All English BATs - Complete Texts

Document: EFS (1 BATs)

BAT 4: Storage of liquid and liquefied gas

Page: 139 | Length: 2,505 chars

BAT

4.1.
Storage of liquid and liquefied gas

In Chapter 3 most of the different storage modes for liquids and liquefied gases are described and the potential emission sources of each storage type are identified and are given an emission score. Scoring the emission sources is a simple and reliable means for identifying the most important emission sources, although, it should be noted that the scores have a relative value and should only be considered for each storage mode in isolation. The sources with an emission score of 3 and more are addressed here in Chapter 4.

ECM scorecards (Emission Control Measures) have been prepared for all storage modes and are shown in Annex 8.9 – ECM Scorecards for storing liquid and liquefied gas. Each scorecard provides information on typical ECM for gaseous and/or liquid emissions and/or waste. The cards also show the emission score of each potential emission source.

Annex 8.9 shows that ECM for fourteen types of storage modes for operational emissions are to be discussed and assessed. This chapter contains an overview of the various ECM that might be applied to all or some of the storage modes. Each discussed ECM is – where possible – assessed by:

- description
- achieved environmental benefit
- operability
- applicability
- safety aspects
- energy/waste/cross-media, and
- economics.

4.1.1.
ECM assessment methodology for the storage of liquid and
liquefied gas

Description: TETSP (Technical European Tank Storage Platform) has defined a practical methodology for assessing the ECM described here in Chapter 4 in order to define which ECM, or combination of ECM perform best in the storage of liquid and liquefied gas in a specific situation. This methodology is based on the principles of a risk-based approach for selecting and qualifying emission points (see Chapter 3), followed by the definition of ECM. TETSP developed this tool, because in their view, it is recognised within the BREF that almost all tanks are different due to their design, their location and the product stored, etc. and it would, therefore, be virtually impossible to define a generic BAT for a certain type of tank.

ECM can denote technical measures and/or operational measures and/or management measures. These measures do not focus just on end-of-pipe techniques with their achievable emissions and costs, but also cover measures such as good operating procedures, adequate training and sound maintenance procedures.

Document: ENE (29 BATs)

BAT 1: BAT is to implement and adhere to an energy efficiency management system

Page: 304 | Length: 4,265 chars

1.
BAT is to implement and adhere to an energy efficiency management system (ENEMS) that incorporates, as appropriate to the local circumstances, all of the following features (see Section 2.1. The letters (a), (b), etc. below, correspond those in Section 2.1):
a.
commitment of top management (commitment of the top management is regarded as a precondition for the successful application of energy efficiency management)
b.
definition of an energy efficiency policy for the installation by top management
c.
planning and establishing objectives and targets (see BAT 2, 3 and 8)
d.
implementation and operation of procedures paying particular attention to:
i)
structure and responsibility
ii)
training, awareness and competence (see BAT 13)
iii)
communication
iv)
employee involvement
v)
documentation
vi)
effective control of processes (see BAT 14)
vii)
maintenance (see BAT 15)
viii)
emergency preparedness and response
ix)
safeguarding compliance with energy efficiency-related legislation and agreements (where such agreements exist).
e.
benchmarking: the identification and assessment of energy efficiency indicators over time (see BAT 8), and the systematic and regular comparisons with sector, national or regional benchmarks for energy efficiency, where verified data are available (see Sections 2.1(e), 2.16 and BAT 9)
f.
checking performance and taking corrective action paying particular attention to:
i)
monitoring and measurement (see BAT 16)
ii)
corrective and preventive action
iii)
maintenance of records
iv)
independent (where practicable) internal auditing in order to determine whether or not the energy efficiency management system conforms to planned arrangements and has been properly implemented and maintained (see BAT 4 and 5)
g.
review of the ENEMS and its continuing suitability, adequacy and effectiveness by top management

Chapter 4

Energy Efficiency
For (h) and (i), see further features on an energy efficiency statement and external verification, below
when designing a new unit, taking into account the environmental impact from the eventual decommissioning of the unit
development of energy-efficient technologies, and to follow developments in energy efficiency techniques.
The ENEMS may be achieved by ensuring these elements form part of existing management systems (such as an EMS) or by implementing a separate energy efficiency management system.
Three further features are considered as supporting measures. Although these features have advantages, systems without them can be BAT. These three additional steps are:

■
(see Section 2.1(h)) preparation and publication (and possibly external validation) of a regular energy efficiency statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate

■
(see Section 2.1(i)) having the management system and audit procedure examined and validated by an accredited certification body or an external ENEMS verifier

■
(see Section 2.1, Applicability, 2) implementation and adherence to a nationally or internationally accepted voluntary system such as:

■
DS2403, IS 393, SS627750, VDI Richtlinie No. 46, etc.

■
(when including energy efficiency management in an EMS) EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the ENEMS. However, non-standardised systems can be equally effective provided that they are properly designed and implemented.

Applicability: All installations. The scope and nature (e.g. level of detail) of applying this ENEMS will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.

4.2.2
Planning and establishing objectives and targets

4.2.2.1
Continuous environmental improvement

An important aspect of environmental management systems is continuing environmental improvement. This requires maintaining a balance for an installation between consumption of energy, raw materials and water, and the emissions (see Sections 1.1.6 and 2.2.1). Planned continuous improvement can also achieve the best cost-benefit for achieving energy savings (and other environmental benefits).

BAT 2: BAT is to continuously minimise the environmental impact of an installation by

Page: 305 | Length: 1,780 chars

2.
BAT is to continuously minimise the environmental impact of an installation by planning actions and investments on an integrated basis and for the short, medium and long term, considering the cost-benefits and cross-media effects.
Applicability: All installations.
‘Continuously’ means the actions are repeated over time, i.e. all planning and investment decisions should consider the overall long term aim to reduce the environmental impacts of the operation. This may mean avoiding short term actions to better use available investments over a longer term, e.g. changes to the core process may require more investment and take longer to

implement, but may bring bigger reductions in energy use and emissions (see examples in Section 2.2.1).
j.
k.

Chapter 4
Energy Efficiency

The environmental benefits may not be linear, e.g. 2 % energy savings every year for 10 years. They may be stepwise, reflecting investment in ENE projects, etc. (see Section 2.2.1). Equally, there may be cross-media effects: for example it may be necessary to increase energy consumption to abate an air pollutant.
Environmental impacts can never be reduced to zero, and there will be points in time where there is little or no cost-benefit to further actions. However, over a longer period, with changing technology and costs (e.g. energy prices), the viability may also change.
4.2.2.2
Identification of energy efficiency aspects of an installation and
opportunities for energy savings
In order to optimise energy efficiency, the aspects of an installation that influence energy efficiency need to be identified and quantified (see Section 2.11). Energy savings can then be identified, evaluated, prioritised and implemented according to BAT 2, above (see Section 2.1(c)).

BAT 3: BAT is to identify the aspects of an installation that influence energy efficiency by

Page: 306 | Length: 907 chars

3.
BAT is to identify the aspects of an installation that influence energy efficiency by carrying out an audit. It is important that an audit is coherent with a systems approach (see BAT 7).
Applicability: All existing installations and prior to planning upgrades or rebuilds. An audit may be internal or external.
The scope of the audit and nature (e.g. level of detail, the time between audits) will depend on the nature, scale and complexity of the installation and the energy consumption of the component processes and systems (see Section 2.8.), e.g.:
■
in large installations with many systems and individual energy-using components such as motors, it will be necessary to prioritise data collection to necessary information and significant uses
■
in smaller installations, a walk-through type audit may be sufficient.
The first energy audit for an installation may be called an energy diagnosis.

BAT 4: When carrying out an audit, BAT is to ensure that the audit identifies the following

Page: 306 | Length: 1,323 chars

4.
When carrying out an audit, BAT is to ensure that the audit identifies the following aspects (see Section 2.11):
a.
energy use and type in the installation and its component systems and processes
b.
energy-using equipment, and the type and quantity of energy used in the installation
c.
possibilities to minimise energy use, such as:

■
controlling/reducing operating times, e.g. switching off when not in use (e.g. see
Sections 3.6, 3.7, 3.8, 3.9, 3.11)
■
ensuring insulation is optimised, e.g. see Sections 3.1.7, 3.2.11 and 3.11.3.7
■
optimising utilities, associated systems, processes and equipment (see Chapter 3)
d.
possibilities to use alternative sources or use of energy that is more efficient, in particular
energy surplus from other processes and/or systems, see Section 3.3
e.
possibilities to apply energy surplus to other processes and/or systems, see Section 3.3
f.
possibilities to upgrade heat quality (see Section 3.3.2).

Chapter 4

Energy Efficiency
Applicability: All installations. The scope of the audit and the nature (e.g. level of detail) will
depend on the nature, scale and complexity of the installation, and the energy consumption of
the component processes and systems.
Examples of some techniques for optimising systems and processes are given in the relevant
sections in Chapter 3.

BAT 5: BAT is to use appropriate tools or methodologies to assist with identifying and

Page: 307 | Length: 626 chars

5.
BAT is to use appropriate tools or methodologies to assist with identifying and
quantifying energy optimisation, such as:
■
energy models, databases and balances (see Section 2.15)
■
a technique such as pinch methodology (see Section 2.12) exergy or enthalpy
analysis (see Section 2.13), or thermoeconomics (see Section 2.14)
■
estimates and calculations (see Sections 1.5 and 2.10.2).
Applicability: Applicable to every sector. The choice of appropriate tool or tools will depend on
the sector, and the size, complexity and energy usage of the site. This will be site-specific, and is
discussed in the relevant sections.

BAT 6: BAT is to identify opportunities to optimise energy recovery within the installation,

Page: 307 | Length: 1,276 chars

6.
BAT is to identify opportunities to optimise energy recovery within the installation,
between systems within the installation (see BAT 7) and/or with a third party (or
parties), such as those described in Sections 3.2, 3.3 and 3.4.
Applicability: The scope for energy recovery depends on the existence of a suitable use for the
heat at the type and quantity recovered (see Sections 3.3 and 3.4, and Annexes 7.10.2 and
7.10.3). A systems approach is set out in Section 2.2.2 and BAT 7). Opportunities may be
identified at various times, such as a result of audits or other investigations, when considering
upgrades or new plants, or when the local situation changes (such as a use for surplus heat is
identified in a nearby activity).
The cooperation and agreement of a third party may not be within the control of the operator,

and therefore may not be within the scope of an IPPC permit. In many cases, public authorities have facilitated such arrangements or are the third party.
4.2.2.3
A systems approach to energy management
The major energy efficiency gains are achieved by viewing the installation as a whole and assessing the needs and uses of the various systems, their associated energies and their interactions (see Sections 1.3.5, 1.4.2 and 2.2.2).

BAT 7: BAT is to optimise energy efficiency by taking a systems approach to energy

Page: 307 | Length: 2,391 chars

7.
BAT is to optimise energy efficiency by taking a systems approach to energy management in the installation. Systems to be considered for optimising as a whole are, for example:

- process units (see sector BREFs)
- heating systems such as:
- steam (see Section 3.2)
- hot water
- cooling and vacuum (see the ICS BREF)
- motor driven systems such as:
- compressed air (see Section 3.7)
- pumping (see Section 3.8)
- lighting (see Section 3.10)
- drying, separation and concentration (see Section 3.11).

Applicability: All installations. The scope and nature (e.g. level of detail, frequency of optimisation, systems to be considered at any one time) of applying this technique will depend on factors such as the nature, scale and complexity of the installation, the energy requirements of the component processes and systems and the techniques considered for application.
4.2.2.4
Establishing and reviewing energy efficiency objectives and indicators
Quantifiable, recorded energy efficiency objectives are crucial for achieving and maintaining energy efficiency. Areas for improvement are identified from an audit (see BAT 3). Indicators need to be established to assess the effectiveness of energy efficiency measures. For process industries, these are preferably indicators related to production or service throughput (e.g. GJ/t product, see Section 1.3), termed specific energy consumption (SEC). Where a single energy objective (such as SEC) cannot be set, or where it is helpful, the efficiency of individual processes, units or systems may be assessed. Indicators for processes are often given in the relevant sector BREFS (for an overview, see [283, EIPPCB])
Production parameters (such as production rate, product type) vary and these may affect the measured energy efficiency and should be recorded to explain variations and to ensure that energy efficiency is realised by the techniques applied (see Sections 1.4 and 1.5). Energy use

and transfers may be complicated and the boundary of the installation or system being assessed should be carefully defined on the basis of entire systems (see Sections 1.3.5 and 1.4.2 and BAT 7). Energy should be calculated on the basis of primary energy, or the energy uses shown as secondary energy for the different utilities (e.g. process heat as steam use in GJ/t, see Section 1.3.6.1).

BAT 8: BAT is to establish energy efficiency indicators by carrying out all of the following:

Page: 308 | Length: 2,361 chars

8.
BAT is to establish energy efficiency indicators by carrying out all of the following:
a.
identifying suitable energy efficiency indicators for the installation, and where necessary, individual processes, systems and/or units, and measure their change over time or after the implementation of energy efficiency measures (see Sections 1.3 and 1.3.4)
b.
identifying and recording appropriate boundaries associated with the indicators (see Sections 1.3.5 and 1.5.1)
c.
identifying and recording factors that can cause variation in the energy efficiency of the relevant process, systems and/or units (see Sections 1.3.6 and 1.5.2).
Applicability: All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy consumption of the component processes and systems.
Secondary or final energies are usually used for monitoring ongoing situations. In some cases, it may be most convenient to use more than one secondary or final energy indicator, for example, in the pulp and paper industry, where both electricity and steam are given as joint energy efficiency indicators. When deciding on the use (or change) of energy vectors and utilities, the energy indicator used may also be the secondary or final energy. However, other indicators such as primary energy or carbon balance may be used, to take account of the production of any secondary energy vector and the cross-media effects, depending on local circumstances (see Section 1.3.6.1).

Chapter 4

Energy Efficiency
4.2.2.5
Benchmarking
Benchmarking is a powerful tool for assessing the performance of a plant and the effectiveness of energy efficiency measures, as well as overcoming paradigm blindness33. Data may be found in sector BREFs, trade association information, national guidance documents, theoretical energy calculations for processes, etc. Data should be comparable and may need to be corrected, e.g. for type of feedstock. Data confidentiality may be important, such as where energy consumption is a significant part of the cost of production, although it may be possible to protect data (see Section 2.16). See also the establishment of energy indicators in BAT 8.
Benchmarking can also be applied to processes and working methods (see Sections 2.5 and 2.16).

BAT 9: BAT is to carry out systematic and regular comparisons with sector, national or

Page: 309 | Length: 1,052 chars

9.
BAT is to carry out systematic and regular comparisons with sector, national or regional benchmarks, where validated data are available.
Applicability: All installations. The level of detail will depend on the nature, scale and

complexity of the installation, and the energy consumption of the component processes and
systems. Confidentiality issues may need to be addressed (see Section 2.16): for instance, the
results of benchmarking may remain confidential. Validated data include those in BREFs, or
those verified by a third party. The period between benchmarkings is sector-specific and usually
long (i.e. years), as benchmark data rarely change rapidly or significantly in a short time
period.
4.2.3
Energy-efficient design (EED)
The planning phase of a new installation, unit or system (or one undergoing major
refurbishment) offers the opportunity to consider the lifetime energy costs of
processes, equipment and utility systems, and to select the most energy-efficient options,
with the best lifetime costs (see Section 2.1(c)).

BAT 10: BAT is to optimise energy efficiency when planning a new installation, unit or

Page: 309 | Length: 1,722 chars

10.
BAT is to optimise energy efficiency when planning a new installation, unit or
system or a significant upgrade (see Section 2.3) by considering all of the following:
a.
the energy-efficient design (EED) should be initiated at the early stages of the conceptual
design/basic design phase, even though the planned investments may not be well-defined.
The EED should also be taken into account in the tendering process
b.
the development and/or selection of energy-efficient technologies (see Sections 2.1(k) and
2.3.1)
c.
additional data collection may need to be carried out as part of the design project or
separately to supplement existing data or fill gaps in knowledge
d.
the EED work should be carried out by an energy expert
e.
the initial mapping of energy consumption should also address which parties in the
project organisations influence the future energy consumption, and should optimise the
energy efficiency design of the future plant with them. For example, the staff in the
(existing) installation who may be responsible for specifying design parameters.

Paradigm blindness is a term used to describe the phenomenon that occurs when the dominant paradigm prevents
one
from seeing viable alternatives, i.e. 'the way we do it is best, because we've always done it this way'

Chapter 4
Energy Efficiency

Applicability: All new and significantly refurbished installations, major processes and systems.
Where relevant in-house expertise on ENE is not available (e.g. non-energy intensive
industries), external ENE expertise should be sought (see Section 2.3).
4.2.4
Increased process integration
There are additional benefits to seeking process integration, such as optimising raw material
usage.

BAT 11: BAT is to seek to optimise the use of energy between more than one process or

Page: 310 | Length: 880 chars

11.
BAT is to seek to optimise the use of energy between more than one process or system (see Section 2.4), within the installation or with a third party.
Applicability: All installations. The scope and nature (e.g. level of detail) of applying this technique will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.
The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of an IPPC permit. In many cases, public authorities have facilitated such arrangements or are the third party.
4.2.5
Maintaining the impetus of energy efficiency initiatives
To successfully achieve ongoing energy efficiency improvement over time, it is necessary to maintain the impetus of energy efficiency programmes (see Section 2.5).

BAT 12: BAT is to maintain the impetus of the energy efficiency programme by using a

Page: 310 | Length: 1,627 chars

12.
BAT is to maintain the impetus of the energy efficiency programme by using a variety of techniques, such as:
a.
implementing a specific energy efficiency management system (see Section 2.1 and BAT 1)
b.
accounting for energy usage based on real (metered) values, which places both the obligation and credit for energy efficiency on the user/bill payer (see Sections 2.5, 2.10.3 and 2.15.2)
c.
the creation of financial profit centres for energy efficiency (see Section 2.5)
d.
benchmarking (see Section 2.16 and BAT 9)
e.
a fresh look at existing management systems, such as using operational excellence (see Section 2.5)
f.
using change management techniques (also a feature of operational excellence, see Section 2.5).
Applicability: All installations. It may be appropriate to use one technique or several techniques together. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy consumption of the component processes and systems. Techniques (a), (b) and (c) are applied and maintained according to the relevant sections referred to. The frequency of application of techniques such as (d), (e) and (f) should be far enough apart to enable the progress of the ENE programme to be assessed, and is therefore likely to be several years.

Chapter 4

Energy Efficiency
4.2.6
Maintaining expertise
Human resources are required for the implementation and control of energy efficiency management, and staff whose work may affect energy should receive training (see Section 2.1(d)(i) and (ii), and Section 2.6).

BAT 13: BAT is to maintain expertise in energy efficiency and energy-using systems by using

Page: 311 | Length: 961 chars

13.
BAT is to maintain expertise in energy efficiency and energy-using systems by using techniques such as:
a.
recruitment of skilled staff and/or training of staff. Training can be delivered by in-house staff, by external experts, by formal courses or by self-study/development (see Section 2.6)
b.
taking staff off-line periodically to perform fixed term/specific investigations (in their original installation or in others, see Section 2.5)
c.
sharing in-house resources between sites (see Section 2.5)
d.
use of appropriately skilled consultants for fixed term investigations (e.g. see Section 2.11)
e.
outsourcing specialist systems and/or functions (e.g. see Annex 7.12)
Applicability: All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.
4.2.7
Effective control of processes

BAT 14: BAT is to ensure that the effective control of processes is implemented by techniques

Page: 311 | Length: 985 chars

14.
BAT is to ensure that the effective control of processes is implemented by techniques such as:
a.
having systems in place to ensure that procedures are known, understood and complied with (see Sections 2.1(d)(vi) and 2.5)
b.
ensuring that the key performance parameters are identified, optimised for energy efficiency and monitored (see Sections 2.8 and 2.10)
c.
documenting or recording these parameters (see Sections 2.1(d)(vi), 2.5, 2.10 and 2.15).
Applicability: All installations. The scope and nature (e.g. level of detail) of applying these techniques will depend on the sector, nature, scale and complexity of the installation, and the energy requirements of the component processes and systems.

Chapter 4
Energy Efficiency

4.2.8
Maintenance
Structured maintenance and the repair of equipment that uses energy and/or controls energy use at the earliest opportunity are essential for achieving and maintaining efficiency (see Sections 2.1(d)(vii), 2.9 and BAT 1).

BAT 15: BAT is to carry out maintenance at installations to optimise energy efficiency by

Page: 312 | Length: 1,607 chars

15.
BAT is to carry out maintenance at installations to optimise energy efficiency by
applying all of the following:
a.
clearly allocating responsibility for the planning and execution of maintenance
b.
establishing a structured programme for maintenance based on technical descriptions of
the equipment, norms, etc. as well as any equipment failures and consequences. Some
maintenance activities may be best scheduled for plant shutdown periods
c.
supporting the maintenance programme by appropriate record keeping systems and
diagnostic testing
d.
identifying from routine maintenance, breakdowns and/or abnormalities possible losses in
energy efficiency, or where energy efficiency could be improved
e.
identifying leaks, broken equipment, worn bearings, etc. that affect or control energy
usage, and rectifying them at the earliest opportunity.
Applicability: All installations. The scope and nature (e.g. level of detail) of applying these
techniques will depend on the nature, scale and complexity of the installation, and the energy
requirements of the component processes and systems. Carrying out repairs promptly has to be
balanced (where applicable) with maintaining the product quality and process stability and the
health and safety issues of carrying out repairs on the operating plant (e.g. it may contain
moving and/or hot equipment, etc.).
4.2.9
Monitoring and measurement
Monitoring and measurement are an essential part of checking in a ‘plan-do-check-act’ system,
such as in energy management (Section 2.1). It is also a part of the effective control of processes
(see BAT 14).

BAT 16: BAT is to establish and maintain documented procedures to monitor and measure,

Page: 312 | Length: 2,523 chars

16.
BAT is to establish and maintain documented procedures to monitor and measure,
on a regular basis, the key characteristics of operations and activities that can have
a significant impact on energy efficiency. Some suitable techniques are given in
Section 2.10.
Applicability: All installations. The scope and nature (e.g. level of detail) of applying this
technique will depend on the nature, scale and complexity of the installation, and the energy
requirements of the component processes and systems.

Chapter 4

Energy Efficiency
4.3
Best available techniques for achieving energy efficiency
in energy-using systems, processes, activities or
equipment
Introduction
Section 4.2.2.3 identifies the importance of seeing the installation as a whole, and assessing the
needs and purposes of the various systems, their associated energies and their interactions.
BAT 7 gives examples of systems commonly found in installations.
In Section 4.2, there are BAT that are generally applicable to all systems, processes and
associated activities. These include:

■
analysing and benchmarking the system and its performance (BAT 1, 3, 4, 8 and 9)
■
planning actions and investments to optimise energy efficiency considering the cost-benefits and cross-media effects (BAT 2)
■
for new systems, optimising energy efficiency in the design of the installation, unit or system and in the selection of processes (BAT 10)
■
for existing systems, optimising the energy efficiency of the system through its operation and management, including regular monitoring and maintenance (see BAT 14, 15 and 16).
The BAT presented in this section therefore assume that these general BAT in Section 4.2 are also applied to the systems described below, as part of their optimisation.
4.3.1
Combustion
Combustion is a widely used process for both direct heating (such as in cement and lime manufacture, steel making) and indirect heating (such as firing steam boiler systems and electricity generation). Techniques for energy efficiency in combustion are therefore addressed in the appropriate sector BREFs. For other cases, such as combustion in associated activities, the Scope of the LCP BREF states:
'…smaller units can potentially be added to a plant to build one larger installation exceeding 50 MW. This means that all kinds of conventional power plants (e.g. utility boiler, combined heat and power plants, district heating plants.) used for mechanical power and heat generation are covered by this (LCP BREF) work.'

BAT 17: BAT is to optimise the energy efficiency of combustion by relevant techniques such

Page: 313 | Length: 4,642 chars

17.
BAT is to optimise the energy efficiency of combustion by relevant techniques such as:
■
those specific to sectors given in vertical BREFs
■
those given in Table 4.1.

Chapter 4
Energy Efficiency

Techniques for sectors and associated activities where combustion is not covered by a vertical BREF
Techniques in the LCP BREF
July 2006 by fuel type and section
Techniques in this document
(the ENE BREF) by section
Coal and
lignite
Biomass
and peat
Liquid
fuels
Gaseous
fuels
Lignite pre-drying
4.4.2
Coal gasification

4.1.9.1
4.4.2
7.1.2
Fuel drying
5.1.2,
5.4.2
5.4.4
Biomass gasification
5.4.2
7.1.2
Bark pressing
5.4.2
5.4.4
Expansion turbine to
recover the energy
content of pressurised
gases
7.1.1 7.1.2
7.4.1 7.5.1
Cogeneration
4.5.5
6.1.8
5.3.3
5.5.4
4.5.5 6.1.8
7.1.6 7.5.2
3.4 Cogeneration
Advanced
computerised control of
combustion conditions
for emission reduction
and boiler performance
4.2.1
4.2.1.9
4.4.3
4.5.4
5.5.3
6.2.1 6.2.1.1
6.4.2 6.5.3.1
7.4.2 7.5.2
Use of the heat content
of the flue-gas for
district heating
4.4.3
Low excess air
4.4.3
4.4.6
5.4.7
6.4.2 6.4.5
7.4.3
3.1.3 Reducing the mass flow of
the flue-gases by reducing the
excess air

Chapter 4

Energy Efficiency
Techniques for sectors and associated activities where combustion
is not covered by a vertical BREF

Techniques in the LCP BREF
July 2006 by fuel type and section
Techniques in this document
(the ENE BREF) by section
Coal and
lignite
Biomass
and peat
Liquid
fuels
Gaseous
fuels
Lowering of exhaust
gas temperatures
4.4.3
6.4.2
3.1.1 Reduction of the flue-gas
temperature by:

- dimensioning for the maximum performance plus a calculated safety factor for surcharges
- increasing heat transfer to the process by increasing either the heat transfer rate, or increasing or improving the heat transfer surfaces
- heat recovery by combining an additional process (for example, steam generation by using economisers,) to recover the waste heat in the flue-gases
- installing an air or water preheater or preheating the fuel by exchanging heat with flue-gases (see 3.1.1 and 3.1.1.1). Note that the process can require air preheating when a high flame temperature is needed (glass, cement, etc.)
- cleaning of heat transfer surfaces that are progressively covered by ashes or carbonaceous particulates, in order to maintain high heat transfer efficiency. Soot blowers operating periodically may keep the convection zones

clean. Cleaning of the heat
transfer surfaces in the
combustion zone is
generally made during
inspection and
maintenance shutdown,
but online cleaning can be
applied in some cases (e.g.
refinery heaters)
Low CO concentration
in the flue-gas
4.4.3
6.4.2
Heat accumulation
6.4.2
7.4.2
Cooling tower
discharge
4.4.3
6.4.2
Different techniques for
the cooling system (see
the ICS BREF)
4.4.3
6.4.2

Techniques for sectors and associated activities where combustion
is not covered by a vertical BREF
Techniques in the LCP BREF
July 2006 by fuel type and section
Techniques in this document
(the ENE BREF) by section
Coal and
lignite
Biomass
and peat
Liquid
fuels
Gaseous
fuels
Preheating of fuel gas
by using waste heat
7.4.2
3.1.1 Reduction of the flue-gas
temperature:
■
preheating the fuel by
exchanging heat with flue-
gases (see 3.1.1). Note that
the process can require air
preheating when a high
flame temperature is
needed (glass, cement,
etc.)
Preheating of
combustion air

7.4.2
3.1.1 Reduction of the flue-gas
temperature:
■
installing an air preheater
by exchanging heat with
flue-gases (see 3.1.1.1).
Note that the process can
require air preheating
when a high flame
temperature is needed
(glass, cement, etc.)
Recuperative and
regenerative burners
3.1.2
Burner regulation and
control
3.1.4
Fuel choice
Note that the use of non-fossil
fuels may be more sustainable,
even if the ENE in use is lower
Oxy-firing (oxyfuel)
3.1.6
Reducing heat losses
by insulation
3.1.7
Reducing losses
through furnace doors
3.1.8
Fluidised bed
combustion
4.1.4.2
5.2.3
Table 4.1: Combustion system techniques to improve energy efficiency
4.3.2
Steam systems
Steam is a widely used heat transport medium because of its non-toxic nature, stability, low cost and high heat capacity, and flexibility in use. Steam utilisation efficiency is frequently neglected, as it is as not as easily measured as the thermal efficiency of a boiler. It may be determined using tools such as those in BAT 5 in conjunction with appropriate monitoring (see Section 2.10).

BAT 18: BAT for steam systems is to optimise the energy efficiency by using techniques such

Page: 316 | Length: 5,291 chars

18.
BAT for steam systems is to optimise the energy efficiency by using techniques such as:
■
those specific to sectors given in vertical BREFs
■
those given in Table 4.2

Chapter 4

Energy Efficiency
Techniques for sectors and associated activities where steam systems
are not covered by a vertical BREF
Techniques in the ENE BREF
Benefits
Section in this
document
DESIGN
Energy-efficient design and
installation of steam distribution
pipework
Optimises energy savings
2.3
Throttling devices and the use of
backpressure turbines: utilise
backpressure turbines instead of
PRVs
Provides a more efficient method of reducing
steam pressure for low-pressure services.
Applicable when size and economics justify
the use of a turbine
OPERATING AND CONTROL
Improve operating procedures and
boiler controls
Optimises energy savings
3.2.4
Use sequential boiler controls (apply
only to sites with more than one
boiler)
Optimises energy savings
3.2.4
Install flue-gas isolation dampers
(applicable only to sites with more
than one boiler)
Optimises energy savings
3.2.4
GENERATION
Preheat feed-water by using:
■
waste heat, e.g. from a process
■
economisers using combustion air
■
deaerated
feed-water
to
heat
condensate
■
condensing the steam used for
stripping and heating the feed
water to the deaerator via a heat
exchanger
Recovers available heat from exhaust gases
and transfers it back into the system by
preheating feed-water
3.2.5
3.1.1
Prevention and removal of scale

deposits on heat transfer surfaces.
(Clean boiler heat transfer surfaces)
Promotes effective heat transfer from the
combustion gases to the steam
3.2.6
Minimise boiler blowdown by
improving water treatment. Install
automatic total dissolved solids
control
Reduces the amount of total dissolved solids
in the boiler water, which allows less
blowdown and therefore less energy loss
3.2.7
Add/restore boiler refractory
Reduces heat loss from the boiler and restores
boiler efficiency
3.1.7
2.9
Optimise deaerator vent rate
Minimises avoidable loss of steam
3.2.8
Minimise boiler short cycling losses
Optimises energy savings
3.2.9
Carrying out boiler maintenance
2.9
DISTRIBUTION
Optimise steam distribution systems
(especially to cover the issues below)
2.9 and 3.2.10
Isolate steam from unused lines
Minimises avoidable loss of steam and
reduces energy loss from piping and
equipment surfaces
3.2.10
Insulation on steam pipes and
condensate return pipes. (Ensure that
steam system piping, valves, fittings
and vessels are well insulated)
Reduces energy loss from piping and
equipment surfaces
3.2.11 and
3.2.11.1
Implement a control and repair
programme for steam traps
Reduces passage of live steam into the
condensate system and promotes efficient
operation of end-use heat transfer equipment.
Minimises avoidable loss of steam
3.2.12
RECOVERY

Techniques for sectors and associated activities where steam systems
are not covered by a vertical BREF
Collect and return condensate to the
boiler for re-use. (Optimise

condensate recovery)
Recovers the thermal energy in the
condensate and reduces the amount of
makeup water added to the system, saving
energy and chemicals treatment
3.2.13
Re-use of flash-steam. (Use high-
pressure condensate to make low-
pressure steam)
Exploits the available energy in the returning
condensate
3.2.14
Recover energy from boiler
blowdown
Transfers the available energy in a blowdown
stream back into the system, thereby reducing
energy loss
3.2.15
Techniques in the LCP BREF July 2006 by fuel type and by section
Coal and
lignite
Biomass and
peat
Liquid fuels
Gaseous fuels
Expansion turbine to recover the
energy content of pressurised gases
7.4.1 and 7.5.1
Change turbine blades
4.4.3
5.4.4
6.4.2
Use advanced materials to reach high
steam parameters
4.4.3
6.4.2
7.4.2
Supercritical steam parameters
4.4.3, 4.5.5
6.4.2
7.1.4
Double reheat
4.4.3, 4.5.5
6.4.2, 6.5.3.1
7.1.4, 7.4.2,
7.5.2
Regenerative feed-water
4.2.3, 4.4.3
5.4.4
6.4.2
7.4.2
Use of heat content of the flue-gas for
district heating
4.4.3
Heat accumulation
6.4.2
7.4.2
Advanced computerised control of the
gas turbine and subsequent recovery

boilers
7.4.2
Table 4.2: Steam system techniques to improve energy efficiency
4.3.3
Heat recovery
The main types of heat recovery systems are described in Section 3.3:
■
heat exchangers (see Section 3.3.1)
■
heat pumps (see Section 3.3.2).
Heat exchange systems are widely used with good results in many industrial sectors and systems, and are widely used for implementing BAT 5 and 11. Heat pumps are being increasingly used.
The use of 'wasted' or surplus heat may be more sustainable than using primary fuels, even if the energy efficiency in use is lower.
Heat recovery is not applicable where there is no demand that matches the production curve. However, it is being applied in an increasing number of cases, and many of these can be found outside of the installation, see Section 3.4 and Annex 7.10.
Techniques for cooling and the associated BAT are described in the ICS BREF, including techniques for the maintenance of heat exchangers.

Chapter 4

Energy Efficiency

BAT 19: BAT is to maintain the efficiency of heat exchangers by both:

Page: 319 | Length: 910 chars

19.
BAT is to maintain the efficiency of heat exchangers by both:

a.
monitoring the efficiency periodically, and

b.
preventing or removing fouling

See Section 3.3.1.1.

4.3.4
Cogeneration

There is significant interest in cogeneration, supported at European Community level by the adoption of Directive 2004/8/EC on the promotion of cogeneration, and Directive 2003/96/EC on energy taxation, as well as by various national level policies and incentives. Relatively small scale plants may now be economically feasible, and incentives may also be available. In many cases, cogeneration has been successfully installed due to the assistance of local authorities. See Section 3.4 and Annex 7.10.3 and 7.10.4.

Utilities modelling, described in Section 2.15.2, can assist the optimisation of generation and heat recovery systems, as well as managing the selling and buying of surplus energy.

BAT 20: BAT is to seek possibilities for cogeneration, inside and/or outside the installation

Page: 319 | Length: 1,997 chars

20.
BAT is to seek possibilities for cogeneration, inside and/or outside the installation (with a third party).

Applicability: The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of an IPPC permit.

Cogeneration is as likely to depend as much on economic conditions as ENE optimisation. Cogeneration opportunities should be sought on the identification of possibilities, on investment either on the generator's side or potential customer's side, identification of potential partners or by changes in economic circumstances (heat, fuel prices, etc.).

In general, cogeneration can be considered when:

- the demands for heat and power are concurrent
- the heat demand (on-site and/or off-site), in terms of quantity (operating times during year), temperature, etc. can be met using heat from the CHP plant, and no significant heat demand reductions can be expected.

Section 3.4 discusses the application of cogeneration, the different types of cogeneration (CHP) plants and their applicability in individual cases.

Successful implementation may depend on a suitable fuel and/or heat price in relation to the price of electricity. In many cases, public authorities (at local, regional or national level) have facilitated such arrangements or are the third party.

4.3.5
Electrical power supply

Quality of the electrical power supply and the manner in which the power is used can affect energy efficiency, see Section 3.5. This may be difficult to understand and is often overlooked. There are often energy losses as unproductive power inside the installation and in the external supply grid. There can also be loss of capacity in the installation's electrical distribution system, leading to voltage drops, causing overheating and premature failure of motors and other equipment. It may also lead to increased charges when buying in electricity.

BAT 21: BAT is to increase the power factor according to the requirements of the local

21.
BAT is to increase the power factor according to the requirements of the local electricity distributor by using techniques such as those in Table 4.3, according to applicability (see Section 3.5.1).

Technique	Applicability
Installing capacitors in the AC circuits to decrease the magnitude of reactive power	All cases. Low cost and long lasting, but requires skilled application
Minimising the operation of idling or lightly loaded motors	All cases

Avoiding the operation of equipment
above its rated voltage
All cases
When replacing motors, using energy-
efficient motors (see Section 3.6.1)
At time of replacement
Table 4.3: Electrical power factor correction techniques to improve energy efficiency

BAT 22: BAT is to check the power supply for harmonics and apply filters if required (see

Page: 320 | Length: 101 chars

22.
BAT is to check the power supply for harmonics and apply filters if required (see
Section 3.5.2).

BAT 23: BAT is to optimise the power supply efficiency by using techniques such as those in

Page: 320 | Length: 2,066 chars

23.
BAT is to optimise the power supply efficiency by using techniques such as those in
Table 4.4, according to applicability:
Technique
Applicability
Section in this document
Ensure power cables have the
correct dimensions for the
power demand
When the equipment is not in use,
e.g. at shutdown or when locating
or relocating equipment
3.5.3
Keep online transformer(s)
operating at a load above
40 ■ 50 % of the rated power
■
for existing plants: when the
present load factor is below
40 %, and there is more than
one transformer
■
on replacement, use a low loss
transformer and with a loading
of 40 ■ 75 %
3.5.4
Use high-efficiency/low loss
transformers
At time of replacement, or where
there is a lifetime cost benefit
3.5.4
Place equipment with a high
current demand as close as
possible to the power source
(e.g. transformer)
When locating or relocating

equipment
3.5.4
Table 4.4: Electrical power supply techniques to improve energy efficiency
4.3.6
Electric-motor-driven subsystems34
Electric motors are widely used in industry. Replacement by electrically efficient motors
(EEMs) and variable speed drives (VSDs) is one of the easiest measures when considering
energy efficiency. However, this should be done in the context of considering the whole system
the motor sits in, otherwise there are risks of:
■
losing the potential benefits of optimising the use and size of the systems, and
subsequently optimising the motor drive requirements
■
losing energy if a VSD is applied in the wrong context.

In this document 'system' is used to refer to a set of connected items or devices which operate together for a specific purpose,
e.g. ventilation, CAS. See the discussion on system boundaries in Sections 1.3.5 and 1.5.1. These systems usually include
motor sub-systems (or component systems).

Chapter 4

Energy Efficiency
The key systems using electric motors are:
■
compressed air (CAS, see Section 3.7)
■
pumping (see Section 3.8)
■
heating, ventilation and air conditioning (see Section 3.9)
■
cooling (see the ICS BREF).

BAT 24: BAT is to optimise electric motors in the following order (see Section 3.6):

Page: 321 | Length: 2,737 chars

24.
BAT is to optimise electric motors in the following order (see Section 3.6):
1.
optimise the entire system the motor(s) is part of (e.g. cooling system, see Section 1.5.1)
2.
then optimise the motor(s) in the system according to the newly-determined load
requirements, by applying one or more of the techniques in Table 4.5, according to
applicability
Driven system energy savings measure
Applicability
Section in this
document1
SYSTEM INSTALLATION or REFURBISHMENT
Using energy-efficient motors (EEM)
Lifetime cost benefit
3.6.1
Proper motor sizing
Lifetime cost benefit
3.6.2
Installing variable speed drives (VSD)

Use of VSDs may be
limited by security and
safety requirements.
According to load. Note
in multi-machine systems
with variable load systems
(e.g. CAS) it may be
optimal to use only one
VSD motor
3.6.3
Installing high-efficiency transmission/reducers
Lifetime cost benefit
3.6.4
Use:
■
direct coupling where possible
■
synchronous belts or cogged V-belts in place
of V belts
■
helical gears in place of worm gears
All
3.6.4
Energy-efficient motor repair (EEMR)
or replacement with an EEM
At time of repair
3.6.5
Rewinding: avoid rewinding and replace with an
EEM, or use a certified rewinding contractor
(EEMR)
At time of repair
3.6.6
Power quality control
Lifetime cost benefit
3.5
SYSTEM OPERATION and MAINTENANCE
Lubrication, adjustments, tuning
All cases
2.9
Note1: Cross-media effects, Applicability and Economics are given in Section 3.6.7
Table 4.5: Electric motor techniques to improve energy efficiency
3.
when the energy-using systems have been optimised, then optimise the remaining (non-optimised) motors according to Table 4.5 and criteria such as:
i.
prioritising the remaining motors running more than 2000 hrs per year for replacement with EEMs
ii.
electric motors driving a variable load operating at less than 50 % of capacity more than 20 % of their operating time, and operating for more than 2000 hours a year should be considered for equipping with variable speed drives.

4.3.7
Compressed air systems (CAS)
Compressed air is widely used as either part of a process or to provide mechanical energy. It is widely used where there is risk of explosion, ignition, etc. In many cases, it is used as an

integral part of the process (such as providing low quality nitrogen as an inert atmosphere, and for blowing, moulding or mixing), and it is difficult to assess its mechanical efficiency. In some cases, e.g. where driving small turbines such as assembly tools, it has a low overall efficiency, and where there are no health and safety constraints, replacement with other drives may be considered (see Section 3.7).

BAT 25: BAT is to optimise compressed air systems (CAS) using the techniques such as those

Page: 322 | Length: 1,888 chars

25.
BAT is to optimise compressed air systems (CAS) using the techniques such as those
in Table 4.6, according to applicability:
Technique
Applicability
Section in this
document
SYSTEM DESIGN, INSTALLATION or REFURBISHMENT
Overall system design, including
multi-pressure systems
New or significant upgrade
3.7.1
Upgrade compressor
New or significant upgrade
3.7.1
Improve cooling, drying and
filtering
This does not include more frequent
filter replacement (see below)
3.7.1
Reduce frictional pressure losses
(for example by increasing pipe
diameter)
New or significant upgrade
3.7.1
Improvement of drives (high-
efficiency motors)
Most cost effective in small
(<10 kW) systems
3.7.2, 3.7.3,
3.6.4
Improvement of drives (speed
control)
Applicable to variable load
systems. In multi-machine
installations, only one machine
should be fitted with a variable
speed drive
3.7.2
Use of sophisticated control
systems
3.7.4
Recover waste heat for use in
other functions
Note that the gain is in terms of
energy, not of electricity
consumption, since electricity is

converted to useful heat
3.7.5
Use external cool air as intake
Where access exists
3.7.8
Storage of compressed air near
highly-fluctuating uses
All cases
3.7.10
SYSTEM OPERATION and MAINTENANCE
Optimise certain end use devices
All cases
3.7.1
Reduce air leaks
All cases. Largest potential gain
3.7.6
More frequent filter replacement
Review in all cases
3.7.7
Optimise working pressure
All cases
3.7.9
Table 4.6: Compressed air system techniques to improve energy efficiency
4.3.8
Pumping systems
Some 30 to 50 % of the energy consumed by pumping systems may be saved through
equipment or control system changes (see Section 3.8).
For electric motors used for driving pumps, see BAT 24. However, the use of VSDs (a key
technique) is also mentioned in Table 4.7.

BAT 26: BAT is to optimise pumping systems by using the techniques in Table 4.7, according

Page: 322 | Length: 3,230 chars

26.
BAT is to optimise pumping systems by using the techniques in Table 4.7, according
to applicability (see Section 3.8):

Chapter 4

Energy Efficiency
Technique
Applicability
Section in
this
document
Additional
information
DESIGN
Avoid oversizing when
selecting pumps and
replace oversized
pumps
For new pumps: all cases
For existing pumps: lifetime cost benefit
3.8.1
3.8.2

Largest single
source of pump
energy wastage
Match the correct
choice of pump to the
correct motor for the
duty
For new pumps: all cases
For existing pumps: lifetime cost benefit
3.8.2
3.8.6
Design of pipework
system (see Distribution
system, below)
3.8.3
CONTROL and MAINTENANCE
Control and regulation
system
All cases
3.8.5
Shut down unnecessary
pumps
All cases
3.8.5
Use of variable speed
drives (VSDs)
Lifetime cost benefit. Not applicable
where flows are constant
3.8.5
See BAT 24, in
Section 4.3.6
Use of multiple pumps
(staged cut in)
When the pumping flow is less than half
the maximum single capacity
3.8.5
Regular maintenance.
Where unplanned
maintenance becomes
excessive, check for:
■
cavitation
■
wear
■
wrong type of pump
All cases. Repair or replace as necessary
3.8.4
DISTRIBUTION SYSTEM
Minimise the number of
valves and bends
commensurate with
keeping ease of
operation and
maintenance
All cases at design and installation
(including changes). May need qualified
technical advice
3.8.3

Avoiding using too
many bends (especially
tight bends)
All cases at design and installation
(including changes). May need qualified
technical advice
3.8.3
Ensuring the pipework
diameter is not too
small (correct pipework
diameter)
All cases at design and installation
(including changes). May need qualified
technical advice
3.8.3
Table 4.7: Pumping system techniques to improve energy efficiency
Note that throttle control wastes less energy than bypass control or no control. However, all are wasteful of energy and should be considered for replacement according to size of the pump and how frequently it is used.

4.3.9
Heating, ventilation and air conditioning (HVAC) systems
A typical HVAC system comprises the equipment providing some or all of the following functions:

- system heating (boilers, see Section 3.2; heat pumps, see Section 3.3.2, etc.)
- cooling (see Section 3.3)
- pumps (see Section 3.8)
- heat exchangers (see Section 3.3.1) transferring or absorbing heat from a space or a process
- space heating and cooling (Section 3.9.1)
- ventilation by fans extracting or providing air through ducts, to or from heat exchangers and/or the external air (see Section 3.9.2).

Studies have shown that about 60 % of the energy in an HVAC system is consumed by the chiller/heat pump and the remaining 40 % by peripheral machinery. Air conditioning is increasingly used across Europe, particularly in the south.
Ventilation is essential for many industrial installations to function. It:

- protects staff from pollutant and heat emissions within premises
- maintains a clean working atmosphere to protect product quality.

Requirements may be dictated by health, safety and process considerations (see Section 3.9).

BAT 27: BAT is to optimise heating, ventilation and air conditioning systems by using

Page: 324 | Length: 3,434 chars

27.
BAT is to optimise heating, ventilation and air conditioning systems by using techniques such as:

■
for ventilation, space heating and cooling, techniques in Table 4.8 according to applicability
■
for heating, see Sections 3.2 and 3.3.1, and BAT 18 and 19
■
for pumping, see Section 3.8 and BAT 26
■
for cooling, chilling and heat exchangers, see the ICS BREF, as well as Section 3.3 and BAT 19 (in this document).

Chapter 4

Energy Efficiency
Energy savings measure
Applicability
Section in this
document
DESIGN and CONTROL
Overall system design. Identify and equip
areas separately for:
■
general ventilation
■
specific ventilation
■
process ventilation
New or significant upgrade. Consider for retrofit on
lifetime cost benefit
3.9.1
3.9.2.1
Optimise the number, shape and size of
intakes
New or upgrade
3.9.2.1
Use fans:
■
of high efficiency
■
designed to operate at optimal rate
Cost effective in all cases
3.9.2.1
3.9.2.2
Manage airflow, including considering dual
flow ventilation
New or significant upgrade
3.9.2.1
Air system design:
■
ducts are of a sufficient size
■
circular ducts
■
avoid long runs and obstacles such as
bends, narrow sections
New or significant upgrade
3.9.2.1
Optimise electric motors, and consider
installing a VSD

All cases. Cost effective retrofit
3.9.2.1,
3.9.2.2, 3.6,
3.6.3, 3.6.7
and BAT 24
Use automatic control systems. Integrate
with centralised technical management
systems
All new and significant upgrades. Cost effective and
easy upgrade in all cases
3.9.2.1
3.9.2.2
Integration of air filters into air duct system
and heat recovery from exhaust air (heat
exchangers)
New or significant upgrade. Consider for retrofit on
lifetime cost benefit. The following issues need to be
taken into account: the thermal efficiency, the
pressure loss, and the need for regular cleaning
3.9.2.1
3.9.2.2
Reduce heating/cooling needs by:

- building insulation
- efficient glazing
- air infiltration reduction
- automatic closure of doors
- destratification
- lowering of temperature set point during non-production period (programmable regulation)
- reduction of the set point for heating and raising it for cooling

Consider in all cases and implement according to
cost benefit
3.9.1
Improve the efficiency of heating systems
through:

- recovery or use of wasted heat (Section 3.3.1)
- heat pumps
- radiative and local heating systems coupled with reduced temperature set points in the non occupied areas of the buildings

Consider in all cases and implement according to
cost benefit
3.9.1
Improve the efficiency of cooling systems
through the use of free cooling

Applicable in specific circumstances
3.9.3
MAINTENANCE
Stop or reduce ventilation where possible
All cases
3.9.2.2
Ensure system is airtight, check joints
All cases
3.9.2.2
Check system is balanced
All cases
3.9.2.2
Manage airflow: optimise
All cases
3.9.2.2
Air filtering, optimise:

■ recycling efficiency
■ pressure loss
■ regular filter cleaning/replacement
■ regular cleaning of system

All cases
3.9.2.2
Table 4.8: Heating, ventilation and air conditioning system techniques to improve energy efficiency

Chapter 4
Energy Efficiency

4.3.10
Lighting
Health and safety at work is the priority criterion for lighting systems requirements. The energy of lighting systems can be optimised according to the specific use requirements, see Section 3.10.

BAT 28: BAT is to optimise artificial lighting systems by using the techniques such as those in

Page: 326 | Length: 1,412 chars

28.
BAT is to optimise artificial lighting systems by using the techniques such as those in Table 4.9 according to applicability (see Section 3.10):
Technique
Applicability
ANALYSIS and DESIGN OF LIGHTING REQUIREMENTS
Identify illumination requirements in terms of both intensity and spectral content required for the intended task
All cases
Plan space and activities in order to optimise the use of natural light
Where this can be achieved by normal operational or maintenance rearrangements, consider in all cases. If

structural changes, e.g. building
work, is required, new or
upgraded installations
Selection of fixtures and lamps according to specific
requirements for the intended use
Cost benefit on lifetime basis
OPERATION, CONTROL, and MAINTENANCE
Use of lighting management control systems
including occupancy sensors, timers, etc.
All cases
Train building occupants to utilise lighting equipment
in the most efficient manner
All cases
Table 4.9: Lighting system techniques to improve energy efficiency
4.3.11
Drying, separation and concentration processes
The separation of (usually) a solid from a liquid may be carried out by one or more stages. By optimising the process steps necessary to achieve the required product, substantial energy savings can be achieved. Energy efficiency may be optimised by using two or more techniques in combination (see Section 3.11).

BAT 29: BAT is to optimise drying, separation and concentration processes by using

Page: 326 | Length: 2,817 chars

29.
BAT is to optimise drying, separation and concentration processes by using techniques such as those in Table 4.10 according to applicability, and to seek opportunities to use mechanical separation in conjunction with thermal processes:

Chapter 4

Energy Efficiency
Technique
Applicability
Additional information
Section in
this
document
DESIGN
Select the optimum
separation technology or
combination of techniques
(below) to meet the specific
process equipments
All cases

3.11.1
OPERATION
Use of surplus heat from
other processes
Depends on the availability of
surplus heat in the installation (or
from third party)
Drying is a good use for
surplus heat
3.11.1
Use a combination of

techniques
Consider in all cases
May have production
benefits, e.g. improved
product quality, increased
throughput
3.11.1
Mechanical processes, e.g.
filtration, membrane
filtration

Process dependent. To achieve high
dryness at lowest energy
consumption, consider these in
combination with other techniques
Energy consumption can
be several orders of
magnitude lower, but will
not achieve high % dryness
3.11.2
Thermal processes, e.g.

- directly heated dryers
- indirectly heated dryers
- multiple effect

Widely used, but efficiency can be
improved by considering other
options in this table
Convective (direct) heat
dryers may be the option
with the lowest energy
efficiency
3.11.3
3.11.3.1
3.11.3.2
3.11.3.3
3.11.3.6

Direct drying
See thermal and radiant techniques,
and superheated steam
Convective (direct) heat
dryers may be the option
with the lowest energy
efficiency
3.11.3.2
Superheated steam
Any direct dryers can be retrofitted
with superheated steam. High cost,
needs lifetime cost benefit
assessment. High temperature may
damage product
Heat can be recovered
from this process
3.11.3.4
Heat recovery (including
MVR and heat pumps)

Consider for almost any continuous
hot air convective dryers

3.11.1
3.11.3.5
3.11.3.6
Optimise insulation of the
drying system
Consider for all systems. Can be
retrofitted

3.11.3.7
Radiation processes e.g.
■
infrared (IR)
■
high frequency (HF)
■
microwave (MW)
Can be easily retrofitted.
Direct application of energy to
component to be dried. They are
compact and
Reduce the need for air extraction.
IR limited by substrate dimensions.
High cost, needs lifetime cost
benefit assessment
More efficient heating.
Can boost production
throughput coupled with
convection or conduction
3.11.4
CONTROL
Process automation in
thermal drying processes
All cases
Savings of between 5 and
10 % can be achieved
compared with using
traditional empirical
controllers
3.11.5
Table 4.10: Drying, separation and concentration system techniques to improve energy efficiency

Document: ICS (2 BATs)

BAT 1: Best available technique

Page: 35 | Length: 580,613 chars

Best available technique

BCDMH
Bromo-chloro-dimethyl hydantoin

BCF
Bioconcentration factor

BNPD
Broomnitropropaandiol

BNS
ß-brom-ß-nitrostyrene

BOD
Biochemical oxygen demand (also named Biological oxygen demand)

BPM
Best practical means

BREF
BAT reference document

BTM
Best technical means

CCA
Copper sulphate, potassium dichromate, arsenic pentoxide

CFU
Colony forming units

COD
Chemical oxygen demand

CWS
Cooling water system

DBNPA
Dibromo-nitrilopropionamide

DPD
N-N-diethyl-p-phenylenediamine

EDF
Electricité de France

EIPPCB
European Integrated Pollution Prevention and Control Bureau

EOX
Extractable organic halogens (X= Cl, Br)

EQS

Environmental quality standard

EUR or €
Unit of european currency

FAC
Free available chlorine

FO
Free oxidant

FRO
Free residual oxidant

IEF
Information exchange forum

€ or EUR
European currency unit

kWth or kWe
1000 Watt (thermal or electric)

LD
Legionnaire's disease

Lp
Legionella pneumpophila

mg/l
Milligram per litre

MBT
Methylene(bis)thiocyanate

MIC
Microbiologically influenced corrosion

Mt or Mt
Metric tonne

MWth or MWe
1000000 Watt (thermal or electric)

mwg
Metre water gorge

Nf
Naegleria fowleri

NOEC
No observed effect level

PEC
Predicted environmental concentration

PHMB
Polyhexamethylenebiguanidechloride (QAC)

PNEC
Predicted no effect concentration

Pow
Partition coefficient over the phases n-octanol and water

ppm
Parts per million

RIZA
Dutch water management institute for inland water management and waste water treatment

QAC
Quarternary Ammonium Compounds

QSARs
Quantitative structure activity relationship

TBTO
Tributyltinoxide

TDS
Total dissolved solids

TEMA
Tubular Exchange Manufacturers Association

THM
Trihalomethanes

TOC
Total organic carbon

TRO
Total residual oxidant

TWG
Technical working group

UV
Ultra violet (light)

VCI
Association of chemical industry in Germany

VDI
Association of German Engineers (Verein Deutscher Ingenieure)

VFD
Variable frequency drive

WFD
Water Framework Directive (to be adopted)

1 GENERAL BAT CONCEPT FOR INDUSTRIAL COOLING SYSTEMS

In numerous industrial processes, heat has to be removed by what is called a waste heat removal system or cooling system. Operating these cooling systems has certain environmental consequences. The level and character of the environmental impact varies depending on the cooling principle and the way these systems are operated. To minimise this impact an "approach" can be followed which aims at prevention of emissions by proper design and selection of techniques.

Within the framework of IPPC, cooling should be considered as an integrated part of the overall energy management of an industrial process. The intention should be to reuse superfluous heat of one process in other parts of the same process or in different processes on site in order to minimise the need for discharge of waste heat into the environment. This will affect the overall energy efficiency of a process and reduce the demand for cooling, for the required capacity of the system and for its operational demands. The optimisation of energy efficiency, however, is a complex exercise and regarded as highly process-specific and as such beyond the scope of this horizontal document. If there are no options for reuse on-site, this does not have to lead automatically to discharge of heat into the environment, but options for reuse off-site in industrial or civil applications may be considered. In the end, if options for reuse of heat cannot be exploited any further, discharge of superfluous heat into the environment is to be considered.

Once the level of heat to be removed has been assessed, a first selection of the appropriate system for cooling can be decided upon. Much of the environmental performance due to the operation of a cooling system can be influenced by proper design and by selection of the right material taking into account the process requirements and local aspects. It is reported that 80% of cooling system performance has already been determined at the design table and 20% by the way the cooling system is operated (so-called 80/20 rule). Many different factors need balancing in assessing what is BAT (best available techniques) for the reduction of the environmental impact of cooling. Right from the start it is important to realise that a cooling system is an auxiliary, but generally crucial and integrated system for an industrial process and that every change applied to the process of cooling may potentially affect the performance of the industrial or manufacturing process to be cooled.

Therefore, the integrated assessment of the consumption and emissions of cooling systems and the decision on the application of a cooling technique both should be made in the light of the total environmental performance of the plant and within the requirements of the process to be cooled, ultimately balanced with costs. The required level of cooling must be guaranteed, with minimal consequences for the environment. The required level of cooling is process-specific. Where some processes can tolerate a certain temporary rise in process temperature, other more temperature sensitive processes might not, as this will have a large impact on the environmental performance of the whole plant.

According to IPPC, the environmental performance of the cooling systems discussed in this BREF must be improved by applying BAT. The question is if and how BAT for cooling systems can be determined in a general sense, where the final determination on what is best is certainly a local matter answering the specific requirements of process, environment and economics. To structure and in some way simplify the complex process of determination of BAT, this document follows the "approach" described above and presented in Figure 1.1. This "approach" should lead to a balanced decision on the application of a system for cooling and on its optimisation based on BAT for both new and existing situations.

The BAT concept consists of the following steps aiming at reduction of emissions and minimisation of the environmental impact:

- reduce the final level of waste heat produced, considering options for reuse;
- define process requirements;
-

consider general site conditions;
•
assess environmental requirements:
-
options for minimisation of resource consumption
-
options for reduction of emissions
•
develop system operation (maintenance, monitoring and risk prevention)
•
apply economic requirements
In Figure 1.1, the BAT “approach” is presented in a schematic way showing the most relevant factors involved in the determination of BAT for industrial cooling systems. For the sake of clarity not all links that can possibly be made between different aspects of cooling have been added in this scheme. For example, there is a link between sound attenuation measures and the reduction of specific direct energy consumption; and the achievable minimum end temperature of a cooling system is limited by the local climatic conditions.
In the following sections the BAT ”approach” will be further discussed in the light of common principles of operating industrial cooling systems and, where possible, indicating what the application of BAT means in the spirit of the IPPC-Directive. By its nature, this optimisation cannot be an exact mathematical comparison of various solutions. The optimisation process includes a similar challenge for all environmental balances, as it requires a comparison of different environmental impacts and a decision about which ones are the least severe or most acceptable. Nevertheless, the suggested BAT “approach” aims at providing significant information on the implications of various solutions for the environment, on costs and risks as well as the influencing factors. Based on this information, a decision can be made which is much more justified than just concentrating on optimising one single factor (e.g. water intake, energy consumption, plume or noise emission etc.).
Examples will be given to indicate the direction of the changes, rather than to specify particular emissions or reductions. Where appropriate, data are shown or reference is made to the annexes, but for most of the factors involved, data on resource use and on emissions of cooling systems are either limited or they are too specific to be generally applicable.
Summarising, the assessment of a cooling system, balancing the different factors, is founded on the following points:
•
the requirements of the process to be cooled take precedence over the measures for reduction of the environmental impact of a cooling system;
•
applying the BAT “approach” is not aiming at a disqualification of any of the configurations described in Chapter 2;
•
the BAT “approach” has more freedom for optimisation and p...
[Text truncated for PDF readability]

BAT 5: BAT 5 technique

Page: 256 | Length: 7,896 chars

BAT 5)
yes
no
Horizontal
BAT
Local specific
BAT
Selection
Aim :
PEC/ PNEC

Information concerning toxicity, persistency
(biodegradability) and treatability of the selected biocide
Figure VIII.2: Combined approach for the assessment of cooling water biocides for existing installations

Legend to Figure VIII.2:

1) implementation of this directive is under preparation;

2) optimisation of the use biocide due to monitoring of parameters relevant for the control of the cooling system and optimisation of dosage (prefer automatic dosage);

2) measures such as pretreatment, side-stream filtration can be considered. Also end-of-pipe measures can be taken into account. A choice for a measure is often situation related. A wide variety of end-of-pipe measures can be considered such as biological treatment, sand filtration, adsorption techniques, oxidation by ozone etc. etc.

4) in this case (normal) BAT criteria towards measures have to be applied; this means an evaluation of different aspects such as: availability of measures, economic impact of the necessary measures related to environmental impact of a measure;

5) in this case if we are dealing with an optimised situation in terms of implementation of measures (process control, optimisation of the use of biocides and implementation of end-of-pipe measures) all within the normal criteria of BAT for abatement measures (see 4). The result of the above evaluation represents the solution which comes closest to the aim PEC/PNEC = 1. Other appropriate additives (with less environmental impact) are not available. For this reason this can be considered as BAT for existing installations.

VIII.2.3 Example of proposed local assessment method

[tm004, Baltus and Berbee, 1996] and [tm149, Baltus et al, 1999]

In the following an example has been worked out according to the method which has been discussed at 29-31st May TWG Meeting in Seville and elaborated since that time into the proposal for the assessment of biocides in Annex VII of this BREF.

According to the scheme of the proposal three major steps can be distinguished:

1) The SELECTION OF BIOCIDES:
The selection of biocides is a tailor made choice for each and every cooling system, and normally is the result of expert discussions between plant operators and chemical suppliers. The benchmark methodology described in appendix VII of this BREF document can be a very use full support tool in the considerations for the selection of biocides. It should be noted that the result of this step is only a first prioritisation of possible biocides. The further elaboration in step 2 and 3 might result in a different order of preference of possible biocides.

2) The OPTIMISATION STEP :
The optimisation step includes all kinds of process-, dosage- and monitoring techniques as well as purification of make up water, side-stream filtration and process control measures such a temporally closure of the bleed of a recirculation system.

3) The LOCAL ASSESSMENT :
The local assessment is the final step in the assessment of biocides and provides plant operators, chemical suppliers and regulators a yard stick which enables them to determine to what extent operations, control techniques and measures have to be applied in order to meet local EQSs.

As example the following situation has been elaborated: a recirculating cooling system has to be treated with chemicals to prevent microbiological fouling of the cooling system. The dimensions of the cooling system are presented in Figure VIII.3.

~~~~~~
V-cooling system = 4500 [m3]
Concentration factor (n) = 3
discharge = 203 [m3/hr]
Intake = 609 [m3/hr]
Surface water
flow [m3/sec]
Optimisation measures
(monitoring and dosage)
Pretreatment measures
Recirculating flow = 18000 [m3/hr]
End of pipe measures
biotreater
PEC :
Predicted concentration of biocide in
surface water

Figure VIII.3: Schematic representation of a recirculating cooling system with the data for the example of a local selection method of cooling systems chemicals

For this example the assumption is made, that the result of step 1 (Benchmark method) resulted in the selection of the biocides hypochlorite in combination with dibromonitrilopropionamide (DBNPA).

The optimisation in terms adequate monitoring and dosage of the hypochlorite shows that the average concentration in the effluent should not exceed a concentration of 0.2 [mg FO/l].

For the non-oxidising biocide DBPNA the optimisation results in a shock dosage at a concentration of 4 [mg/l] (frequency: once a day).

DPBNA is an additive which readily hydrolyses in water ($\tau 1/2 = 2$ hr). This property of the additive can be a benefit in reducing the emissions from the cooling system and the realisation of a more effective use of the biocide. By closing the discharge during and after dosage for a certain period the concentration of the biocide will be reduced in the system. In this particular case, where DPBNA is been considered, the temporally closure of the bleed provides an additional (optimisation) option to reduce the amount of biocides discharged into the environment. From the operators point of view the question is: to what extent will it be possible to close the bleed of the recirculating system, in order to reduce the concentration of DBPNA through hydrolysis to a sufficient level, without hampering a good operational performance of the cooling system? This sufficient level is a concentration of DPBNA in the effluent leading to a concentration in the recipient (PEC: predicted environmental concentration) which will not exceed the EQS.

In the next table the predicted concentration of DBNPA in several types of surface water is calculated and in the last column the reduction percentage required to meet the EQS for these surface waters has been determined.

Table VIII.3: Predicted concentrations of DBNPA in different surface waters for this example

Situation:

Recirculating cooling system ; discharge volume (bleed) : 203 [m3/hr]; biocide used : DBPNA ; Dosage : shock (daily) : concentration : 4 [mg/l] ; EQS : 7 [µg/l].

Dimensions
Receiving water
Flow
[m3/sec]
Width
[m]
Depth
~~~~~~

[m]
Velocity
[m/sec]
Dilution
after
discharge
PEC
[ug/l]
Necessary
reduction [%]
to meet EQS
Average river

2,6
0,192

36,4
80,5
Large river

3,8
0,552

5,2

Small river/brook

1,5
0,067

98,5
Large canal

0,033

43,5
83,9
Small canal

0,04

97,6
Ditch
0,15

0,03

99,5

Lake
-
-
1,5
0,01

99,5

The Table VIII.3 shows that a direct discharge leads to an exceeding of the EQS for most of the selected surface waters. Only a discharge of the effluent in a large river leads to an acceptable concentration of DBPNA in surface water.

For this example the PEC is calculated using a model which is generally excepted in the Netherlands and is used by permitting authorities for a local impact assessment after BAT in a more general sense has been determined (combined approach). The Dutch model is based on the Fisher equations. The PEC is calculated at a distance of 10 times the width of the receiving water system with a maximum of 1000 m (for lakes at a distance of ¼ of the diameter).

It is expected that most member states will have their own methodologies or will use dilution factors for different type of recipients to determine the PEC.

The Environmental Quality Standard for DBPNA is calculated according the methodology that has been laid down in Annex V of the Water Framework Directive. The data listed in the table below result in a n EQS for DBNPA of 7 [ug/l]. (one NOEC and 3 acute data result in a safety factor of 100; lowest concentration /100 ■ 7 [ug/l] [1]).

Table VIII.4: Ecological data of DBNPA

Parameter	Concentration
LC-50 (fish) 96-hr	2 [mg/l]
MIC (algea)	2 [mg/l]
LC-50 (crustacean)	

Document: LVIC-S (1 BATs)

BAT 11: 11. When using acid neutralisation for the utilisation of spent post-hydrolytic ('strong')

Page: 246 | Length: 165,841 chars

11. When using acid neutralisation for the utilisation of spent post-hydrolytic ('strong') sulphuric acid, minimise the amount of material sent for disposal by optimising the production of useable gypsum products – see Sections 3.3.3.2.1, 3.3.4.11, 3.3.4.11.2 and 3.3.4.12.

12. Where spent acid is reconcentrated and re-used at the TiO2 plant site or off site, either for the digestion of titanium ore or the manufacture of other co-products (such as wet phosphoric acid, fertilisers, cement additives), minimise energy consumption for the concentration of sulphuric acid and salt roasting, while reducing the content of the metal sulphates in the concentrated acid to the minimum level, in order not to allow for their build up in the acid recycling loop – see Sections 3.3.3.2.1, 3.3.4.11, 3.3.4.11.1, 3.3.4.12 and 3.3.4.13.

13. Use calcination systems that minimise energy usage without compromising the quality of the TiO2 pigments, such as pressure filters prior to calcining and hot off-gases recycling on the kilns to save energy – see Sections 3.3.4.7 and 3.3.4.8.

14. For the calciner off-gas treatment, apply the system in which typically dust and SO3 aerosol are removed by electrostatic precipitators, while the SO2 component of the gas is catalytically oxidised to SO3 and absorbed to form sulphuric acid, which is then recycled – see Sections 3.3.3.3.5, 3.3.4.8 and 3.3.4.10.2. Refer also to BAT 18 (2) below.

15. Promote the recovery and production of ferrous sulphate, ferric sulphate, iron oxide, and other copperas related products, as well as reconcentrated sulphuric acid and gypsum, which are all potential co-products in the manufacturing of TiO2 by the sulphate process – see Section 3.3.4.12.

16. Minimise the emission of TiO2 dust and the discharge of TiO2 particles in liquid effluents originating from the finishing operations – see Sections 3.3.3.3.6, 3.3.3.4 and 3.3.4.9. Refer also to BAT 18 (1) and 19 (2) below.

Chapter 3

Large Volume Inorganic Chemicals – Solids and Others
17. Improve the overall energy efficiency in the sulphate process (for plants operated at full capacity level) in the range of 23 – 41 GJ/t TiO2 pigment (see Sections 3.3.3.2.1, 3.3.4.11 and 3.3.4.13) and from this:

1)
23 – 29 GJ/t TiO2 pigment in the process with sulphuric acid neutralisation
2)
33 – 41 GJ/t TiO2 pigment in the process with sulphuric acid reconcentration.

Given different combinations of systems used across the EU TiO2 industry for acid neutralisation and/or acid reconcentration, the extreme ranges as in 1) and 2) above, apply only as indicative levels for the estimation of the overall energy efficiency in the TiO2 plant in question.

Note also that the finishing section consumes a large share of the total energy (in the range of 10 – 15 GJ/t TiO2 pigment), and this energy use is highly dependent on the characteristics of the final product. An increase of energy required in the finishing operations is foreseen if customer specifications call for finer particle size in the final pigment product.

Increased sulphate removal from liquid effluent streams requires higher energy usage.

18. Total emission levels to air associated with the application of BAT (for all the possible configurations of the titanium dioxide plant based on sulphate process), are:

1) Dust/particulate matter
0.004 – 0.45 kg/t TiO_2 pigment
<5 – 20 mg/Nm^3
2) SO_2
1.0 – 6.0 kg/t TiO_2 pigment
3) NO_2
monitor NO_X emissions from the calciner*
4) H_2S
0.003 – 0.05 kg/t TiO_2 pigment

(*) There is no evidence that any primary measures are used in this industry. NO_X monitoring can help find the basis for future actions.

19. Total emission levels to water associated with the application of BAT (for all the possible configurations of the titanium dioxide plant based on sulphate process), are:

1) SO_4 total

100 – 550 kg/t TiO_2 pigment
2) Suspended solids

1.0 – 40 kg/t TiO_2 pigment
3) Iron compounds (Fe)

0.3 – 125 kg/t TiO_2 pigment
4) Mercury (Hg)

0.32 mg – 1.5 g/t TiO_2 pigment
5) Cadmium (Cd)

1.0 mg – 2.0 g/t TiO_2 pigment

Due to insufficient data reported, no BAT AELs were identified for V, Zn, Cr, Pb, Ni, Cu, As, Ti and Mn.

Chapter 4
Large Volume Inorganic Chemicals – Solids and Others

CARBON BLACK

4.1
General information

4.1.1
The carbon black industry

About 65 % of the world's consumption of carbon black is used in the production of tyres and tyre products for automobiles and other vehicles. Roughly 30 % goes into other rubber products such as hose, belting, mechanical and moulded goods, footwear and other uses, with the remainder being used in plastics, printing ink, paint, paper and miscellaneous applications [13, EIPPCB, 2000].

Long term growth in carbon black consumption is expected to closely parallel that of the rubber industry at about 1 – 2 % per year [13, EIPPCB, 2000], [47, InfoMil, 2002].

This relatively low percentage – when compared to the production records of the automotive industry – is due to the fact that the service life of tyres has been continuously improving. Therefore, the growth rate of other products using carbon black is more pronounced [47, InfoMil, 2002]. Variations around this growth line will depend on the cost of energy and on environmental issues, including partial replacement of carbon black by silica to produce the 'green' tyre [13, EIPPCB, 2000].

Today, the global installed capacity is approximately eight million tonnes per year, with a worldwide demand for carbon blacks currently in the order of six million tonnes per year. This quantity is produced by more than 150 carbon black plants situated in 35 countries [47, InfoMil, 2002]. The most important regions are north America, western and eastern Europe, and Asia, while south America, Africa, and Australia are at the lower end of the scale.

As a member of the carbon family, carbon black differs from other carbon-based materials in many respects, with an important difference being that of bulk density. This property has prompted carbon black production facilities to be located as close as possible to consumers since, when compared with carbon black feedstock, the transportation costs for carbon black are considerably higher. Consequently, carbon black plants are concentrated in those parts of the world where major portions of the industry requiring this material are located.

The production capacity of carbon black (1996) by geographical regions is given in Table 4.1.

Country or region
Capacity, kt per year
North America

Western Europe

Eastern Europe

Asia

South America

Africa, Australia

Total

Table 4.1:
Carbon black production capacity (1996)
[47, InfoMil, 2002]

Since carbon black is predominantly used in rubber products – mainly in tyres – most carbon black production facilities are located in countries that have large tyre and automotive industries.

Table 4.2 shows the carbon black capacity and number of plants in western Europe.

Country
Capacity, kt per year
Number of plants
Location

Germany

Dortmund, Hannover,
Hürth-Kalscheuren
France

Berre L'etang,
Lillebonne, Ambes
Italy

Ravenna, Ravenna,
S. Martino di Trecate
United Kingdom

Stanlow/Ellesmere
Avonmouth
Netherlands

Rozenburg
Botlek – Rotterdam
Spain

Puerto de Zierbenna
Santander
Sweden

Malmö
Belgium

Willebroek
Portugal

Sines
Czech Republic

Valasske-Mezirici
Hungary

Tiszaujvaros
Poland

Jaslo, Gliwice
Total EU-25

Romania

Pitesti
Croatia

Kutina
Total Europe

Table 4.2:
Carbon black production: capacity, number of plants and location in Europe
[47, InfoMil, 2002]

Following the rationalisation and concentration of the automotive and tyre industries, a consolidation of the carbon black industry occurred. The result was that of five major US based producers having worldwide activities in 1980, only two companies (company 1 and 3 in the list given in Table 4.3) survived – with the German-based company 2 shown in Table 4.3 becoming a third major producer. These three global companies, together with local producers having capacities in excess of 200 kt per year, are listed in Table 4.3.

Company name/Country*
Number of
plants
Estimated capacity,
kt per year
Capacity share, %
1. Company 1/US

2. Company 2/Germany

3. Company 3/US

4. Company 4/US

5. Company 5/US

6. Company 6/Japan

7. Company 7/US

Total 'Big Seven'

Total 'Others'

World total

~8000

* Plants and their capacities are included if at least 50 % of the shares are controlled by the company
Table 4.3:
Major world carbon black producers
[47, In...
[Text truncated for PDF readability]

Document: POL (18 BATs)

BAT 1: implement and adhere to an Environmental Management System

Page: 280 | Length: 3,204 chars

1. BAT is to implement and adhere to an Environmental Management System

A number of environmental management techniques are determined as BAT. The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

An Environmental Management System (EMS) incorporates, as appropriate to individual circumstances, the following features:

•
definition of an environmental policy for the installation by top management (commitment of the top management is regarded as a precondition for a successful application of other features of the EMS)
•
planning and establishing the necessary procedures
•
implementation of the procedures, paying particular attention to
–
structure and responsibility
–
training, awareness and competence
–
communication
–
employee involvement
–
documentation
–
efficient process control
–
maintenance programme
–
emergency preparedness and response
–
safeguarding compliance with environmental legislation.
•
checking performance and taking corrective action, paying particular attention to
–
monitoring and measurement (see also [32, European Commission, 2003])
–
corrective and preventive action
–
maintenance of records
–
independent (where practicable) internal auditing in order to determine whether or not the environmental management system conforms to planned arrangements and has been properly implemented and maintained.
•
review by top management.

Chapter 13
Polymers

Three further features, which can complement the above stepwise, are considered as supporting measures. However, their absence is generally not inconsistent with BAT. These three additional steps are:

- having the management system and audit procedure examined and validated by an accredited certification body or an external EMS verifier
- preparation and publication (and possibly external validation) of a regular environmental statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate
- implementation and adherence to an internationally accepted voluntary system such as EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the EMS. In particular EMAS, which embodies all the above-mentioned features, gives higher credibility. However, non-standardised systems can in principle be equally effective provided that they are properly designed and implemented.

Specifically for the polymer industry, it is also important to consider the following potential features of the EMS:

- the environmental impact from the eventual decommissioning of the unit at the stage of designing a new plant
- the development of cleaner technologies
- where practicable, the application of sectoral benchmarking on a regular basis, including energy efficiency and energy conservation activities, choice of input materials, emissions to air, discharges to water, consumption of water and generation of waste.

BAT 2: reduce fugitive emissions by advanced equipment design (see Section 12.1.2.)

Page: 281 | Length: 1,058 chars

2. BAT is to reduce fugitive emissions by advanced equipment design (see Section 12.1.2.)

Technical provisions to prevent and minimise fugitive emissions of air pollutants include:

- use of valves with bellow or double packing seals or equally efficient equipment. Bellow valves are especially recommended for highly toxic services
- magnetically driven or canned pumps, or pumps with double seals and a liquid barrier
- magnetically driven or canned compressors, or compressors using double seals and a liquid barrier
- magnetically driven or canned agitators, or agitators with double seals and a liquid barrier
- minimisation of the number of flanges (connectors)
- effective gaskets
- closed sampling systems
-

drainage of contaminated effluents in closed systems
•
collection of vents.

For new installations, these techniques have to be taken into account in the plant design. For existing units, they are applied step by step following the results of the techniques described in Section 12.1.3 and Section 12.1.4 (see BAT 3 and 4).

BAT 3: carry out a fugitive loss assessment and measurement to classify components

Page: 281 | Length: 257 chars

3. BAT is to carry out a fugitive loss assessment and measurement to classify components in terms of type, service and process conditions to identify those elements with the highest potential for fugitive loss (see Section 12.1.3).

Chapter 13

Polymers

BAT 4: establish and maintain an equipment monitoring and maintenance (M&M;)

Page: 282 | Length: 284 chars

4. BAT is to establish and maintain an equipment monitoring and maintenance (M&M) and/or leak detection and repair (LDAR) programme (see Section 12.1.4) based on a component and service database in combination with the fugitive loss assessment and measurement (see Section 12.1.3).

BAT 5: reduce dust emissions (see Section 12.1.5) with a combination of the

Page: 282 | Length: 620 chars

5. BAT is to reduce dust emissions (see Section 12.1.5) with a combination of the following techniques:

•
dense phase conveying is more efficient to prevent dust emissions than dilute phase conveying
•
reduction of velocities in dilute phase conveying systems to as low as possible
•
reduction of dust generation in conveying lines through surface treatment and proper alignment of pipes
•
use of cyclones and/or filters in the air exhausts of dedusting units. The use of fabric filter systems is more effective, especially for fine dust [27, TWGComments, 2004]
•
use of wet scrubbers [27, TWGComments, 2004].

BAT 6: minimise plant start-ups and stops (see Section 12.1.6) to avoid peak

Page: 282 | Length: 171 chars

6. BAT is to minimise plant start-ups and stops (see Section 12.1.6) to avoid peak emissions and reduce overall consumption (e.g. energy, monomers per tonne of product).

BAT 7: secure the reactor contents in case of emergency stops (e.g. by using

Page: 282 | Length: 125 chars

7. BAT is to secure the reactor contents in case of emergency stops (e.g. by using containment systems, see Section 12.1.7).

BAT 8: recycle the contained material from BAT 7 or to use it as fuel.

Page: 282 | Length: 76 chars

8. BAT is to recycle the contained material from BAT 7 or to use it as fuel.

BAT 9: prevent water pollution by appropriate piping design and materials (see

Page: 282 | Length: 327 chars

9. BAT is to prevent water pollution by appropriate piping design and materials (see Section 12.1.8)

To facilitate inspection and repair, effluent water collection systems at new plants and retrofitted systems are, e.g.

- pipes and pumps placed aboveground
- pipes placed in ducts accessible for inspection and repair.

BAT 10: use separate effluent collection systems (see Section 12.1.8) for:

Page: 282 | Length: 309 chars

10. BAT is to use separate effluent collection systems (see Section 12.1.8) for:

- contaminated process effluent water
- potentially contaminated water from leaks and other sources, including cooling water and surface run-off from process plant areas, etc.
- uncontaminated water.

Chapter 13
Polymers

BAT 11: treat the air purge flows coming from degassing silos and reactor vents (see

Page: 283 | Length: 333 chars

11. BAT is to treat the air purge flows coming from degassing silos and reactor vents (see Section 12.1.9) with one or more of the following techniques:

- recycling
- thermal oxidation
- catalytic oxidation
- flaring (only discontinuous flows).

In some cases, the use of adsorption techniques may be considered BAT as well.

BAT 12: use flaring systems to treat discontinuous emissions from the reactor system

Page: 283 | Length: 279 chars

12. BAT is to use flaring systems to treat discontinuous emissions from the reactor system (see Section 12.1.10)

Flaring of discontinuous emissions from reactors is considered BAT if these emissions cannot be recycled back into the process or used as fuel (see BAT 7 above).

BAT 13: use, where possible, power and steam from cogeneration plants (see Section

Page: 283 | Length: 304 chars

13. BAT is to use, where possible, power and steam from cogeneration plants (see Section 12.1.11)

Cogeneration is normally installed when the plant uses the steam produced, or where an outlet for the steam produced is available. The electricity produced can either be used by the plant or exported.

BAT 14: recover the reaction heat through the generation of low pressure steam (see

Page: 283 | Length: 209 chars

14. BAT is to recover the reaction heat through the generation of low pressure steam (see Section 12.1.12) in processes or plants where internal or external consumers of the low pressure steam are available.

BAT 15: re-use the potential waste from a polymer plant (see Section 12.1.15)

Page: 283 | Length: 156 chars

15. BAT is to re-use the potential waste from a polymer plant (see Section 12.1.15)

Generally, the re-use of potential waste is favourable over landfill.

BAT 16: use pigging systems in multiproduct plants with liquid raw materials and

Page: 283 | Length: 118 chars

16. BAT is to use pigging systems in multiproduct plants with liquid raw materials and products (see Section 12.1.16)

BAT 17: use a buffer for waste water upstream of the waste water treatment plant to

Page: 283 | Length: 234 chars

17. BAT is to use a buffer for waste water upstream of the waste water treatment plant to achieve a constant quality of the waste water (see Section 12.1.17)

This applies to all waste water producing process, such as PVC and ESBR.

BAT 18: treat waste water efficiently (see Section 12.1.18)

Page: 283 | Length: 579 chars

18. BAT is to treat waste water efficiently (see Section 12.1.18)

Waste water treatment can be carried out in a central plant or in a plant dedicated to a special activity. Depending on the waste water quality, additional dedicated pretreatment is required. Waste water treatment can be carried out in a central plant or in a plant dedicated to a special activity.

Chapter 13

Polymers
13.2
BAT for the production of polyolefins

Additionally to the generic BAT (see Section 13.1), for the production of polyolefins, the following BAT have to be taken into account.