbrugs</u>

a) A proper design and operation of the biological treatment plant is applied
b) Biomass is controlled by on site laboratory and plant operators on a daily basis
c) The adding of nutrition to the effluent treatment plant is continuously monitored and adjusted by operators.

BAT 17 Emissions of noise - In order to reduce the emissions of noise from pulp and paper manufacturing, BAT is to use a combination of the techniques given below

<table>
<tr><th></th><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a</td><td>Noise-reduction programme</td><td>A noise-reduction programme includes identification of sources and affected areas, calculations and measurements of noise levels in order to rank sources according to noise levels, and identification of the most cost effective combination of techniques, their implementation and monitoring</td><td>Generally applicable</td></tr>
<tr><td>b</td><td>Strategic planning of the location of equipment, units and buildings</td><td>Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens</td><td>Generally applicable to new plants. In the case of existing plants, the relocation of equipment and production units may be restricted by the lack of space or by excessive costs</td></tr>
<tr><td>c</td><td>Operational and management techniques in buildings containing noisy equipment</td><td>This includes:
- improved inspection and maintenance of equipment to prevent failures
- closing of doors and windows of covered areas
- equipment operation by experienced staff
- avoidance of noisy activities during night-time
- provisions for noise control during maintenance activities</td><td rowspan="4">Generally applicable</td></tr>
<tr><td>d</td><td>Enclosing noisy equipment and units</td><td>Enclosure of noisy equipment, such as wood handling, hydraulic units, and compressors in separate structures, such as buildings or soundproofed cabinets, where internal-external lining is made of impact-absorbent material</td></tr>
<tr><td>e</td><td colspan="2">Use of low-noise equipment and noise-reducers on equipment and ducts</td></tr>
<tr><td>f</td><td>Vibration insulation</td><td>Vibration insulation of machinery and decoupled arrangement of noise sources and potentially resonant components</td></tr>
<tr><td>g</td><td>Soundproofing of buildings</td><td>This potentially includes use of:
- sound-absorbing materials in walls and ceilings
- sound-isolating doors
- double-glazed windows</td><td></td></tr>
<tr><td>h</td><td>Noise abatement</td><td>Noise propagation can be reduced by inserting barriers between emitters and receivers. Appropriate barriers include protection walls, embankments and buildings. Suitable noise abatement techniques include fitting silencers and attenuators to noisy equipment such as steam releases and dryer vents</td><td>Generally applicable to new plants. In the case of existing plants, the insertion of obstacles may be restricted by the lack of space</td></tr>
<tr><td>i</td><td colspan="2">Use of larger wood-handling machines to reduce lifting and transport times and noise from logs falling onto log piles or the feed table</td><td rowspan="2">Generally applicable</td></tr>
<tr><td>j</td><td colspan="2">Improved ways of working, e.g. releasing logs from a lower height onto the log piles or the feed table; immediate feedback of the level of noise for the workers</td></tr>
</table>

BAT conclusions with respect to techniques for Saugbrugs

a) A noise assessment programme is applied including third party comprehensive measurements. Actions taken according to conclusions.
b) Applied to new equipment being installed.
c) All 5 sub points applied
d) Equipment enclosure done to keep noise emissions below max target levels.
e) Use of low noise equipment and noise reducers is considered when new equipment is acquired or noise measurements indicate above max noise levels.
f) NA
g) Buildings and fitted windows and doors reduce noise to acceptable levels. Focus on keeping doors closed.
h) Done if noise measurements indicate above target levels.
i) Noise from falling logs eliminated in 2013 when SGW plant was shut down.
j) NA

BAT 18 Decommissioning - In order to prevent pollution risks when decommissioning a plant, BAT is to use the general techniques given below

	Technique
a	Ensure that underground tanks and piping are either avoided in the design phase or that their location is well known and documented.
b	Establish instructions for emptying process equipment, vessels and piping.
c	Ensure a clean closure when the facility is shut down, e.g. to clean up and rehabilitate the site. Natural soil functions should be safeguarded, if feasible.
d	Use a monitoring programme, especially relative to groundwater, in order to detect possible future impacts on site or in neighbouring areas.
e	Develop and maintain a site closure or cessation scheme, based on risk analysis, that includes a transparent organisation of the shutdown work, taking into account relevant local specific conditions.

a) To be implemented in new projects, rebuilds etc.
b-e) Part of eventual decommissioning project

BAT 19-39 are NA

8.4 BAT CONCLUSIONS FOR MECHANICAL PULPING

BAT 40 Waste water and emissions to water - In order to reduce fresh water use, waste water flow, and the pollution load, BAT is to use a suitable combination of the techniques specified in BAT 13, BAT 14, BAT 15 and BAT 16 and of the techniques given below

	Technique	Description	Applicability
a	Counter-current flow of process water and separation of water systems	See Section 8.7.2.1	Generally applicable
b	High consistency bleaching		
c	Washing stage before the refining of softwood mechanical pulp using chip pretreatment		
d	Substitution of NaOH by $Ca(OH)_2$ or $Mg(OH)_2$ as alkali in peroxide bleaching		Applicability for the highest brightness levels may be restricted
e	Fibre and filler recovery and treatment of white water (papermaking)		Generally applicable
f	Optimum design and construction of tanks and chests (papermaking)		

BAT-associated emission levels
See Table 8.16. The BAT-AELs also apply to mechanical pulp mills. The reference waste water flow for integrated mechanical, CTM and CTMP pulp mills are set out in BAT 5.

Table 8.16: BAT-associated emission levels for the direct waste water discharge to receiving waters from the integrated production of paper and board from mechanical pulps produced on site

Parameter	Yearly average kg/t
Chemical oxygen demand (COD)	0.9 - 4.5 (1)
Total suspended solids (TSS)	0.06 - 0.45
Total nitrogen	0.03 - 0.1 (2)
Total phosphorus	0.001 - 0.01

ı the case of highly bleached mechanical pulp (70 - 100 % of fibre in final paper), emission levels of up to 8 kg/t may occur.
Vhen biodegradable or eliminable chelating agents cannot be used due to pulp quality requirements (e.g. high brightness), the emissions of total nitrogen might be higher than this BAT-AEL and should be assessed on a case-by-case basis.

The BOD concentration in the treated effluents is expected to be low (around 25 mg/l as a 24-hour composite sample).

<u>BAT conclusions with respect to techniques for Saugbrugs</u>

a) Counter flow of process water is generally applied
b) High consistency bleaching is applied
c) Chips undergo washing before refining.
d) $Mg(OH)_2$ replaced NaOH as alkali source many years ago.
e) Disc filters are used for recovering fibres and fillers plus white water treatment.
f) Design and construction of tanks is performed as part of larger investment projects partnered with consultants. This ensures optimal design.

BAT-AEL conclusion for Saugbrugs:
An initial remark is that Saugbrugs is currently investing in a 150 MNOK revamp in the effluent treatment plant. A new anaerobic reactor will come on stream in 2017.

COD
The existing specific COD emission limit for Saugbrugs is 5 kg/tonne (yearly average) and BAT levels are 0,9– 4,5 kg/tonne according to table 8.16. Measured and reported figures from Saugbrugs are periodically higher than the existing limit of 5 kg/tonne. Saugbrugs, being a mill with peroxide bleaching and a high content of mechanical fibres in final paper, should be subject to footnote 1, indicating a level of up to 8 kg/tonne. Around 90% of the total fibre material in the SC paper from Saugbrugs is thermomechanical pulp (TMP). The TMP content has moved upwards the last years.

TSS
Saugbrugs does presently not comply with the BAT-AEL of up to 0,45 kg TSS/tonne (table 8.16). See the calculation of yearly emission of total suspended solids (TSS) below:

Existing discharge permit: 1,1 tonne TSS/day * 365 day =	402 tonne TSS
Actual 2013: 0,34 kg TSS/tonne * 465737 tonne =	158 tonne TSS
Actual 2014: 0,74 kg TSS/tonne * 433796 tonne =	321 tonne TSS
Actual 2015: 0,78 kg TSS/tonne * 420693 tonne =	328 tonne TSS
BAT-AEL: 0,45 kg TSS/tonne * 435000(1) tonne =	196 tonne TSS

(1) 435000 tonne production corresponds to Saugbrugs targeted production volume in 2016.

This means that the emission of TSS according to the BAT-AEL is around half of the existing discharge permit.

Total nitrogen
See the calculation of yearly emission of total Nitrogen (total N) below:

Existing discharge permit: 180 kg total N/day * 365 day =	65700 kg total N
Actual 2013: 102,04 g total N/tonne * 465737 tonne =	47524 kg total N
Actual 2014: 117,73 g total N/tonne * 433796 tonne =	51070 kg total N
Actual 2015: 126,43 g total N/tonne * 420693 tonne =	53188 kg total N
BAT-AEL: 0,1 kg total N/tonne * 435000(1) tonne =	43500 kg total N

The proposed BAT-AEL is around 30% lower than the existing discharge permit.
Today Saugbrugs does not comply with total nitrogen BAT-AEL (table 8.16), but could probably be achieved in the existing ETP-process provided a COD permission of 8 kg/tonne according to table 8.16. Footnote 2 in table 8.16 applies for Saugbrugs: "When biodegradable or eliminable chelating agents cannot be used due to pulp quality requirements (e.g. high brightness), the emissions of total nitrogen might be higher than this BAT-AEL and should be assessed on a case-by-case basis". Readily biodegradable complexing agents do not have the same efficiency in the pretreatment of pulp before bleaching as EDTA (which we use today).

Total phosphorus
See the calculation of yearly emission of total phosphorus (total P) below:

Existing discharge permit: 15 kg total N/day * 365 day =	5475 kg total P
Actual 2013: 8,49 g total P/tonne * 465737 tonne =	3954 kg total P
Actual 2014: 14,22 g total P/tonne * 433796 tonne =	6168 kg total P
Actual 2015: 15,29 g total P/tonne * 420693 tonne =	6432 kg total P
BAT-AEL: 0,01 kg total P/tonne * 435000(1) tonne =	4350 kg total P

The proposed BAT-AEL is around 20% lower than the existing discharge permit. Today Saugbrugs does not comply with total phosphorous BAT-AEL (table 8.16).

Nutrients – operation of the ETP, dosages of nutrients and effluent effects
The additions of nutrients (urea and phosphoric acid) to adjust the C:N:P-ratio are essential to obtain stable operation of the ETP and thereby comply with the permission limits. Our experience is that we get the lowest COD and suspended material emissions when allowing emissions of total nitrogen and total phosphorous close to our current permission limits. Moving outside this operational window makes us fail in complying with the regulations on COD and suspended solids. As the suspended solids mainly consist of residues from the active sludge treatment (biological material containing according to literature ~12% N and 2% P), it contributes to failing also on total phosphorous and total nitrogen emissions.

Therefore, stricter regulations on total nitrogen and total phosphorous could make it harder to comply with all emission limits, even including total nitrogen and total phosphorous.

Normal operation
An initial remark is that Saugbrugs is currently reporting all observations, not restricting this to periods of "normal operation". The specific emission limit of COD is a yearly average. The other emission limits are yearly or monthly averages per 24 hours.

Specific emission levels (emission parameter per tonne produced paper): Start and stop situations and unplanned paper machine breakdown can result in normal load in the effluent treatment plant, but because of low paper production there will be few or no tonnes of paper to spread the emission parameter on. This will lead to a very high specific value. This will not be compensated on days when we consume the already produced pulp stock. Given that the emission is 5 tonne COD to recipient as a monthly average. On a normal day we produce around 1300 tonnes of paper (95% dry substance or 1372 tonne Adt) and say we get a specific COD of 3,8 kg/tonne. On a day with paper machine stops the COD emission to recipient can still be 5 tonne, but then the paper production might be 100 tonnes. The specific COD will then become 50 kg/tonne for this day. On a stop day for the TMP plant the COD emission can be reduced to 2,5 tonne that can be divided by 1300 tonne. This will give a specific COD emission of 1,9 kg/tonne. When calculating the average the 50 kg/tonne will have more impact than the 1,9 kg/tonne, but none of the values should have been a part of the calculation of the average. Such misleading calculation can be avoided by discarding values from irregular production days. "Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board, Annex II, 10.2.1 Variation of emissions during different reference periods", discusses what values to include in the data for emission calculations. It is stated: "BAT-AELs for daily average reference periods are based on an outlier- adjusted data set. This approach corresponds to normal operating conditions which means that extraordinary failures or disruptions are excluded" and "A simple method to dismiss atypical peak values to establish BAT-AELs is to calculate the 95th percentile for the daily average values. Other percentiles and approaches are also possible and are applied in Europe."

BAT 41 Energy consumption and efficiency - In order to reduce the consumption of thermal and electrical energy, BAT is to use a combination of the techniques given below

	Technique	Applicability
a	Use of energy efficient refiners	Applicable when replacing, rebuilding or upgrading process equipment
b	Extensive recovery of secondary heat from TMP and CTMP refiners and reuse of recovered steam in paper or pulp drying	Generally applicable
c	Minimisation of fibre losses by using efficient reject refining systems (secondary refiners)	
d	Installation of energy saving equipment, including automated process control instead of manual systems	
e	Reduction of fresh water use by internal process water treatment and recirculation systems	
f	Reduction of the direct use of steam by careful process integration using e.g. pinch analysis	

BAT conclusions with respect to techniques for Saugbrugs

a) Saugbrugs applies the use of high consistency and high intensive double disc refining resulting in low refining specific energy. Double disc refiners are energy efficient.
b) All process steam from refining is subject to reboiling
c) All rejects are subjected reject refining, apart from 0.5 % of production which is under closed loop control to effluent. The fractions, being rejected from 2nd stage screening and 6th stage cleaners are not suitable for paper production.
d) Energy saving equipment is preferred, and automated process control is implemented.
e) Process water is recirculated and subject to counter flow to such an extent that Saugbrugs complies with specific effluent volumes BAT.
f) The direct use of steam is limited and subject to energy optimization continuous programme.

8.6 BAT CONCLUSIONS FOR PAPERMAKING AND RELATED PROCESSES

BAT 47 Waste water and emissions to water - In order to reduce the generation of waste water, BAT is to use a combination of the techniques given below

	Technique	Description	Applicability
a	Optimum design and construction of tanks and chests	See Section 8.7.2.1	Applicable to new plants and to existing plants in the case of a major refurbishment
b	Fibre and filler recovery and treatment of white water		Generally applicable
c	Water recirculation		Generally applicable. Dissolved organic, inorganic, and colloidal materials may restrict the water reuse in the wire section
d	Optimisation of showers in the paper machine		Generally applicable

BAT conclusions with respect to techniques

a) The process equipment for the paper machines are designed by leading paper mill engineering companies. PM6 was designed in 1992 by CTS. The design was based on best practice. PM4 and PM5 are of somewhat elderly design. They were designed using the best available knowledge at the time being.

b) All 3 paper machines have modern save all disc filters for recovery of filler and fines from the white water. The disc filter is considered BAT.

c) The 3 paper machines use recirculated process water in all positions where applicable. They use fresh water in high pressure showers which is also compliant to BAT.

d) Optimization of showers in the paper machine. Generally the showers are optimized in order to achieve good cleaning function. In some positions, water amount has been possible to limit.

BAT 48 Waste water and emissions to water - In order to reduce fresh water use and emissions to water from speciality paper mills, BAT is to use a combination of the techniques given below

	Technique	Description	Applicability
a	Improvement of paper production planning	Improved planning to optimise production batch combinations and length	Generally applicable
b	Management of water circuits to fit changes	Adjust water circuits to be able to cope with changes of paper grades, colours and chemical additives used	
c	Waste water treatment plant ready to cope with changes	Adjust waste water treatment to be able to cope with variations of flows, low concentrations and varying types and amounts of chemical additives	
d	Adjustment of the broke system and of chest capacities		
e	Minimisation of release of chemical additives (e.g. grease-/water proof agents) containing per- or polyfluorinated compounds or contributing to their formation		Applicable only for plants producing paper with grease- or water-repellent properties
f	Switch to low AOX-containing product aids (e.g. to substitute use of wet strength agents based on epichlorohydrin resins)		Applicable only for plants producing paper grades with high wet strength

<u>BAT conclusions with respect to techniques for Saugbrugs</u>

a) Production planning is driven by market demands. From a productivity point of view the batch lengths are preferred to be as long as possible which is of mutual interest with the BAT requirements.

b) The 3 paper machines produce qualities that do not require change of process water when changing grades. We do not i.e produce different coloured paper etc.

c) Waste water plant is given notice prior to any planned dumps of water systems and towers. Prior to major mill shuts a drainage plan is laid in order to minimize the drawbacks for the effluent plant.

d) Broke stored volume is run in counter phase to white water volume in order to minimize over run in case of brakes on the paper machines and sudden need for freshwater intake.

e) NA

f) NA

BAT 49 Waste water and emissions to water - In order to reduce emission loads of coating colours and binders which can disturb the biological waste water treatment plant, BAT is to use technique (a) given below or, in case this is technically not feasible, technique (b) given below

	Technique	Description	Applicability
a	Recovery of coating colours/recycling of pigments	Effluents containing coating colours are collected separately. The coating chemicals are recovered by e.g.: i) ultrafiltration; :reening-flocculationdewatering process with return of the pigments to the coating process. The clarified water could be reused in the process	For ultrafiltration, the applicability may be restricted when: - effluent volumes are very small - coating effluents are generated in various places of the mill - many changes in coating occur; or - different coating colour recipes are incompatible
b	Pretreatment of effluents which contain coating colours	Effluents which contain coating colours are treated e.g. by flocculation to protect the subsequent biological waste water treatment	Generally applicable

<u>BAT conclusions with respect to techniques for Saugbrugs</u>

a) and b) Saugbrugs has no coating of paper. BAT 49 do not apply for the mill.

BAT 50 Waste water and emissions to water - In order to prevent and reduce the pollution load of waste water into receiving waters from the whole mill, BAT is to use a suitable combination of the techniques specified in BAT 13, BAT 14, BAT 15, BAT 47, BAT 48 and BAT 49.

BAT-associated emission levels
See Table 8.20 and Table 8.21.

The BAT-AELs in Table 8.20 and Table 8.21 also apply to the paper and board making process of integrated kraft, sulphite, CTMP and CMP pulp and paper mills.

The reference waste water flow for non-integrated paper and board mills is set out in BAT 5.

Table 8.20: BAT-associated emission levels for the direct waste water discharge to receiving waters from a non-integrated paper and board mill (excluding speciality paper)

Parameter	Yearly average kg/t
Chemical oxygen demand (COD)	0.15 - 1.5 ([1])
Total suspended solids (TSS)	0.02 - 0.35
Total nitrogen	0.01 - 0.1 0.01 - 0.15 for tissue paper
Total phosphorus	0.003 - 0.012
Adsorbable organically bound halogens (AOX)	0.05 for decor and wet strength paper

([1]) For graphic paper mills, the upper end of the range refers to mills manufacturing paper that use starch for the coating process.

The BOD concentration in the treated effluents is expected to be low (around 25 mg/l as a 24-hour composite sample).

Table 8.21: BAT-associated emission levels for the direct waste water discharge to receiving waters from a non-integrated speciality paper mill

Parameter	Yearly average kg/t (')
Chemical oxygen demand (COD)	0.3 - 5 (2)
Total suspended solids (TSS)	0.10 - 1
Total nitrogen	0.015 - 0.4
Total phosphorus	0.002 - 0.04
Adsorbable organically bound halogens (AOX)	0.05 for decor and wet strength paper
Iills having special characteristics, such as a high number of grade changes (e.g. of > 5 per day as a yearly average) or producing very light-weight speciality papers (< 30 g/m^2 as yearly average) might have higher emissions than the upper end of the range. he upper end of the BAT-AEL range refers to mills producing highly comminuted paper which requires intensive refining and to mills with frequent changes of paper grades (e.g. >1 - 2 changes/day as yearly average).	

<u>BAT conclusions with respect to techniques for Saugbrugs</u>
BAT 50 see BAT 13, BAT 14, BAT 15, BAT 47, BAT 48 and BAT 49. Tables 8.20 and 8.21 give guidelines to non integrated mills. Saugbrugs is an integrated pulp and paper manufacturer.

BAT 51 Emissions to air - In order to reduce VOC emissions from off-line or on-line coaters, BAT is to choose coating colour recipes (compositions) that reduce VOC emissions.

<u>BAT conclusions with respect to techniques for Saugbrugs</u>
Saugbrugs do not have coaters. BAT 51 does not apply.

BAT 52 Waste generation - In order to minimise the amount of solid waste to be disposed of, BAT is to prevent waste generation and to carry out recycling operations by the use of a combination of the techniques given below (see general BAT 20).

	Technique	Description	Applicability
a	Fibre and filler recovery and treatment of white water	See Section 8.7.2.1	Generally applicable
b	Broke recirculation system	Broke from different locations /phases of papermaking process is collected, repulped and returned to the fibre feedstock	Generally applicable
c	Recovery of coating colours/recycling of pigments	See Section 8.7.2.1	
d	Reuse of fibre sludge from primary waste water treatment	Sludge with a high fibre content from the primary treatment of waste water can be reutilised in a production process	Applicability may be limited by product quality requirements

BAT conclusions with respect to techniques for Saugbrugs

a) Saugbrugs have disc filters on all 3 paper machines separating filler and fines from the white water. The cleaned water is utilized in the paper making process. The mentioned ultra filtration process is not implemented. As mentioned in chapter 7 this is a technique implemented only at a few paper making facilities.
b) Broke recirculation is applied on all 3 paper machines.
c) NA
d) Fiber sludge from primary waste water is not being recirculated to the paper production. The requirements to cleanliness does not allow that. The fiber sludge is collected, pressed and burned producing process steam.

BAT 53 Energy consumption and efficiency - In order to reduce the consumption of thermal and electrical energy, BAT is to use a combination of the techniques given below

	Technique	Applicability
a	Energy saving screening techniques (optimised rotor design, screens and screen operation)	Applicable to new mills or major refurbishments
b	Best practice refining with heat recovery from the refiners	
c	Optimised dewatering in the press section of paper machine/wide nip press	Not applicable to tissue paper and many speciality papers grades
d	Steam condensate recovery and use of efficient exhaust air heat recovery systems	Generally applicable
e	Reduction of direct use of steam by careful process integration using e.g. pinch analysis	
f	High efficient refiners	Applicable to new plants
g	Optimisation of the operating mode in existing refiners (e.g. reduction of no load power requirements)	Generally applicable
h	Optimised pumping design, variable speed drive control for pumps, gearless drives	
i	Cutting edge refining technologies	
j	Steam box heating of the paper web to improve the drainage properties/dewatering capacity	Not applicable to tissue paper and many speciality papers grades
k	Optimised vacuum system (e.g. turbo fans instead of water ring pumps)	Generally applicable
l	Generation optimisation and distribution network maintenance	
m	Optimisation of heat recovery, air system, insulation	
n	Use of high efficient motors (EFF1)	
o	Preheating of shower water with a heat exchanger	
p	Use of waste heat for sludge drying or upgrading of dewatered biomass	
q	Heat recovery from axial blowers (if used) for the supply air of the drying hood	
r	Heat recovery of exhaust air from the Yankee hood with a trickling tower	
s	Heat recovery from the infrared exhaust hot air	

BAT conclusions with respect to techniques for Saugbrugs

a) New screens have not been installed to the paper machines since 2004.
b) The paper machines have no refiners producing steam with value to recover. Any heat produced warms the process, thus reducing the need for adding fresh energy to maintain the recovered system temperature.
c) None of the paper machine has a wide nip press (shoe press) as referred to in BAT 53. This because the technology is newer than the paper machines and the rebuilt to the mentioned technology is quite costly. For PM6 such a rebuild is on the long-term plan in case the future financial situation will allow it.
d) All 3 paper machines have modern heat recovery from the drying section exhaust. Steam condensate recovery is applied to major steam consumption points. Condensate is recirculated to the boiler house.
e) PM4, PM5 and PM6 utilize direct steam injection in order to heat the short circulation. Heat exchanger and recirculation of condensate have so far been too costly in todays situation.
f) Saugbrugs do only low effect post refining of pulp, a rebuild has not been considered.
g) PM6 has idled 3 out of 4 post refiners. PM4 and PM5 has reduced from 5 to 2 kraft pulp refiners, thus reducing no load power.
h) Some pumps still have constant speed and throttle valves, where applicable rebuilds are done over time.
i) N.A
j) PM6 has press section steam box. PM4 and PM5 run without. PM4 due to limited space available and PM5 due to limitations in drive speed.
k) The paper machines are built with water ring pumps. Rebuild to alternative vacuum systems has not been considered due to high investment costs. Vacuum systems have been optimized in order to reduce electrical consumption.
l) Applied.
m) Optimization of heat recovery should be considered.
n) High efficient electrical motors are purchased when replacing out phased motors. The paper mills do not have a programme to change working motors with new more efficient ones.
o) Shower water is heated with excess energy from the pulp mill, drying section heat recovery and only if needed with fresh steam.
p) Not implemented
q) Not implemented, the paper mill has no such blowers.
r) NA
s) NA

8.7 DESCRIPTION OF TECHNIQUES

The column to the right in the tables in chapter 8.7 gives the status for the Saugbrugs operation.

8.7.1 Description of techniques for the prevention and control of emissions to air

8.7.1.1. Dust

8.7.1.2 NO_X

Technique	Description	Saugbrugs
Reduction of air/fuel ratio	The technique is mainly based on the following features: - careful control of air used for combustion (low excess oxygen), - minimisation of air leakages into the furnace, - modified design of the furnace combustion chamber.	Applied.
Optimised combustion and combustion control	Based on permanent monitoring of appropriate combustion parameters (e.g. O_2, CO content, fuel/air ratio, un-burnt components), this technique uses control technology for achieving the best combustion conditions. NO_X formation and emissions can be decreased by adjusting the running parameters, the air distribution, excess oxygen, flame shaping and the temperature profile	Applied
Staged incineration	Staged incineration is based on the use of two burning zones, with controlled air ratios and temperatures in a first chamber. The first burning zone operates at sub-stoichiometric conditions to convert ammonia compounds into elementary nitrogen at high temperature. In the second zone, additional air feed completes combustion at a lower temperature. After the two-stage incineration, the flue-gas flows to a second chamber to recover the heat from the gases, producing steam to the process	Applied
Fuel selection/low-N fuel	The use of fuels with a low nitrogen content is applied to reduce the amount of NO_X emissions from the oxidation of nitrogen contained in the fuel during combustion. The combustion of CNCG or biomass-based fuels increases NO_X emissions compared to oil and natural gas, as CNCG and all wood- derived fuels contain more nitrogen than oil and natural gas. Due to higher combustion temperatures, gas firing leads to higher NO_X levels than oil firing	No selection of fuels, using bark and sludge From production. Some purchased fuel; Wood based waste materials.
Low-NO_X burner	Low-NO_X burners are based on the principles of reducing peak flame temperatures, delaying but completing the combustion and increasing the heat transfer (increased emissivity of the flame). It may be associated with a modified design of the furnace combustion chamber	Not applicable
Staged injection of spent liquor	The injection of spent sulphite liquor into the boiler at various vertically staged levels prevents the formation of NO_X, and provides for complete combustion	Not applicable
Selective non-catalytic reduction (SNCR)	The technique is based on the reduction of NO_X to nitrogen by reaction with ammonia or urea at a high temperature. Ammonia water (up to 25 % NH_3), ammonia precursor compounds or urea solution is injected into the combustion gas to reduce NO to N_2. The reaction has an optimum effect in a temperature window of about 830 °C to 1 050 °C, and sufficient retention time must be provided for the injected agents to react with NO. Dosing rates of ammonia or urea have to be controlled to keep NH_3 slip at low levels	Not applied

8.7.1.3 SO2 /TRS emissions prevention and control

Technique	Description	Saugbrugs
High dry solid black liquor	With a higher dry solid content of the black liquor, the combustion temperature increases. This vaporises more sodium (Na), which can bind the SO_2 forming Na_2SO_4, thus reducing SO_2 emissions from the recovery boiler. A drawback to the higher temperature is that emissions of NO_X may increase	Not applicable
Fuel selection/low-S fuel	The use of low-sulphur content fuels with sulphur contents of about 0.02 - 0.05 % by weight (e.g. forest biomass, bark, low-sulphur oil, gas) reduces SO_2 emissions generated by the oxidation of sulphur in the fuel during combustion	Not applied
Optimised firing	Techniques such as efficient firing rate control system (air-fuel, temperature, residence time), control of excess oxygen or good mixing of air and fuel	Applied
Control of Na_2S content in lime mud feed	Efficient washing and filtration of the lime mud reduces the concentration of Na_2S, thus reducing the formation of hydrogen sulphide in the kiln during the re-burning process	Not applicable
Collection and recovery of SO_2 emissions	Highly concentrated SO_2-gas streams from acid liquor production, digesters, diffusers or blow tanks are collected. SO_2 is recovered in absorption tanks with different pressure levels, both for economic and environmental reasons	Not applicable
Incineration of odorous gases and TRS	Collected strong gases can be destroyed by burning them in the recovery boiler, in dedicated TRS burners, or in the lime kiln. Collected weak gases are suitable for burning in the recovery boiler, lime kiln, power boiler or in the TRS burner. Dissolving tank vent gases can be burnt in modern recovery boilers	Not applicable
Collection and incineration of weak gases in a recovery boiler	Combustion of weak gases (large volume, low SO_2 concentrations) combined with a back-up system. Weak gases and other odorous components are simultaneously collected to be burnt in the recovery boiler. From the exhaust gas of the recovery boiler, the sulphur dioxide is then recovered by countercurrent multistage scrubbers and reused as a cooking chemical. As a back-up system, scrubbers are used	Not applicable
Wet scrubber	Gaseous compounds are dissolved in a suitable liquid (water or alkaline solution). Simultaneous removal of solid and gaseous compounds may be achieved. Downstream of the wet scrubber, the flue-gases are saturated with water and a separation of the droplets is required before discharging the flue-gases. The resulting liquid has to be treated by a waste water process and the insoluble matter is collected by sedimentation or filtration	Not applicable
ESP or multicyclones with multistage venturi scrubbers or multistage double inlet downstream scrubbers	The separation of dust is carried out in an electrostatic precipitator or multistage cyclone. For the magnesium sulphite process, the dust retained in the ESP consists mainly of MgO but also to a minor extent, K, Na or Ca compounds. The recovered MgO ash is suspended with water and cleaned by washing and slaking to form $Mg(OH)_2$ which is then used as an alkaline scrubbing solution in the multistage scrubbers in order to recover the sulphur component of the cooking chemicals. For the ammonium sulphite process, the ammonia base (NH_3) is not recovered, as it is decomposed in the combustion process in nitrogen. After the removal of dust, the fluegas is cooled down by passing through a cooling scrubber operated with water and it then enters a three or more staged scrubber of the flue-gas where the SO_2 emissions are scrubbed with the $Mg(OH)_2$ alkaline solution in the case of the magnesium sulphite process, and with a 100 % fresh NH_3 solution in the case of the ammonium sulphite process.	Not applicable

8.7.2 Description of techniques to reduce fresh water use/waste water flow and the pollution load in waste water

8.7.2.1 Process-integrated techniques

Technique	Description	Saugbrugs
Dry debarking	Dry debarking of wood logs in dry tumbling drums (water being used only in washing of the logs, and then recycled with only a minimum purge to the waste water treatment plant)	Applied
Totally chlorine free bleaching (TCF)	In TCF bleaching, the use of chlorine containing bleaching chemicals is completely avoided and thus so are the emissions of organic and organochlorinated substances from bleaching	Applied
Modern elemental chlorine free (ECF) bleaching	Modern ECF bleaching minimises the consumption of chlorine dioxide by using one or a combination of the following bleaching stages: oxygen, hot acid hydrolysis stage, ozone stage at medium and high consistency, stages with atmospheric hydrogen peroxide and pressurised hydrogen peroxide or the use of a hot chlorine dioxide stage	Applied
Extended delignification	Extended delignification by (a) modified cooking or (b) oxygen delignification enhances the degree of delignification of pulp (lowering the kappa number) before bleaching and thus reduces the use of bleaching chemicals and the COD load of waste water. Lowering the kappa number by one unit before bleaching can reduce the COD released in the bleach plant by approximately 2 kg COD/ADt. The lignin removed can be recovered and sent to the chemicals and energy recovery system	Not applicable
(a) Extended modified cooking	Extended cooking (batch or continuous systems) comprises longer cooking periods under optimised conditions (e.g. alkali concentration in the cooking liquor is adjusted to be lower at the beginning and higher at the end of the cooking process), to extract a maximum amount of lignin before bleaching, without undue carbohydrate degradation or excessive loss of pulp strength. Thus, the use of chemicals in the subsequent bleaching stage and the organic load of the waste water from the bleach plant can be reduced	Not applicable
(b) Oxygen delignification	Oxygen delignification is an option to remove a substantial fraction of the lignin remaining after cooking, in case the cooking plant has to be operated with higher kappa numbers. The pulp reacts under alkaline conditions with oxygen to remove some of the residual lignin	Not applicable
Closed and efficient brown stock screening and washing	Brown stock screening is carried out with slotted pressure screens in a multistage closed cycle. Impurities and shives are thus removed at an early stage in the process. Brown stock washing separates dissolved organic and inorganic chemicals from the pulp fibres. The brown stock pulp may be washed first in the digester, then in high efficiency washers before and after oxygen delignification, i.e. before bleaching. Carry-over, chemical consumption in bleaching, and the emission load of waste water are all reduced. Additionally, it allows for recovery of the cooking chemicals from the washing water. Efficient washing is done by counter-current multistage washing, using filters and presses. The water system in the brown stock screening plant is completely closed	Not applicable
Partial process water recycling in the bleach plant	Acid and alkaline filtrates are recycled within the bleach plant counter-currently to the pulp flow. Water is purged either to the waste water treatment plant or, in a few cases, to post-oxygen washing. Efficient washers in the intermediate washing stages are a prerequisite for low emissions. A bleach plant effluent flow of 12 - 25 m^3/ADt is achieved in efficient mills (kraft)	Applied

Technique	Description	Saugbrugs
Effective spill monitoring and containment, also with chemical and energy recovery	An effective spill control, catchment and recovery system that prevents accidental releases of high organic and sometimes toxic loads or peak pH values (to the secondary waste water treatment plant) comprises: onductivity or pH monitoring at strategic locations to detect losses and spills; ollecting diverted or spilled liquor at the highest possible liquor solids concentration; eturning collected liquor and fibre to the process at appropriate locations; reventing spills of concentrated or harmful flows from critical process areas (including tall oil and turpentine) from entering the biological effluent treatment; dequately dimensioned buffer tanks for collecting and storing toxic or hot concentrated liquors.	Applied
Maintaining sufficient black liquor evaporation and recovery boiler capacity to cope with peak loads	Sufficient capacity in the black liquor evaporation plant and in the recovery boiler ensure that additional liquor and dry solids loads due to the collection of spills or bleach plant effluents can be dealt with. This reduces losses of weak black liquor, other concentrated process effluents and potentially bleach plant filtrates. The multi-effect evaporator concentrates weak black liquor from brown stock washing and, in some cases, also biosludge from the effluent treatment plant and/or salt cake from the ClO_2 plant. Additional evaporation capacity above normal operation gives sufficient contingency to recover spills and to treat potential bleach filtrate recycle streams	Not applicable
Stripping the contaminated (foul) condensates and reusing the condensates in the process	Stripping the contaminated (foul) condensates and reuse of condensates in the process reduces the fresh water intake of a mill and the organic load to the waste water treatment plant. In a stripping column, steam is lead counter-currently through the previously filtered process condensates that contain reduced sulphur compounds, terpenes, methanol and other organic compounds. The volatile substances of the condensate accumulate in the overhead vapour as non-condensable gases and methanol and are withdrawn from the system. The purified condensates can be reused in the process, e.g. for washing in the bleach plant, in brown stock washing, in the causticising area (mud washing and dilution, mud filter showers), as TRS scrubbing liquor for lime kilns, or as white liquor make-up water. The stripped non-condensable gases from the most concentrated condensates are fed into the collection system for strong malodorous gases and are incinerated. Stripped gases from moderately contaminated condensates are collected into the low volume high concentration gas system (LVHC) and incinerated	Not applicable
Evaporating and incinerating effluents from	The effluents are first concentrated by evaporation and then combusted as biofuel in a recovery boiler. Sodium carbonate containing dust and melt from the furnace bottom are dissolved to recover soda solution	Not applicable
Recirculation of washing liquids from pre-bleaching to brown stock washing and evaporation to reduce emissions from	Prerequisites for the use of this technique are a relatively low kappa number after cooking (e.g. 14 - 16), sufficient capacity of tanks, evaporators and recovery boiler to cope with additional flows, the possibility to clean the washing equipment from deposits, and a moderate brightness level of the pulp (< 87 % ISO) as this technique may lead to a slight loss of brightness in some cases. For market paper pulp producers or others that have to reach very high brightness levels (> 87 % ISO), it may be difficult to apply MgO pre-bleaching	Not applicable
Counter-current flow of process water	In integrated mills, fresh water is introduced mainly through the paper machine showers from which it is fed upstream towards the pulping department	Applied

Technique | Description | Saugbrugs

Technique	Description	Saugbrugs
Separation of water systems	Water systems of different process units (e.g. pulping unit, bleaching and paper machine) are separated by washing and dewatering the pulp (e.g. by wash presses). This separation prevents carry-over of pollutants to subsequent process steps and allows for removing disturbing substances from smaller volumes	Applied
High consistency (peroxide) bleaching	For high consistency bleaching, the pulp is dewatered e.g. by a twin wire or other press before bleaching chemicals are added. This allows for more efficient use of bleaching chemicals and results in a cleaner pulp, less carry-over of detrimental substances to the paper machine and generates less COD. Residual peroxide may be recirculated and reused	Applied
Fibre and filler recovery and treatment of white water	White water from the paper machine can be treated by the following techniques: a) 'Save-all' devices (typically drum or disc filter or dissolved air flotation units etc.) that separate solids (fibres and filler) from the process water. Dissolved air flotation in white water loops transforms suspended solids, fines, small-size colloidal material and anionic substances into flocks that are then removed. The recovered fibres and fillers are recirculated to the process. Clear white water can be reused in showers with less stringent requirements for water quality. b) Additional ultrafiltration of the pre-filtered white water results in super clear filtrate with a quality sufficient for use as high pressure shower water, sealing water and for the dilution of chemical additives	Applied
Clarification of white water	The systems for water clarification used almost exclusively in the paper industry are based on sedimentation, filtration (disc filter) and flotation. The most used technique is dissolved air flotation. Anionic trash and fines are agglomerated into physically treatable flocs by using additives. High-molecular, water-soluble polymers or inorganic electrolytes are used as flocculants. The generated agglomerates (flocs) are then floated off in the clarification basin. In dissolved air flotation (DAF), the suspended solid material is attached to air bubbles	Applied
Water recirculation	Clarified water is recirculated as process water within a unit or in integrated mills from the paper machine to the pulp mill and from the pulping to the debarking plant. Effluent is mainly discharged from the points with the highest pollution load (e.g. clear filtrate of the disc filter in pulping, debarking)	Not applied
Optimum design and construction of tanks and chests (papermaking)	Holding tanks for stock and white water storage are designed so that they can cope with process fluctuations and varying flows also during start-ups and shutdowns	Applied
Washing stage before refining softwood mechanical pulp	Some mills pretreat softwood chips by combining pressurised preheating, high compression and impregnation to improve pulp properties. A washing stage before refining and bleaching significantly reduces COD by removing a small, but highly concentrated effluent stream that can be treated separately	Not applied
Substitution of NaOH by $Ca(OH)_2$ or Mg $(OH)_2$ as alkali in peroxide bleaching	The use of $Ca(OH)_2$ as alkali results in approximately 30 % lower COD emission loads; while keeping brightness levels high. Also $Mg(OH)_2$ is used to replace NaOH	MgOH2 applied
Closed-loop bleaching	In sulphite pulp mills using sodium as a cooking base, the bleach plant effluent can be treated, e.g. by ultrafiltration, flotation and separation of resin and fatty acids which enables closed-loop bleaching. The filtrates from bleaching and washing are reused in the first washing stage after cooking and finally recycled back to the chemical recovery units	Not applicable
pH adjustment of weak liquor before/inside the evaporation plant	Neutralisation is done before evaporation or after the first evaporation stage, to keep organic acids dissolved in the concentrate, in order for them to be sent with the spent liquor to the recovery boiler	Not applicable

Anaerobic treatment of the condensates from the evaporators	**See Section 8.7.2.2 (combined anaerobic-aerobic treatment)**	**Not applicable**
Stripping and recovery of SO_2 from condensates of evaporators	**SO_2 is stripped from the condensates; concentrates are treated biologically, while SO_2 is sent for recovery as a cooking chemical**	**Not applicable**
Monitoring and continuous control of the process water quality	**Optimisation of the entire 'fibre-water-chemical additive-energy system' is necessary for advanced closed water systems. This requires a continuous monitoring of the water quality and staff motivation, knowledge and action related to the measures needed to ensure the required water quality**	**Not applied**
Prevention and elimination of biofilms by using methods that minimise emissions of biocides	**A continuous input of microorganisms by water and fibres leads to a specific microbiological equilibrium in each paper plant. To prevent extensive growth of the microorganisms, deposits of agglomerated biomass or biofilms in water circuits and equipment, often biodispersants or biocides are used. When using catalytic disinfection with hydrogen peroxide, biofilms and free germs in process water and paper slurry are eliminated by using methods that minimise emissions of biocides.**	**Not used**
Removal of calcium from process water by controlled precipitation of calcium carbonate	**Lowering the calcium concentration by controlled removal of calcium carbonate (e.g. in a dissolved air flotation cell) reduces the risk of undesired precipitation of calcium carbonate or scaling in water systems and equipment, e.g. in section rolls, wires, felts and shower nozzles, pipes or biological waste water treatment plants**	**Not applicable**
Optimisation of showers in paper machine	**Optimising showers involves: a) the reuse of process water (e.g. clarified white water) to reduce fresh water use, and b) the application of special design nozzles for the showers**	**Applied**

8.7.2.2 Waste water treatment

Technique	Description	Saugbrugs
Primary treatment	Physico-chemical treatment, such as equalisation, neutralisation or sedimentation. Equalisation (e.g. in equalising basins) is used to prevent large variations in flow rate, temperature and contaminant concentrations and thus to avoid overloading the waste water treatment system	Applied
Secondary (biological) treatment	For the treatment of waste water by means of microorganisms, the available processes are aerobic and anaerobic treatment. In a secondary clarification step, solids and biomass are separated from effluents by sedimentation, sometimes combined with flocculation	Applied
a) Aerobic treatment	In aerobic biological waste water treatment, biodegradable dissolved and colloidal material in the water is transformed in the presence of air by microorganisms partly into a solid cell substance (biomass) and partly into carbon dioxide and water. Processes used are: - one- or two-stage activated sludge; - biofilm reactor processes; iofilm/activated sludge (compact biological treatment plant). This technique consists in combining moving bed carriers with activated sludge (BAS). The generated biomass (excess sludge) is separated from the effluent before the water is discharged	Applied
b) Combined anaerobic-aerobic treatment	Anaerobic waste water treatment converts the organic content of waste water by means of microorganisms in the absence of air, into methane, carbon dioxide, sulphide, etc. The process is carried out in an airtight tank reactor. The microorganisms are retained in the tank as biomass (sludge). The biogas formed by this biological process consists of methane, carbon dioxide and other gases such as hydrogen and hydrogen sulphide and is suitable for energy generation. Anaerobic treatment is to be seen as pretreatment before aerobic treatment, due to the remaining COD loads. Anaerobic pretreatment reduces the amount	Applied
Tertiary treatment	Advanced treatment comprises techniques, such as filtration for further solids removal, nitrification and denitrification for nitrogen removal or flocculation/precipitation followed by filtration for phosphorus removal. Tertiary treatment is normally used in cases where primary and biological treatment are not sufficient to achieve low levels of TSS, nitrogen or phosphorus, which may be required e.g. due to local conditions	Applied
Properly designed and operated biological treatment plant	A properly designed and operated biological treatment plant includes the appropriate design and dimensioning of treatment tanks/basins (e.g. sedimentation tanks) according to hydraulic and contaminant loads. Low TSS emissions are achieved by ensuring the good settling of the active biomass. Periodical revisions of the design, dimensioning and operation of the waste water treatment plant facilitate achieving these objectives	Applied

8.7.3 Description of techniques for waste generation prevention and waste management

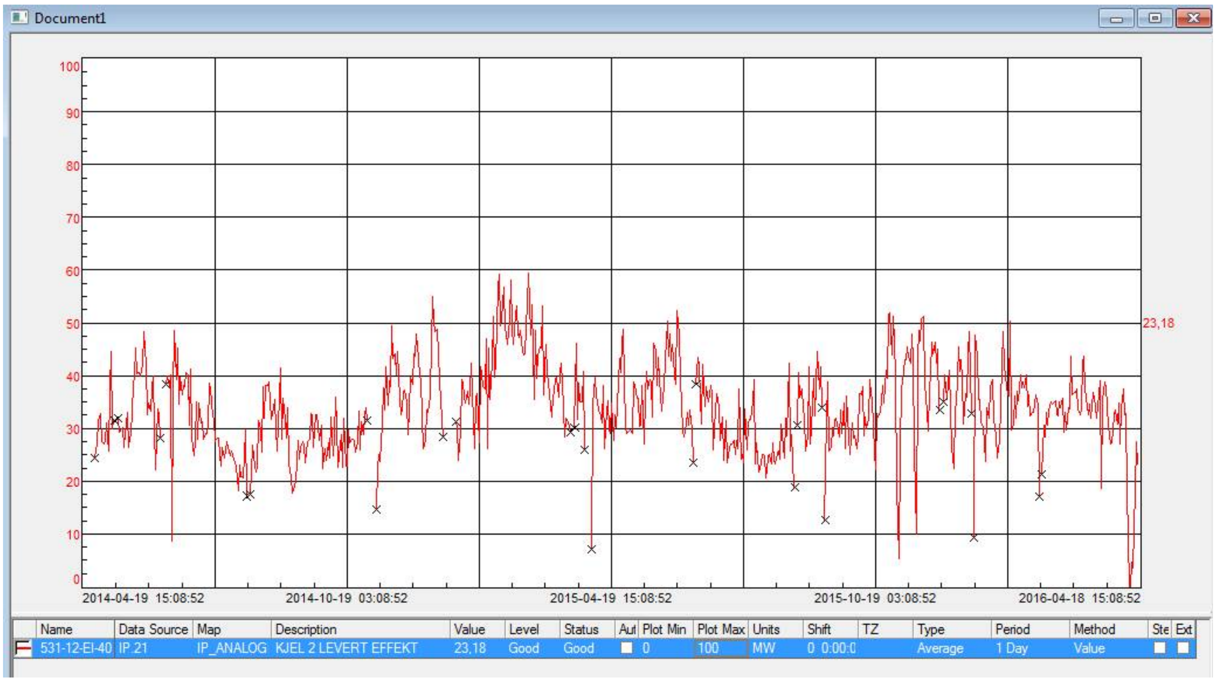
Technique	Description	Saugbrugs
Waste assessment and waste management system	Waste assessment and waste management systems are used to identify feasible options for optimising prevention, reuse, recovery, recycling and final disposal of waste. Waste inventories allow for identifying and classifying type, characteristics, amount and origin of each waste fraction	Applied
Separate collection of different waste fractions	The separate collection of different waste fractions at the points of origin and, if appropriate, intermediate storage can enhance the options for reuse or recirculation. Separate collection also includes segregation and classification of hazardous waste fractions (e.g. oil and grease residues, hydraulic and transformer oils, waste batteries, scrap electrical equipment, solvents, paints, biocides or chemical residues)	Applied
Merging of suitable residue fractions	Merging of suitable fractions of residue depending on the preferred options for reuse/recycling, further treatment and disposal	Applied
Pretreatment of process residues before reuse or recycling	Pretreatment comprises techniques such as: ewatering e.g. of sludge, bark or rejects and in some cases drying to enhance reusability before utilisation (e.g. increase calorific value before incineration); or ewatering to reduce weight and volume for transport. For dewatering belt presses, screw presses, decanter centrifuges or chamber filter presses are used; rushing/shredding of rejects e.g. from RCF processes and removal of metallic parts, to enhance combustion characteristics before incineration; iological stabilisation before dewatering, in case agricultural utilisation is	Applied
Material recovery and recycling of process residues on site	Processes for material recovery comprise techniques such as: eparation of fibres from water streams and recirculation into feedstock; - recovery of chemical additives, coating pigments, etc.; ecovery of cooking chemicals by means of recovery boilers, causticising, etc.	Generally not applicable. Fibre in waste water streams not suitable for feedstock
Energy recovery on- or off-site from wastes with high organic content	Residues from debarking, chipping, screening etc. like bark, fibre sludge or other mainly organic residues are burnt due to their calorific value in incinerators or biomass power plants for energy recovery	Applied
External material utilisation	Material utilisation of suitable waste from pulp and paper production can be done in other industrial sectors, e.g. by: ring in the kilns or mixing with feedstock in cement, ceramics or bricks production (includes also energy recovery); omposting paper sludge or land spreading suitable waste fractions in agriculture; se of inorganic waste fractions (sand, stones, grits, ashes, lime) for construction, such as paving, roads, covering layers etc. The suitability of waste fractions for off-site utilisation is determined by the composition of the waste (e.g. inorganic/mineral content) and the evidence that the foreseen recycling operation does not cause harm to the environment or health	Not applied
Pretreatment of waste fraction before disposal	Pretreatment of waste before disposal comprises measures (dewatering, drying etc.) reducing the weight and volume for transport or disposal	Applied

Do horizontal BREF`s apply to the Saugbrugs operation?

Of the present BREF BAT conclusions the PP (Pulp and Paper) BREF applies for Saugbrugs. Other draft BREF BATs that will be concluded soon and could be of interest are discussed below.

1) BREF LCP (Large Combustion Plants)

Delivered effect from Saugbrugs combustion plant the last two years:



Some facts: Figures for the recent years are mainly between 25MW and 50MW. The plant has only in few cases, the past two years delivered over 50MW. The reason for this is wear and the quality of the combustible material.

Feedback to Norsk Industri on cost estimates for BREF for LCP

Background

A memo (enclosed below) from Norsk Industri asks for feedback on future emission limit according to BREF for LCP's.

<u>Cost in 1000 NOK.</u>

203: SO_2 BAT-AEL for liquid fuels
Total rated thermal input <300 MW_{th}. Daily average or average over sampling period.
Current proposal for existing plants – the higher end is 200 mg/Nm^3.
For industrial HFO boilers and district heating plants put into operation no later than 27 November 2003 and operated <1500 h/yr and for which secondary abatement techniques or

fuel change from HFO to another fuel (natural gas, LFO, LNG etc.) is not applicable, the higher end of the BAT-AEL range is 850 mg/Nm^3.

If applicable, what is the estimated cost of:
- current proposal (200 mg/Nm^3):
- CEPI proposal (850 mg/Nm^3):

204: SO_2 techniques for biomass/peat
e) Duct sorbent injection (DSI); cost of keeping this generally applicable to new and existing boilers versus cost if existing boilers with ESP is exempted?

If applicable, what is the estimated cost of:
- current proposal (applicable for both new and existing boilers):
- CEPI proposal (exemption for existing boilers):

f) Spray-dry absorber (SDA); cost of keeping this generally applicable to new and existing boilers versus cost if existing boilers with ESP as dust abatement technique is exempted?

If applicable, what is the estimated cost of:
- current proposal (applicable for both new and existing boilers):
- CEPI proposal (exemption for existing boilers):

205: SO_2 biomass/peat
BAT-AELs for SO_2, yearly average for existing plants, fuels with average sulphur content is 0,1 % or higher, cost if the higher end of the BAT-AEL range is 100 mg/Nm3, versus cost if this is set to 200 mg/Nm^3?

If applicable, what is the estimated cost of:
- current proposal (100 mg/Nm^3):
- CEPI proposal (200 mg/Nm^3):

For boilers with rated thermal input of 100-300 MW, burning fuel with average sulphur content <0,1 %, cost if higher end of BAT-AEL range is kept at 215 mg/Nm3 versus CEPIs suggestion of setting it at 330 mg/Nm3.

If applicable, what is the estimated cost of:
- current proposal (215 mg/Nm^3):
- CEPI proposal (330 mg/Nm^3):

206: NO_x biomass/peat
100-300 MW total rated thermal input:
For existing BFB and grate combustion plants the upper end of the BAT-AEL range is 240 mg/Nm^3 as a yearly average and 320 mg/Nm^3 as a daily average. Cost of this compared to keep the averages as follows: yearly 180 mg/Nm^3 and daily 220 mg/Nm^3.

If applicable, what is the estimated cost of:

- current proposal (yearly 180 and daily 220 mg/Nm^3):
- CEPI proposal (yearly 240 and daily 320 mg/Nm^3):

50-100 MW total rated thermal input:
For existing plants change the higher end of the BAT-AEL yearly from 225 to 250 mg/Nm3 and daily from 275 to 310 mg/Nm3.

If applicable, what is the estimated cost of:
- current proposal (yearly 2250 and daily 275 mg/Nm^3):
- CEPI proposal (yearly 250 and daily 310 mg/Nm^3):

207: Dust for biomass/peat

Table 1: Current proposal for existing plants:

mg/Nm^3	Yearly average	Daily average
<100 MW	2-15	2-22
100-300	2-12	2-18
>300	2-10	2-16

Table 2: CEPI proposal for existing plants:

mg/Nm^3	Yearly average	Daily average
<100 MW	5-22	5-40
100-300	5-18	5-35
>300	5-10	5-16

If applicable, what is the estimated cost of:
- current proposal (table 1):
- CEPI proposal (table 2):

176: HCl for biomass/peat

Impact if the following footnote is kept, without the bold text, compared to if the bold text is included:
(1bis) For plants burning fuels where the average Cl content is ≥ 0.1 wt-% (dry), or for existing plants co-combusting biomass with sulphur-rich fuel (e.g. peat) or using alkali chloride-converting additives (e.g. elemental sulphur), or for plants with an average Cl content in the fuel of < 0.1 wt-% (dry) operated < 1500 h/yr, the higher end of the BATAEL range for the yearly average for new plants is 15 mg/Nm^3, the higher end of the BAT-AEL range for the yearly average for existing plants is 25 mg/Nm^3 **or 50 mg/Nm^3 in the case of existing plants operated with ESP**. The daily BAT-AEL range does not apply to these plants. For existing plants with an average Cl content in the fuel of ≥ 0.1 wt-% (dry) operated < 1500 h/yr, the higher end of the BAT-AEL range for the yearly average is 50 mg/Nm^3.

If applicable, what is the estimated cost of:
- current proposal (without bold text):
- CEPI proposal (with bold text):

<u>Feedback from Saugbrugs (18.12.2015):</u>

203: Not applicable to Saugbrugs; only for LCP's above 100 MW

204: SO2 techniques for biomass / peat
e) Duct sorbent injection.
The current proposal will entail installation of a DSI at Saugbrugs. This is in the range of 10 mnok installation and 1 mnok/year operation

The alternative CEPI proposal entails no consequences for Saugbrugs

f) Spray-dry absorber
The current proposal will entail installation of SDA at Saugbrugs. This is in the range of 10 mnok installation and operational costs of 1 mnok/year.

The alternative CEPI proposal entails no consequences for Saugbrugs.

205: SO2 biomass/peat
The current proposal of 100 mg/Nm3 is not reached with existing LCP/composition of fuels. Average levels the later two years has been 115 mg/Nm3. A new limit of 100 mg/Nm3 entails one or more of the following:

- Restrictions as to the use of chemicals with sulphur in the paper production processes. This will favour the use of other chemicals in pH control and brightening processes entailing operational costs increase in the range of 5 mnok/year.
- An installation of DSI (see above)
- An installation of SDA (see above)
- An installation of bag filters in combination with DSI or SDA. Installation costs is estimated at 50 MNOK and operation is estimated at 4 mnok/year.

The CEPI proposal is 200 mg/Nm3. As a yearly average this will have no consequences for Saugbrugs as the yearly average at Saugbrugs is in the 115 mg/Nm3 range. However, there are a number of single days where the 200 limit is exceeded. This will entail more flexible use of fuels, restricting sludge burning on days with high SO2 emissions. This results in more challenges with fuel logistics since storage bins and transport systems will have more factors taken into account. Yearly higher operational costs to loss of fuel flexibility are estimated at 2 mnok.

206 NOx biomass/peat 50-100 MW LCP
Current proposal is 225/275 (yearly/daily)
Saugbrugs has the later two years had NOx emmisions in the 180 – 200 range with daily values peaking around 300. We will be able to meet the proposed requirements but with a low margin of deviations.

207 Dust for biomass/PET.
The current proposal for <100 MW LCP's is 2-15/2-22 (yearly/daily) averages. The yearly average at Saugbrugs is around 3.3 mg/Nm3. The proposal will not have consequences for Saugbrugs.

176 HCl for biomass/PET

The current proposal with a limit of 25 mg/Nm3 can not be reached with the fuels now used. The Cl primarily comes from purchased building material residue and internal waste. The current proposal will entail investments in bag filters combined with either DSI or SDA.

The CEPI proposal has no consequences for Saugbrugs

Summary

Emission limits related to HCl and SO2 will entail large investments in the range of 50 MNOK and operational costs in the range 4 MNOK/year for Saugbrugs. The paper market is global and the proposals will put Saugbrugs in an unacceptable cost position.

2) BREF WT (Waste Treatment)

Generally, this BREF does not cover landfills. The incineration of waste is covered in the Waste Incineration BREF.

Our ETP (Effluent Treatment Plant) is not covered by the WT (Waste Treatment) BREF. Here we refer to Scope 3: installations for the disposal of non-hazardous waste as defined in Annex II A to Directive 75/442/EEC under headings D8 and D9, with a capacity exceeding 50 tonnes per day, and chapter 2.2 Biological treatments of waste, aerobic and anaerobic treatment.

The Saugbrugs biological effluent treatment plant capacity is far less than 50 tonnes per day.

3) BREF WI (Waste Incineration)

This BREF covers installations for the incineration of hazardous and municipal waste.
Saugbrugs is not covered by this BREF since the mill do not do any incineration of hazardous waste. See the table below.

Mapping of waste incineration operations within pulp and paper industry was done by CEPI in September 2015. The mapping concerning Saugbrugs is given below:

Mapping of waste incineration operations within pulp and paper industry - please retun this questionnaire to CEPI by Friday4 September 2015 tl															
Admin. Info.	Ctriterion 1: Fuel				Criterion 2: Waste									Operating permit	
Mill name	Fossil fuel	Biomass (IED Art 3.31.a)		Waste	Waste defined as biomass (IED Art 3.31.b)		Non-hazardous waste			Hazardous waste			Technology	IED Annex I (BREF)	
	Fill in type of fossil fuel used e.g. coal, oil, natural gas	Fill in type of biomass fuel used i.e vegetable matter from forestry e.g. clean wood, bark, ...	Capacity of boiler(s) used for biomass (MW) Specify for each boiler e.g. 20; 75	Indicate if waste is incinerated or is co-incinerated (yes/no)	Fill in type of waste defined as biomass used i.e. vegetable waste from e.g. forestry, virgin papermaking sludge, deinking sludge, wastewater treatment sludge	Specify amount of waste defined as biomass incinerated (tonnes/ year)	Fill in type of non-hazardous waste used e.g. municipal waste, commercial waste, industrial waste (e.g. de-ink sludge, sewage sludge) NB. this fraction can be the same as Column I: 'waste defined as biomass'	Specify amount of non-hazardous waste incinerated (tonnes/hour)	Fill in heat contribution i.e. percentage of heat released from non-hazardous waste (%)	Fill in type of hazardous waste used	Specify amount of hazardous waste incinerated (tonnes/ day)	Fill in heat contribution i.e. percentage of heat released from hazardous waste (%)	Type of waste incinerator technology e.g. fluidized bed, pyrolysis/ gasification	Have your mill an operating permit based on IED Annex I, section 1.1 (BREF-LCP, large combustion plant) (yes/no)	Have your mill an operating permit based on IED Annex I, section 5.2 (BREF-WI, waste incineration) (yes/no)
	text	text	MW	yes / no	text	tonnes/year	text	tonnes/hour	%	text	tonnes/day	%	text	yes / no	yes / no
Norske Skog Saugbrugs AS	Oil	bark, demolition wood, sludges from effluent plant, factory waste.	70 MW	No	bark, demolition wood, sludges from effluent plant, factory waste.	130 030 tonn wet biomass/ year	bark, demolition wood, sludges from effluent plant, factory waste.	No	0 %	No	No	0 %	No	Yes	No