

**ONDERWERP**  
BREF Industrial cooling systems

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## BREF Industrial cooling systems

Below a summary is given on the BAT conclusions based on the BREF Industrial cooling systems (date December 2001).

### Introduction

The BREF Industrial cooling systems is a horizontal BREF. In a horizontal approach it is assumed that the environmental aspects of the applied techniques and the associated reduction measures can be assessed and that generic BAT can be identified that are independent of the industrial processes in which techniques are applied. Industrial cooling systems are an integrated part of the industrial process to be cooled. The cooling systems within the scope of this BREF are used in many of the industrial sectors under the scope of IPPC. Consequently, the variety of applications, techniques and operational practices is enormous. Additionally, the thermodynamic character of the process leads to further variations in performance and consequently in the environmental effects.

Due to this large variation, comparisons between techniques leading to general conclusions on BAT are difficult. The identification of a general preventive approach is considered to be possible, based on practical experience with reduction of emissions from cooling systems.

In this preventive approach or, primary BAT-approach, attention is firstly given to the process to be cooled. The design and the construction of the cooling system are an essential second step, in particular for new installations. Finally, changes of equipment and the way in which the cooling system should be operated will address new installations, but are particularly important in existing systems, where technological options are considerably limited and cost-intensive.

The proposed techniques are applied techniques. They have proven to be effective, although quantification is difficult and they may create unrealistic expectations. It can be assumed that all measures proposed as BAT, and which are not entirely dependent on the local situation, can be considered for new systems. With respect to existing installations, care must be taken as the assessment is more difficult where options are limited and depend on a multitude of (process) factors. There do not seem to be many obstacles to implementation of operational measures in existing cooling systems, unless the technological design limits the number of options for modification.

In Tables 4.3 to 4.12 of the BREF techniques are presented that are considered BAT, following on from the primary BAT-approach for:

- increasing the overall energy efficiency,
- reduction of use of water and of cooling water additives,
- reduction of emissions to air and water,
- reduction of noise,
- reduction of entrainment of aquatic organisms and
- reduction of biological risks.

For each environmental issue the consequences for other media of the application of a reduction technique have been identified. Generally speaking every change made to a cooling system must be carefully balanced against the associated effects and in this sense the optimization of industrial cooling is a cross-media issue.

For new cooling installations it is BAT to start identifying reduction measures in the design phase, applying equipment with low energy requiring requirement and by choosing the appropriate material for equipment in contact with the process substance and/or the cooling water. In this sense the following quotation is exemplary: "in practice... attention to design, layout and maintenance of the cooling water system has a relatively low priority compared to the environmental consequences of a poorly designed and/or operated cooling water system. Since little attention is paid to design factors, treatments often have to make up for bad design, and therefore need to be chosen in such a way that they minimize risks of fouling. Few changes of this attitude are to be expected as long as there is a low level of awareness of the long-term costs of operating and maintaining poorly designed CWS".

If dry air cooling systems are the preferred option, measures are primarily related to reduction of direct energy consumption and noise emissions and the optimization of size with respect to the required cooling surface.

For existing installations, technological measures can be BAT under certain circumstances. Generally, a change in technology is cost-intensive where overall efficiency must be maintained. Cost evaluation should then compare investment costs of the change versus the change in operational costs and validate the reduction effect versus other environmental consequences. For example, it would need a comparison between the environmental effect of recirculating the cooling water - requiring the application of biocidal water treatment - against a once-through system without biocides, but a large heat emission to the aquatic environment. In the case of pre-assembled off-the-peg cooling towers, a change in technology seems feasible both technically and economically. No comparable data have been submitted that can support this, but supplier experience is that it is relatively easy to change small size cooling towers, for example, from a closed recirculating wet to a closed recirculating hybrid or wet/dry configuration. This would not need major process modifications or construction work. For large custom-designed towers that are erected on-site, technological changes are not easy to make. A different technology generally means a completely new cooling tower.

For existing wet cooling systems, where the focus is largely on environmental measures to reduce water use and to emissions of chemicals to the surface water, BAT has not so much technological but rather an operational character. Monitoring, operation and maintenance are the key issues here.

## BEST AVAILABLE TECHNIQUES FOR INDUSTRIAL COOLING SYSTEMS

Item	Description	BAT	Implemented [Yes/No]	Remark (How, Why not, Alternative)
<b>Reduction of energy consumption</b>	In an integrated approach to cooling an industrial process, both the direct and indirect use of energy are taken into account. In terms of the overall energy efficiency of an installation, the use of a once-through systems is BAT, in particular for processes requiring large cooling capacities (e.g. > 10 MWth).	<ul style="list-style-type: none"> <li>Table 4.3: BAT for increasing overall energy efficiency</li> </ul>	Yes	Chillers are selected to allow for variable operation
<b>Reduction of water requirements</b>	For new systems the following statements can be made:	<ul style="list-style-type: none"> <li>In the light of the overall energy balance, cooling with water is most efficient;</li> <li>For new installations a site should be selected for the availability of sufficient quantities of (surface) water in the case of large cooling water demand;</li> <li>The cooling demand should be reduced by optimising heat reuse;</li> <li>For new installations a site should be selected for the availability of an adequate receiving water, particularly in case of large cooling water discharges; Where water availability is limited, a technology should be chosen that enables different modes of operation requiring less water for achieving the required cooling capacity at all</li> </ul>	No	<p>Water cooling is not used.</p> <p>Heat recovery chillers are proposed. In normal operation, they transfer the heat energy between the chilled water and heating water rather than rejecting the energy. Only when an imbalance of system occur do they reject the energy to the air. When heating is required they act as a heat pump and remove energy from the air.</p>

Item	Description	BAT	Implemented [Yes/No]	Remark (How, Why not, Alternative)
		times; In all cases recirculating cooling is an option, but this needs careful balancing with other factors, such as the required water conditioning and a lower overall Energy efficiency.		
	For existing water cooling systems, increasing heat reuse and improving operation of the system can reduce the required amount of cooling water. In the case of rivers with limited availability of surface water, a change from a once-through system to a recirculating cooling systems is a technological option and may be considered BAT. For power stations with large cooling capacities, this is generally considered as a cost-intensive exercise requiring a new construction. Space requirements must be taken into account.		• No	Not relevant as this is a new building
<b>Reduction of entrainment of organisms</b>		• Table 4.4: BAT for reduction of water requirements	• No	Not relevant as water is not used for heat rejection
<b>Reduction of emissions to water</b>		• Table 4.5: BAT for reduction of entrainment	• No	Not relevant as water is not used for heat rejection
<b>General BAT approach to reduce heat emissions</b>			• No	Not relevant as water is not used for heat rejection
<b>General BAT approach to reduce chemical</b>			• No	Not relevant as water is not used for heat rejection

Item	Description	BAT	Implemented [Yes/No]	Remark (How, Why not, Alternative)
<b>emissions to water</b>				
<b>Prevention by design and maintenance</b>		Table 4.6: BAT for reduction of emissions to water by design and maintenance techniques	• No	Not relevant as water is not used for heat rejection
<b>Control by optimised cooling water treatment</b>		Table 4.7: BAT for reduction of emissions to water by optimised cooling water treatment	• No	Not relevant as water is not used for heat rejection
<b>Reduction of emissions to air</b>		Table 4.8: BAT for reduction of emissions to air	• Yes	Heat recovery chiller will be used that will re-use the energy and reduce any heat emissions
<b>Reduction of noise emissions</b>		Table 4.9: BAT for the reduction of noise emissions	• Yes	The heat recovery chillers will come with factory installed acoustic insulation. Low noise fans are used as part of the equipment
<b>Reduction of risk of leakage</b>		Table 4.10: BAT to reduce the risk of leakage	• No	Not relevant as water is not used for heat rejection
<b>Reduction of biological risk</b>		Table 4.11: BAT to reduce biological growth	• No	There are no systems that will allow biological growth