

Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

Industrial Wastewater Fundamentals

AquaSPICE Course 2024

Laurence Palmowski & Team



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- Industrial Wastewater Fundamentals
- Industrial Wastewater Policies
- Best Available Techniques



Industrial Wastewater Fundamentals

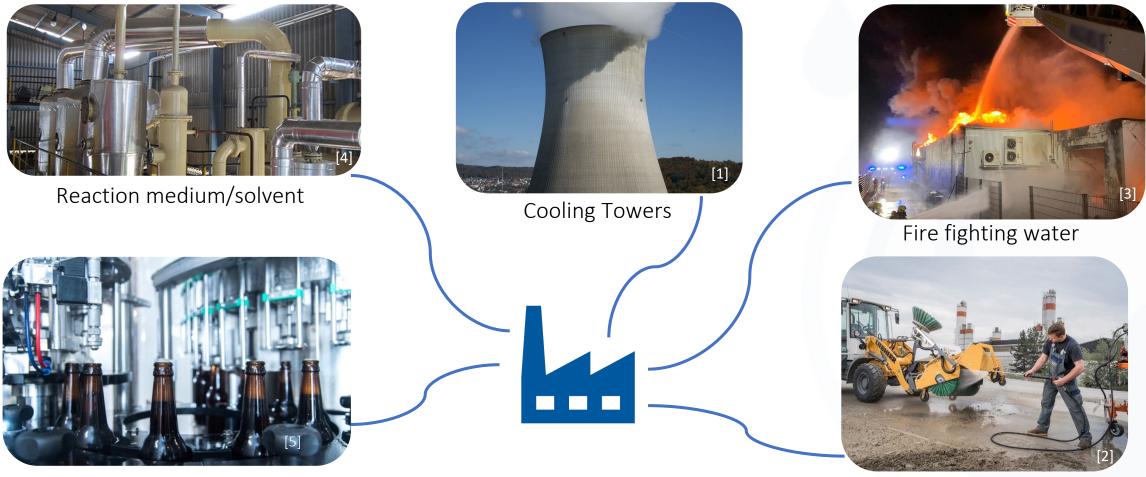




 Global water use European water use 12% 21% 22% 19% 69% 57% ■ Agriculture ■ Industries ■ Municipalities



Use of Water in Industry



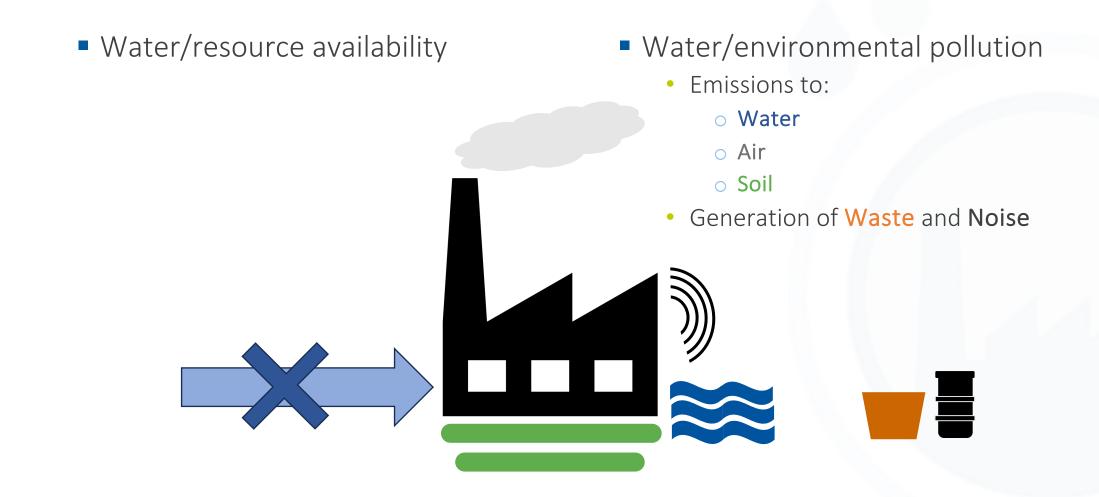
Integral part of the product

Cleaning



Environmental Challenges of Industrial Sector

Regarding Water





- Extensive metering and water balances
- Leak detection
- Compliant water discharge within limit values,
 - specified in regulations



- Appropriate water and wastewater treatment
 - techniques ---- Process Innovation
- Water reuse ____ Circular Innovation





Pollutants (depending on industry):

- Organic pollutants
 - Human and animal waste
- Inorganic pollutants
 - Heavy metals
 - Metal ions
 - Pesticides
- Suspended solids (e.g. sand, clay, colloids)
- Nutrients (e.g. phosphorus, ammonia)
- Pathogens (e.g. viruses, bacteria)



• etc.



Pollutants in Industrial Wastewater I/II

Water quality parameters:

- Physical parameters (e.g. temperature, total suspended/dissolved solids (TSS, TDS), electrical conductivity, color, odor,...)
- Chemical parameters (e.g. pH, water hardness, dissolved oxygen, ...)
- Biological parameters







Industrial Wastewater Policies





UN Sustainable Development Goals

Regarding Industrial Water Use



Target 6.3:

"[...] *improve water quality* by reducing pollution, [...] substantially increasing recycling and safe reuse globally.

Target 6.4:

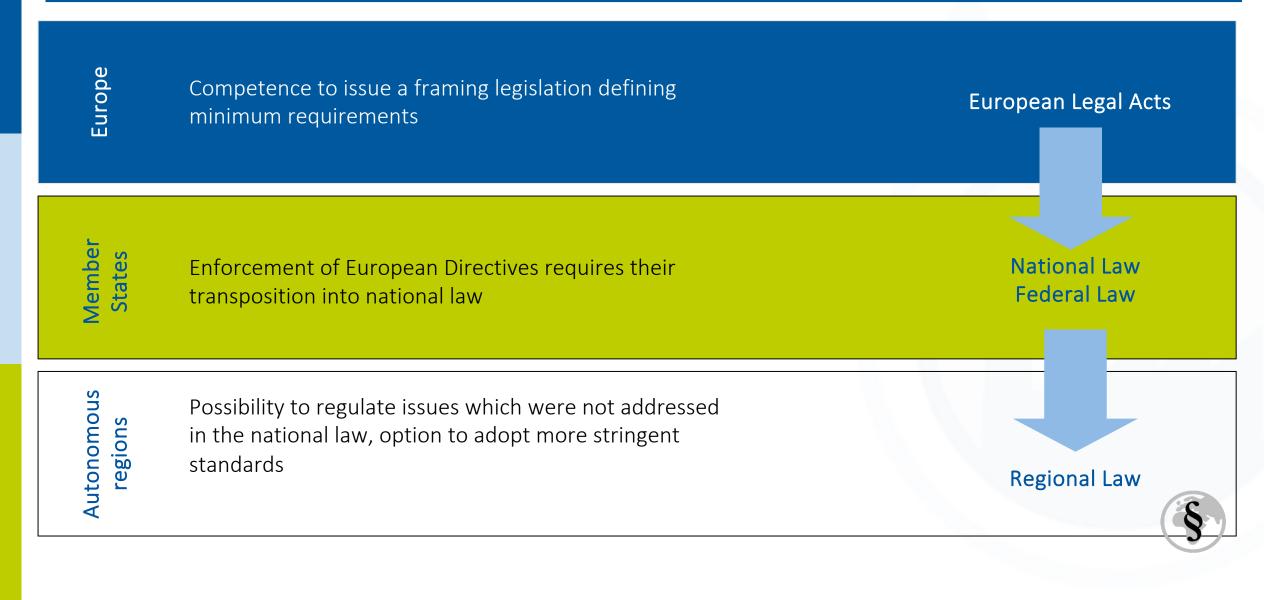
"[...] *increase water-use efficiency* across all sectors [...] to address water scarcity.

• Target 12.4:

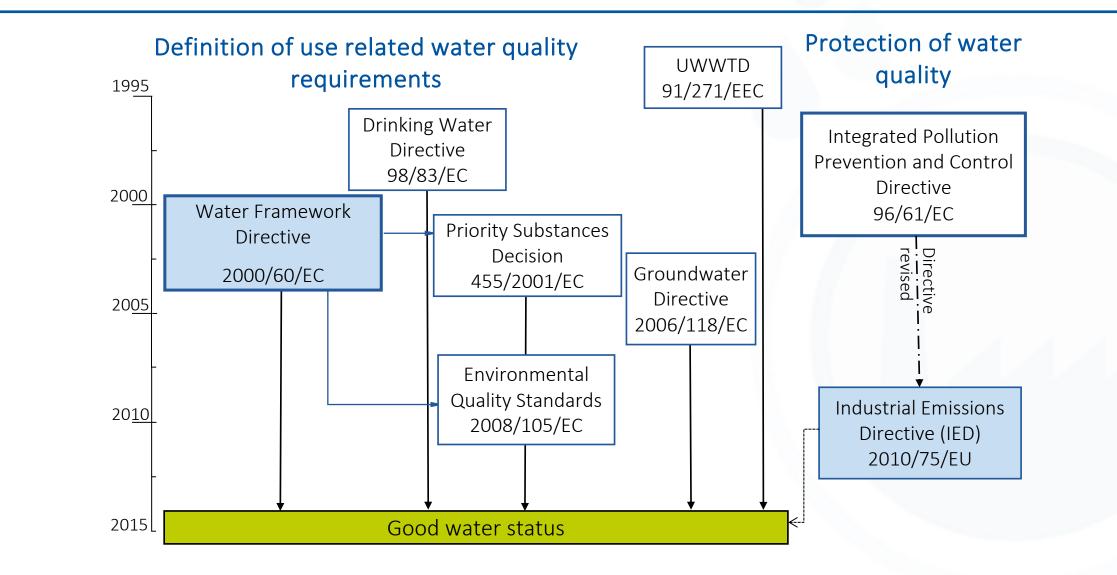
"[...] achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil [...].



Levels of European Legislation









Water Framework Directive (WFD)

WIFID

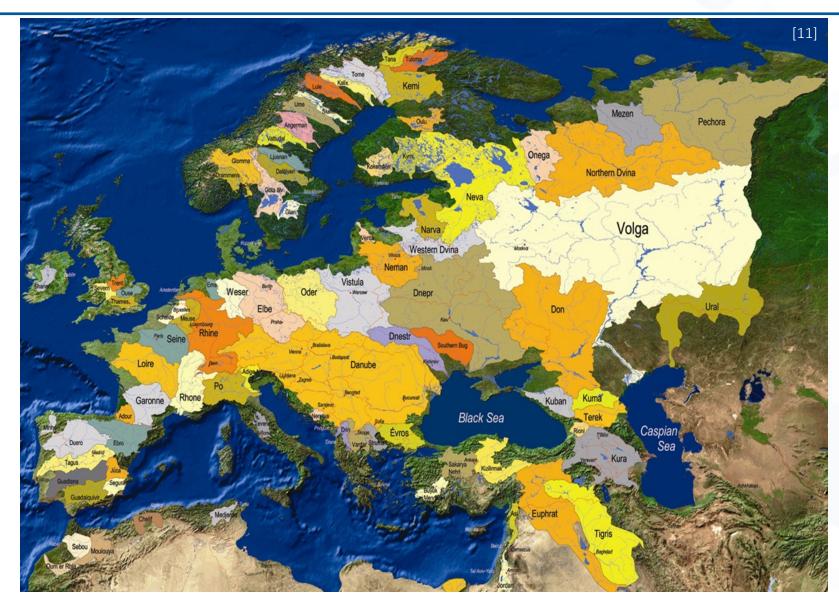


- Aim: Achieving "good status" for all EU ground and surface waters by 2015/2027
- Background:
 - natural conditions and water management issues vary greatly across EU
 - WFD sets quality goals and methods to maintain good water quality
- Strategy: Water management based on river basins
 - Set reference conditions and monitor status of water
 - Assess impact of human activity
 - Full cost recovery of water services, polluters pay principle

22.12.2000 EN Official Journal of the I	European Communities L 327	
(Acts whose public	ation is obligatory)	
DIRECTIVE 2000/60/EC OF THE EUROPE/ of 23 Oct		
establishing a framework for Commun		
THE ELROPEAN PARLIMENT AND THE COUNCEL OF THE ELROPEAN UNDOR. Having regard to the Trrary establishing the European Community, and in particular Article 175(1) thereof.	(1) The declaration of the Ministerial Seminar or groundwater held at The Jague in 1991 recognised th need for action to avoid long-term deterioration or freshwater quality and quantity and called for programme of actions to be implemented by the typ 2000 aiming at sustainable management and protection	
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asked the Commission to submit proposals to improve ecological quality in Community surface waters.	(6) On 21 February 1996 the Commission adopted communication to the European Parliament and th Council on European Community water policy setti out the principles for a Community water policy.	
 (¹) OJ C 184, 17.6.1997, p. 20, OJ C 16, 20.1.1998, p. 14 and OJ C 108, 7.4.1998, p. 94. (²) OJ C 355, 21.11.1997, p. 83. 		
 (¹) OJ C 180, 11.6.1998, p. 38. (²) Opinion of the European Parliament of 11 February 1999 [OJ C 150, 28.5.1999, p. 419], confirmed on 16 September 1999, and Council Common Position of 22 October 1999 [OJ C 343, 	(7) On 9 September 1996 the Commission presented proposal for a Decision of the European Parliament an	
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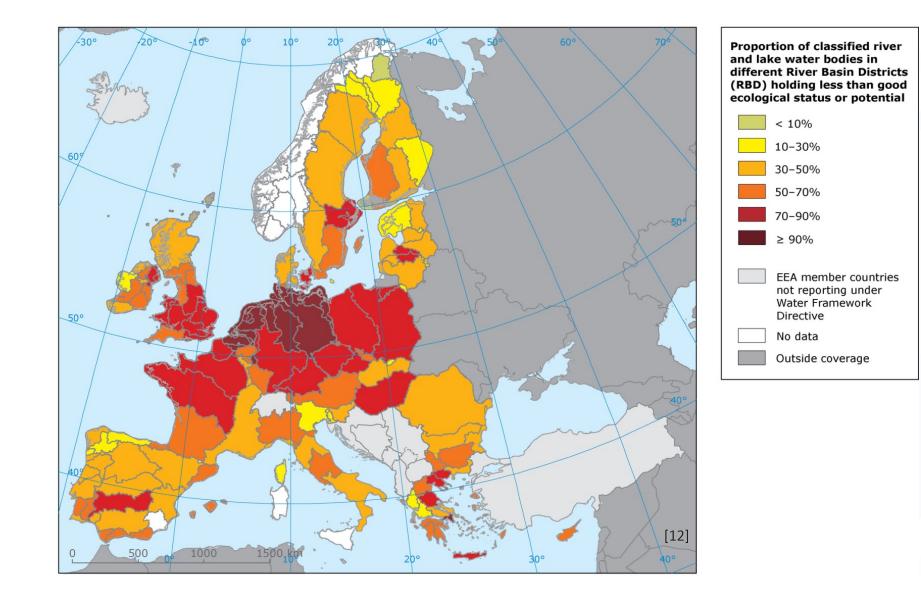
European River Catchments



WIFID



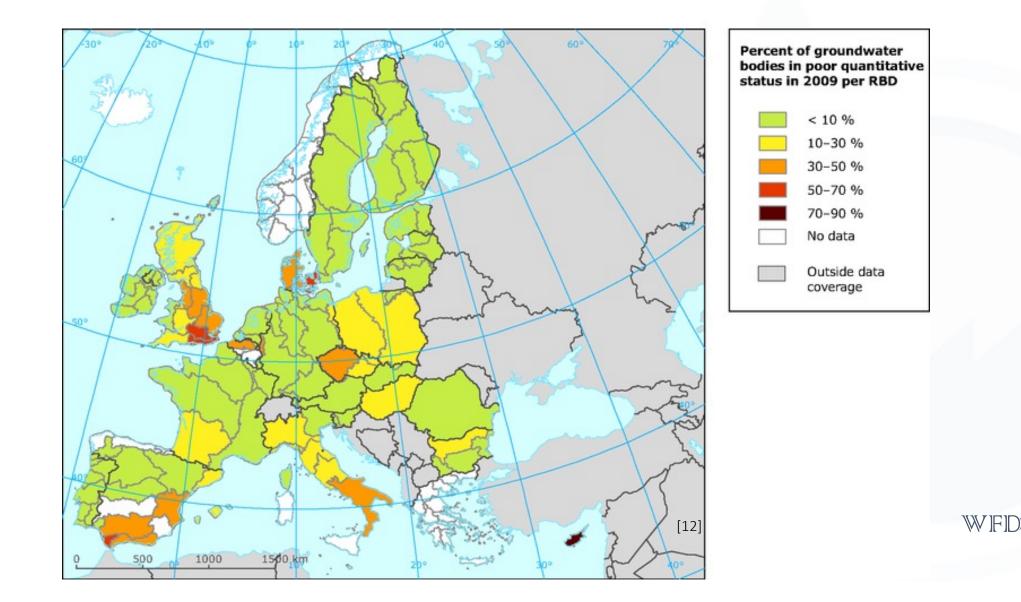
Ecological status of EU surface water bodies



WFL



Ecological status of EU groundwater bodies





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- Strategy: Water management based on river basins
 - Set reference conditions and monitor status of water
 - Assess impact of human activity
 - Full cost recovery of water services, polluters pay principle
- Review (December 2019)
 - Room for improvements (investments, implementation, ...)
 - WFD achieved higher level of water bodies
 - ightarrow contribute to achieving SDGs
- Proposal for revision (adopted in October 2022)
 - Updated list of pollutants

22.12.2000 EN Official Journal of the	Europea	n Communities L 327
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Regions (^b),	(4)	Waters in the Community are under increasing pressu from the continuous growth in demand for sufficient
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2000. (⁵) OI C 209, 9.8.1988, p. 3.	(*) OJ L 20, 26.1.1980, p. 43. Directive as amended by Directive p1/692/EEC (OJ L 377, 31.12.1991, p. 48).	



Industrial Emissions Directive (IED)



17.12.2010

Official Journal of the European Ut

DIRECTIVES

DIRECTIVE 2010/75/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCE of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (Recart)

(Text with EEA relevand

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ent and of the Council of 23 October 2001 on the lin

an Parliament and of the Council of 15 Januar oncerning integrated pollution prevention and cou-In the interests of clarity, those Directives shou

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ment as a whole. It is, then

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fore, appropriate to provide for an integrated approach t

tion and control of emissions into air, water an

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THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EURO-PEAN UNION.

Union, and in particular Article 192(1) thereof

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Acting in accordance with the ordinary legislative procedure (1),

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cil Directive 78/176/EEC of 20 February 1978 on wash from the titanium dioxide industry (*), Council Directiv

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1999/13/EC of 11 March 1999 on the limitation of

) OI C 182, 4.8.2009, p. 46

nal) and decision of the Cou OI L 54, 25,21978, n. 19.

OLT 378 31.12.1982 m

ium dioxide industry (9, Council Dire

- Aim: Achieve a high level of environmental protection from industrial activities
- Sectors:
 - Energy
 - Chemicals
 - Metal production and processing
 - Waste management
 - Etc.
- Operator obligations:
 - prevent/reduce industrial emissions into air, water and land
 - Avoidance of waste production, recycling where possible, disposal while avoiding any impact on the environment
 - Efficient use of energy

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    → All appropriate preventive measures are taken by applying the best available techniques
    (BAT)
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Best Available Techniques





- Definition of the European Commission for Best Available Techniques (BAT)
 - Most effective and advanced stage of operation methods which indicate the practical suitability of particular techniques to prevent or reduce emissions.
 - **Best** = Most effective in achieving a high level of protection of the environment as a whole.
 - Available = Implementation in relevant industrial sector feasible under economically and technically viable conditions.
 - Techniques = Both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.







https://www.youtube.com/watch?v=d2kprBd8Tk0



Goals of BAT Concept



Prevention and control of industrial pollution to protect human health and the environment across countries

Global level goal: harmonize procedures and technologies

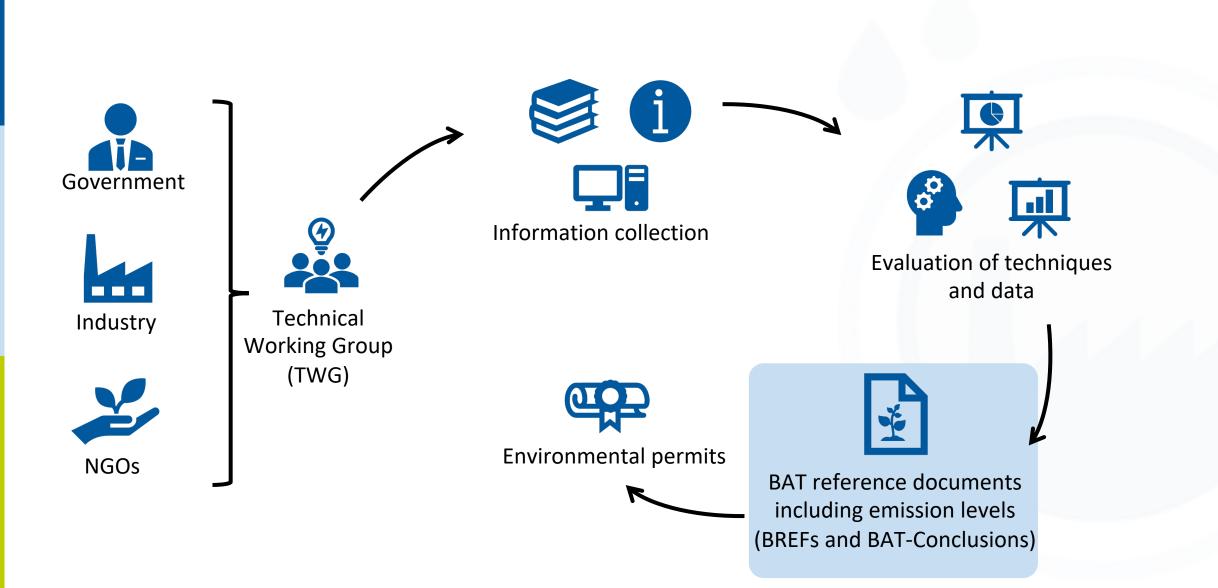


Local level goal: provide guidance for governments to identify permit conditions for industry (BAT-based permitting), e.g.:

- Emission level values (obtained under normal operating conditions using BAT or a combination of BAT)
- Technical requirements
- Plant/production management requirements
- Plant/production monitoring requirements (for emissions, consumption of resources and waste generation)



How to determine BATs in the EU - Sevilla Process





Exemplary BREFs for Industrial Water Treatment

Depending on Sector/Topic



Industrial Cooling Systems (2001)

Chemical Sector (2016)

Waste Treatment (2018)



Example: BREF on Waste Treatment (WT)

Wastewater treatment

BREF WT content:

- Scope
- General Information
 - Types of wastewater in EU
 - Economics of waste treatment sector
 - ...
- Processes and techniques commonly used for waste treatment
- BAT conclusions, including
 - BAT for wastewater treatment
 - BAT-associated limit values (BAT-AEL)





BAT for wastewater treatment

BAT 20. In order to reduce emissions to water, BAT is to treat waste water using an appropriate combination of the techniques given below.

	Technique (¹)	Typical pollutants targeted	Applicability				
P	Preliminary and primary treatment, e.g.						
a.	Equalisation	All pollutants					
b.	Neutralisation	Acids, alkalis	Concellar applicable				
c.	Physical separation, e.g. screens, sieves, grit separators, grease separators, oil-water separation or primary settlement tanks	Gross solids, suspended solids, oil/grease	Generally applicable.				
P	hysico-chemical treatment, e.g.						
d.	Adsorption	Adsorbable dissolved non-biodegradable or inhibitory pollutants, e.g. hydrocarbons, mercury, AOX					
e.	Distillation/rectification	Dissolved non- biodegradable or inhibitory pollutants that can be distilled, e.g. some solvents					
f.	Precipitation	Precipitable dissolved non-biodegradable or inhibitory pollutants, e.g. metals, phosphorus					

BAT-associated limit values (BAT-AEL)

Table 6.1: BAT-associated emission levels (BAT-AELs) for direct discharges to a receiving water body

Substance/Parameter	BAT-AEL (¹)	Waste treatment process to which the BAT-AEL applies	
Total organic carbon (TOC) (²)	10–60 mg/l	 All waste treatments except treatment of water-based liquid waste 	
	10–100 mg/l (³) (⁴)	 Treatment of water-based liquid waste 	
Chemical oxygen demand (COD) (²)	30–180 mg/l	 All waste treatments except treatment of water-based liquid waste 	
	30–300 mg/l (³) (⁴)	 Treatment of water-based liquid waste 	
Total suspended solids (TSS)	5-60 mg/l	All waste treatments	
Hydrocarbon oil index (HOI)	0.5–10 mg/l	 Mechanical treatment in shredders of metal waste Treatment of WEEE containing VFCs and/or VHCs Re-refining of waste oil Physico-chemical treatment of waste with calorific value Water washing of excavated contaminated soil Treatment of water-based liquid waste 	



Literature and Further Information





Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

Thank you!

Laurence Palmowski & Team











Illustration sources

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