



University of Natural Resources and  
Applied Life Sciences, Vienna  
Department of Water, Atmosphere and  
Environment

# Chemistry for Civil Engineering

## 811.357

Teil: **Guidelines**

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# Guideline values – Drinking water



- WHO -Guidelines for Drinking Water 3rd edition 2004
- EU- Water intended for human consumption (Drinking Water Directive 1998 98/83/EG)
- EU: Food law (Lebensmittelsicherheits-und Verbraucherschutzgesetz LMSVG (BGBl 13/2006))
- A: Drinking water regulation: Water intended for human consumption BGBl.304/2001 and Codex Alimentarius Austriacus (Lebensmittelcodex Chapter B1, 2002
- A: Bottled Water: Mineralwasser und Quellwasser-VO BGBl. 309/1999 and Chapter B17 Tafelwasser etc. 2003
- <http://ris1.bka.gv.at/>

# Regulations on water quality (examples)



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- **Surface water**

WFD, (60/2000/EG), List of priority substances (PS/PHS) 2008/105/EG

A: Qualitätsziel-VO Chemie OW – QZVO Chemie (BGBl II 96/2006)

- **Ground water**

A: Grundwasserschutz-VO BGBl. II Nr. 398/2000

Qualitätsziel-VO Chemie GW (2010),

EU: Groundwater Directive (2006/118/EC)

- **Bathing water**

EU-RL (2006/7/EC), ÖNORMEN etc.

- **Irrigation water**

WHO 2006, ÖWAV-Regelblatt Nr 11/2003

- **Waste water**

EU- Urban Waste Water Treatment Directive (UWWT (91/271/EC),

A: AW-Emissions-VO, (BGBl 210/1996), Indirekteinleiter-VO (222/1998)

EU: EPER-V (300/2002)- European Pollutant Emission Register , IPPC- Directive - Directive on Industrial Emissions

# WHO-Guidelines



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[http://www.who.int/water\\_sanitation\\_health/dwq/gdwq3/en/](http://www.who.int/water_sanitation_health/dwq/gdwq3/en/)

# WHO-Guidelines



[http://www.who.int/water\\_sanitation\\_health/dwq/gdwq3/en/index.html](http://www.who.int/water_sanitation_health/dwq/gdwq3/en/index.html)

- Naturally occurring chemicals for which no GV have been established
- GV for naturally occurring chemicals that are of health significance
- GV for chemicals from industrial sources and human dwellings that are of health significance
- Chemicals from agricultural activities excluded from GV value derivation
- Guideline values for chemicals from agricultural activities that are of health significance in drinking-water
- Chemicals used in water treatment for which GV have not been established
- GV for chemicals used in water treatment or materials in contact with drinking-water that are of health significance in drinking-water
- GV for pesticides used in water for public health purposes that are of health significance in drinking-water
- Radionuclides

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# Naturally occurring chemicals for which no GV have been established (WHO, 2004)



Chemical	Reason for not establishing a guideline value	Remarks
Chloride	Occurs in drinking-water at concentrations well below those at which toxic effects may occur	May affect acceptability of drinking-water (see chapter 10)
Hardness	Occurs in drinking-water at concentrations well below those at which toxic effects may occur	May affect acceptability of drinking-water (see chapter 10)
Hydrogen sulfide	Occurs in drinking-water at concentrations well below those at which toxic effects may occur	May affect acceptability of drinking-water (see chapter 10)
pH	Values in drinking-water are well below those at which toxic effects may occur	An important operational water quality parameter
Sodium	Occurs in drinking-water at concentrations well below those at which toxic effects may occur	May affect acceptability of drinking-water (see chapter 10)
Sulfate	Occurs in drinking-water at concentrations well below those at which toxic effects may occur	May affect acceptability of drinking-water (see chapter 10)
Total dissolved solids (TDS)	Occurs in drinking-water at concentrations well below those at which toxic effects may occur	May affect acceptability of drinking-water (see chapter 10)

# GV for naturally occurring chemicals that are of health significance (WHO, 2004)



Chemical	Guideline value <sup>a</sup> (mg/litre)	Remarks
Arsenic	0.01 (P)	
Barium	0.7	
Boron	0.5 (T)	
Chromium	0.05 (P)	For total chromium
Fluoride	1.5	Volume of water consumed and intake from other sources should be considered when setting national standards
Manganese	0.4 (C)	
Molybdenum	0.07	
Selenium	0.01	
Uranium	0.015 (P,T)	Only chemical aspects of uranium addressed

<sup>a</sup> P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited; T = provisional guideline value because calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, etc.; C = concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, resulting in consumer complaints.

# GV for chemicals from industrial sources and human dwellings that are of health significance (WHO, 2004)



Inorganics	Guideline value (mg/litre)	Remarks
Cadmium	0.003	
Cyanide	0.07	
Mercury	0.001	For total mercury (inorganic plus organic)

Organics	Guideline value <sup>a</sup> (µg/litre)	Remarks
Benzene	10 <sup>b</sup>	
Carbon tetrachloride	4	
Di(2-ethylhexyl)phthalate	8	
Dichlorobenzene, 1,2-	1000 (C)	
Dichlorobenzene, 1,4-	300 (C)	
Dichloroethane, 1,2-	30 <sup>b</sup>	
Dichloroethene, 1,1-	30	

# GV for chemicals from industrial sources and human dwellings that are of health significance (WHO, 2004)

Organics	Guideline value <sup>a</sup> (µg/litre)	Remarks
Dichloroethene, 1,2-	50	
Dichloromethane	20	
Edetic acid (EDTA)	600	Applies to the free acid
Ethylbenzene	300 (C)	
Hexachlorobutadiene	0.6	
Nitrilotriacetic acid (NTA)	200	
Pentachlorophenol	9 <sup>b</sup> (P)	
Styrene	20 (C)	
Tetrachloroethene	40	
Toluene	700 (C)	
Trichloroethene	70 (P)	
Xylenes	500 (C)	

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<sup>a</sup> P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited; C = concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.

<sup>b</sup> For non-threshold substances, the guideline value is the concentration in drinking-water associated with an upper-bound excess lifetime cancer risk of  $10^{-5}$  (one additional cancer per 100 000 of the population ingesting drinking-water containing the substance at the guideline value for 70 years). Concentrations associated with estimated upper-bound excess lifetime cancer risks of  $10^{-4}$  and  $10^{-6}$  can be calculated by multiplying and dividing, respectively, the guideline value by 10.

# Chemicals from agricultural activities excluded from GV value derivation (WHO, 2004)

Chemical	Reason for exclusion
Amitraz	Degrades rapidly in the environment and is not expected to occur at measurable concentrations in drinking-water supplies
Chlorobenzilate	Unlikely to occur in drinking-water
Chlorothalonil	Unlikely to occur in drinking-water
Cypermethrin	Unlikely to occur in drinking-water
Diazinon	Unlikely to occur in drinking-water
Dinoseb	Unlikely to occur in drinking-water
Ethylene thiourea	Unlikely to occur in drinking-water
Fenamiphos	Unlikely to occur in drinking-water
Formothion	Unlikely to occur in drinking-water
Hexachlorocyclohexanes (mixed isomers)	Unlikely to occur in drinking-water
MCPB	Unlikely to occur in drinking-water
Methamidophos	Unlikely to occur in drinking-water
Methomyl	Unlikely to occur in drinking-water
Mirex	Unlikely to occur in drinking-water
Monocrotophos	Has been withdrawn from use in many countries and is unlikely to occur in drinking-water
Oxamyl	Unlikely to occur in drinking-water
Phorate	Unlikely to occur in drinking-water
Propoxur	Unlikely to occur in drinking-water
Pyridate	Not persistent and only rarely found in drinking-water
Quintozene	Unlikely to occur in drinking-water
Toxaphene	Unlikely to occur in drinking-water
Triazophos	Unlikely to occur in drinking-water
Tributyltin oxide	Unlikely to occur in drinking-water
Trichlorfon	Unlikely to occur in drinking-water



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# Chemicals from agricultural activities for which guideline values have not been established (WHO, 2004)



Chemical	Reason for not establishing a guideline value
Ammonia	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Bentazone	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Dichloropropane, 1,3- Diquat	Data insufficient to permit derivation of health-based guideline value Rarely found in drinking-water, but may be used as an aquatic herbicide for the control of free-floating and submerged aquatic weeds in ponds, lakes and irrigation ditches
Endosulfan	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Fenitrothion	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Glyphosate and AMPA	Occurs in drinking-water at concentrations well below those at which toxic effects may occur

# Guideline values for chemicals from agricultural activities that are of health significance in drinking-water (WHO, 2004)



Non-pesticides	Guideline value <sup>a</sup> (mg/litre)	Remarks
Nitrate (as NO <sub>3</sub> <sup>-</sup> )	50	Short-term exposure
Nitrite (as NO <sub>2</sub> <sup>-</sup> )	3	Short-term exposure
	0.2 (P)	Long-term exposure
Pesticides used in agriculture	Guideline value <sup>a</sup> (µg/litre)	Remarks
Alachlor	20 <sup>b</sup>	
Aldicarb	10	Applies to aldicarb sulfoxide and aldicarb sulfone
Aldrin and dieldrin	0.03	For combined aldrin plus dieldrin
Atrazine	2	
Carbofuran	7	
Chlordane	0.2	
Chlorotoluron	30	
Cyanazine	0.6	
2,4-D (2,4-dichlorophenoxyacetic acid)	30	Applies to free acid
2,4-DB	90	
1,2-Dibromo-3-chloropropane	1 <sup>b</sup>	
1,2-Dibromoethane	0.4 <sup>b</sup> (P)	
1,2-Dichloropropane (1,2-DCP)	40 (P)	

# Guideline values for chemicals from agricultural activities that are of health significance in drinking-water (WHO, 2004)

1,3-Dichloropropene	20 <sup>b</sup>
Dichlorprop	100
Dimethoate	6
Endrin	0.6
Fenoprop	9
Isoproturon	9
Lindane	2
MCPA	2
Mecoprop	10
Methoxychlor	20
Metolachlor	10
Molinate	6
Pendimethalin	20
Simazine	2
2,4,5-T	9
Terbuthylazine	7
Trifluralin	20

<sup>a</sup> P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited.

<sup>b</sup> For substances that are considered to be carcinogenic, the guideline value is the concentration in drinking-water associated with an upper-bound excess lifetime cancer risk of  $10^{-5}$  (one additional cancer per 100 000 of the population ingesting drinking-water containing the substance at the guideline value for 70 years). Concentrations associated with estimated upper-bound excess lifetime cancer risks of  $10^{-4}$  and  $10^{-6}$  can be calculated by multiplying and dividing, respectively, the guideline value by 10.

# Disinfection by-products present in disinfected waters (from IPCS, 2000) (WHO, 2004)



Disinfectant	Significant organohalogen products	Significant inorganic products	Significant non-halogenated products
Chlorine/ hypochlorous acid	THMs, haloacetic acids, haloacetonitriles, chloral hydrate, chloropicrin, chlorophenols, <i>N</i> -chloramines, halofuranones, bromohydrins	chlorate (mostly from hypochlorite use)	aldehydes, cyanoalkanoic acids, alkanolic acids, benzene, carboxylic acids
Chlorine dioxide		chlorite, chlorate	unknown
Chloramine	haloacetonitriles, cyanogen chloride, organic chloramines, chloramino acids, chloral hydrate, haloketones	nitrate, nitrite, chlorate, hydrazine	aldehydes, ketones
Ozone	bromoform, monobromoacetic acid, dibromoacetic acid, dibromoacetone, cyanogen bromide	chlorate, iodate, bromate, hydrogen peroxide, hypobromous acid, epoxides, ozonates	aldehydes, ketoacids, ketones, carboxylic acids

# Chemicals used in water treatment for which GV have not been established (WHO, 2004)



Chemical	Reason for not establishing a guideline value
<b><i>Disinfectants</i></b>	
Chlorine dioxide	Rapid breakdown of chlorine dioxide; also, the chlorite provisional guideline value is protective for potential toxicity from chlorine dioxide
Dichloramine	Available data inadequate to permit derivation of health-based guideline value
Iodine	Available data inadequate to permit derivation of health-based guideline value, and lifetime exposure to iodine through water disinfection is unlikely
Silver	Available data inadequate to permit derivation of health-based guideline value
Trichloramine	Available data inadequate to permit derivation of health-based guideline value
<b><i>Disinfection by-products</i></b>	
Bromochloroacetate	Available data inadequate to permit derivation of health-based guideline value
Bromochloroacetonitrile	Available data inadequate to permit derivation of health-based guideline value
Chloroacetones	Available data inadequate to permit derivation of health-based guideline values for any of the chloroacetones
Chlorophenol, 2-	Available data inadequate to permit derivation of health-based guideline value
Chloropicrin	Available data inadequate to permit derivation of health-based guideline value
Dibromoacetate	Available data inadequate to permit derivation of health-based guideline value

Dichlorophenol, 2,4-	Available data inadequate to permit derivation of health-based guideline value
Monobromoacetate	Available data inadequate to permit derivation of health-based guideline value
MX	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Trichloroacetonitrile	Available data inadequate to permit derivation of health-based guideline value

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***Contaminants from treatment chemicals***

Aluminium	Owing to limitations in the animal data as a model for humans and the uncertainty surrounding the human data, a health-based guideline value cannot be derived; however, practicable levels based on optimization of the coagulation process in drinking-water plants using aluminium-based coagulants are derived: 0.1 mg/litre or less in large water treatment facilities, and 0.2 mg/litre or less in small facilities
Iron	Not of health concern at concentrations normally observed in drinking-water, and taste and appearance of water are affected at concentrations below the health-based value

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***Contaminants from pipes and fittings***

Asbestos	No consistent evidence that ingested asbestos is hazardous to health
Dialkyltins	Available data inadequate to permit derivation of health-based guideline values for any of the dialkyltins
Fluoranthene	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Inorganic tin	Occurs in drinking-water at concentrations well below those at which toxic effects may occur
Zinc	Not of health concern at concentrations normally observed in drinking-water, but may affect the acceptability of water

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# GV for chemicals used in water treatment or materials in contact with drinking-water that are of health significance in drinking-water (WHO, 2004)

Disinfectants	Guideline value <sup>a</sup>	Remarks	Atmosphere and
	(mg/litre)		
Chlorine	5 (C)	For effective disinfection, there should be a residual concentration of free chlorine of $\geq 0.5$ mg/litre after at least 30 min contact time at pH <8.0	
Monochloramine	3		

Disinfection by-products	Guideline value <sup>a</sup>	Remarks
	( $\mu$ g/litre)	
Bromate	10 <sup>b</sup> (A, T)	
Bromodichloromethane	60 <sup>b</sup>	
Bromoform	100	
Chloral hydrate (trichloroacetaldehyde)	10 (P)	
Chlorate	700 (D)	
Chlorite	700 (D)	
Chloroform	200	
Cyanogen chloride	70	For cyanide as total cyanogenic compounds
Dibromoacetonitrile	70	
Dibromochloromethane	100	
Dichloroacetate	50 (T, D)	
Dichloroacetonitrile	20 (P)	

Formaldehyde	900
Monochloroacetate	20
Trichloroacetate	200
Trichlorophenol, 2,4,6-	200 <sup>b</sup> (C)
Trihalomethanes	

The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1

Contaminants from treatment chemicals	Guideline value <sup>a</sup> (µg/litre)	Remarks
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Acrylamide	0.5 <sup>b</sup>
Epichlorohydrin	0.4 (P)

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Contaminants from pipes and fittings	Guideline value <sup>a</sup> (µg/litre)	Remarks
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Antimony	20	
Benzo[a]pyrene	0.7 <sup>b</sup>	
Copper	2000	Staining of laundry and sanitary ware may occur below guideline value
Lead	10	
Nickel	20 (P)	
Vinyl chloride	0.3 <sup>b</sup>	

<sup>a</sup> P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited; A = provisional guideline value because calculated guideline value is below the practical quantification level; T = provisional guideline value because calculated guideline value is below the level that can be achieved through practical treatment methods, source control, etc.; D = provisional guideline value because disinfection is likely to result in the guideline value being exceeded; C = concentrations of the substance at or below the health-based guideline value may affect the appearance, taste or odour of the water, causing consumer complaints.

<sup>b</sup> For substances that are considered to be carcinogenic, the guideline value is the concentration in drinking-water associated with an upper-bound excess lifetime cancer risk of  $10^{-5}$  (one additional cancer per 100 000 of the population ingesting drinking-water containing the substance at the guideline value for 70 years). Concentrations associated with estimated upper-bound excess lifetime cancer risks of  $10^{-4}$  and  $10^{-6}$  can be calculated by multiplying and dividing, respectively, the guideline value by 10.

# GV for pesticides used in water for public health purposes that are of health significance in drinking-water (WHO, 2004)

Pesticides used in water for public health purposes <sup>a</sup>	Guideline value (µg/litre)
Chlorpyrifos	30
DDT and metabolites	1
Pyriproxyfen	300

<sup>a</sup> Only pyriproxyfen is recommended by WHOPES for addition to water for public health purposes.

**Table 8.29. Guideline values for cyanotoxins that are of health significance in drinking-water**

	Guideline value <sup>a</sup> (µg/litre)	Remarks
Microcystin-LR	1 (P)	For total microcystin-LR (free plus cell-bound)

<sup>a</sup> P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited.

# Radionuclides (WHO, 2004)



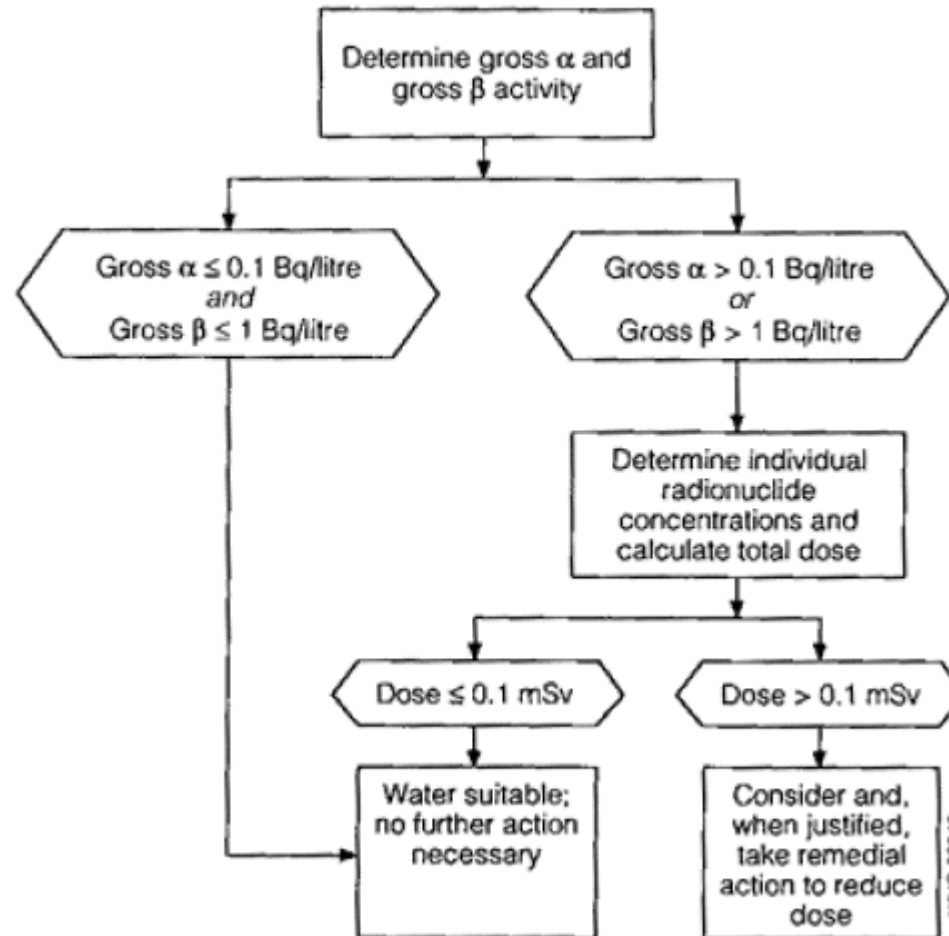
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- “The health risk associated with the presence of naturally occurring radionuclides in drinking-water should also be taken into consideration, although the contribution of drinking-water to total exposure to radionuclides **is very small under normal circumstances**.
- Formal guideline values are **not** set for **individual radionuclides** in drinking-water.
  - The RDL of 0.1mSv is also equal to 10% of the dose limit for members of the population, recommended by both the ICRP (1991) and the International Basic Safety Standards (IAEA, 1996).
- Rather, the approach used is based on screening drinking-water for **gross alpha and gross beta radiation** activity. While finding levels of activity above screening values does not indicate any immediate risk to health, it should trigger further investigation into determining the radionuclides responsible and the possible risks, taking into account local circumstances.”

# Radioactivity measurements



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9/1/2006 OAW

# Units of radioactivity



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The SI unit of *radioactivity* is the **becquerel**, where  $1 \text{ Bq} = 1 \text{ disintegration per second}$ . The radiation dose resulting from ingestion of a radionuclide depends on a number of chemical and biological factors. These include the fraction of the intake that is absorbed from the gut, the organs or tissues to which the radionuclide may be transported and deposited, and the time that the radionuclide might remain in the organ or tissue before excretion. The nature of the radiation emitted on decay, and the sensitivity of the irradiated organs or tissues to radiation must also be considered.

The ***absorbed dose*** refers to how much energy is deposited in material by the radiation. The SI unit for absorbed dose is the **gray (Gy)**.  $1 \text{ Gy} = 1 \text{ J/kg}$  (joule/kg).

# Units of radioactivity



The *equivalent dose* is the product of the absorbed dose and a factor related to the particular type of radiation (depending on the ionizing capacity and density).

The *effective dose* of radiation received by a person is in simple terms the sum of the equivalent doses received by all tissues or organs, weighted to “tissue weighting factors”. These reflect different sensitivities to radiation of different organs and tissues in the human body. The SI unit for the equivalent and effective dose is the *sievert (Sv)*.  $1 \text{ Sv} = 1 \text{ J/kg}$ .

To reflect the persistence of radionuclides in the body, once ingested, the *committed effective dose* is a measure of the total effective dose received over a lifetime (70 years) following intake of a radionuclide (internal exposure).

The term ‘dose’ is may be used as a general term to mean either absorbed dose (Gy) or effective dose (Sv), depending on the situation. For monitoring purposes ‘doses’ are determined from the concentration of the radionuclide in a given material. In the case of water, this is becquerels per litre (Bq/L, or Bq/mL). This value is converted to an *effective human dose per year (mSv/yr)* using a dose conversion factor (mSv/Bq) and the average annual consumption of water in litres per year (L/yr).

# Reference values – drinking water



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Environment

- WHO -Guidelines for Drinking Water 2004
- 1998 EU Guideline (98/83/EG)
- Water intended for human consumption BGBl.304/2001
- Codex Alimentarius chapter B1, 2002
- Chapter B17 Bottled waters etc. 2003

# Drinking Water Investigation

(98/83/EC and BGBl.304/2001)



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## **Local inspection –**

Investigation of the water supply systems  
from a sanitary point of view

## **Sampling –**

Conservation, transport und field investigations

## **Water analysis -**

microbiological  
physicochemical  
microscopical  
radioactivity measurement

# Drinking Water Part B Chemical parameters

(98/83/EC and BGBl.304/2001)



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Parameter	Parametric value	Unit	Notes
Acrylamide	0,10	$\mu\text{g/l}$	Note 1
Antimony	5,0	$\mu\text{g/l}$	
Arsenic	10	$\mu\text{g/l}$	
Benzene	1,0	$\mu\text{g/l}$	
Benzo(a)pyrene	0,010	$\mu\text{g/l}$	
Boron	1,0	mg/l	
Bromate	10	$\mu\text{g/l}$	Note 2
Cadmium	5,0	$\mu\text{g/l}$	
Chromium	50	$\mu\text{g/l}$	
Copper	2,0	mg/l	Note 3
Cyanide	50	$\mu\text{g/l}$	
1,2-dichloroethane	3,0	$\mu\text{g/l}$	
Epichlorohydrin	0,10	$\mu\text{g/l}$	Note 1
Fluoride	1,5	mg/l	

# Drinking Water Part B Chemical parameters

(98/83/EC and BGBl.304/2001)



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Lead	10	$\mu\text{g/l}$	Notes 3 and 4
Mercury	1,0	$\mu\text{g/l}$	
Nickel	20	$\mu\text{g/l}$	Note 3
Nitrate	50	$\text{mg/l}$	Note 5
Nitrite	0,50	$\text{mg/l}$	Note 5
Pesticides	0,10	$\mu\text{g/l}$	Notes 6 and 7
Pesticides – Total	0,50	$\mu\text{g/l}$	Notes 6 and 8
Polycyclic aromatic hydrocarbons	0,10	$\mu\text{g/l}$	Sum of concentrations of specified compounds; Note 9
Selenium	10	$\mu\text{g/l}$	
Tetrachloroethene and Trichloroethene	10	$\mu\text{g/l}$	Sum of concentrations of specified parameters
Trihalomethanes – Total	100	$\mu\text{g/l}$	Sum of concentrations of specified compounds; Note 10
Vinyl chloride	0,50	$\mu\text{g/l}$	Note 1

# Drinking Water Part B Chemical parameters

(98/83/EC and BGBl.304/2001)



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*Note 1:* The parametric value refers to the residual monomer concentration in the water as calculated according to specifications of the maximum release from the corresponding polymer in contact with the water.

*Note 2:* Where possible, without compromising disinfection, Member States should strive for a lower value.

For the water referred to in Article 6(1)(a), (b) and (d), the value must be met, at the latest, 10 calendar years after the entry into force of the Directive. The parametric value for bromate from five years after the entry into force of this Directive until 10 years after its entry into force is 25 µg/l.

*Note 3:* The value applies to a sample of water intended for human consumption obtained by an adequate sampling method <sup>(1)</sup> at the tap and taken so as to be representative of a weekly average value ingested by consumers. Where appropriate the sampling and monitoring methods must be applied in a harmonised fashion to be drawn up in accordance with Article 7(4). Member States must take account of the occurrence of peak levels that may cause adverse effects on human health.

*Note 4:* For water referred to in Article 6(1)(a), (b) and (d), the value must be met, at the latest, 15 calendar years after the entry into force of this Directive. The parametric value for lead from five years after the entry into force of this Directive until 15 years after its entry into force is 25 µg/l.

Member States must ensure that all appropriate measures are taken to reduce the concentration of lead in water intended for human consumption as much as possible during the period needed to achieve compliance with the parametric value.

When implementing the measures to achieve compliance with that value Member States must progressively give priority where lead concentrations in water intended for human consumption are highest.

*Note 5:* Member States must ensure that the condition that  $[\text{nitrate}]/50 + [\text{nitrite}]/3 \leq 1$ , the square brackets signifying the concentrations in mg/l for nitrate (NO<sub>3</sub>) and nitrite (NO<sub>2</sub>), is complied with and that the value of 0,10 mg/l for nitrites is complied with ex water treatment works.

# Drinking Water Part B Chemical parameters (98/83/EC and BGBl.304/2001)



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*Note 6:* 'Pesticides' means:

- organic insecticides,
- organic herbicides,
- organic fungicides,
- organic nematocides,
- organic acaricides,
- organic algicides,
- organic rodenticides
- organic slimicides,
- related products (*inter alia*, growth regulators)

and their relevant metabolites, degradation and reaction products.

Only those pesticides which are likely to be present in a given supply need be monitored.

*Note 7:* The parametric value applies to each individual pesticide. In the case of aldrin, dieldrin, heptachlor and heptachlor epoxide the parametric value is 0,030  $\mu\text{g/l}$ .

*Note 8:* 'Pesticides – Total' means the sum of all individual pesticides detected and quantified in the monitoring procedure.

*Note 9:* The specified compounds are:

- benzo(b)fluoranthene,
- benzo(k)fluoranthene,
- benzo(ghi)perylene,
- indeno(1,2,3-cd)pyrene.

*Note 10:* Where possible, without compromising disinfection, Member States should strive for a lower value.

The specified compounds are: chloroform, bromoform, dibromochloromethane, bromodichloromethane.

For the water referred to in Article 6(1)(a), (b) and (d), the value must be met, at the latest, 10 calendar years after the entry into force of this Directive. The parametric value for total THMs from five years after the entry into force of this Directive until 10 years after its entry into force is 150  $\mu\text{g/l}$ .

# Drinking Water Part C Indicator parameters (98/83/EC and BGBl.304/2001)



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Parameter	Parametric value	Unit	Notes
Aluminium	200	$\mu\text{g/l}$	
Ammonium	0,50	$\text{mg/l}$	
Chloride	250	$\text{mg/l}$	Note 1
<i>Clostridium perfringens</i> (including spores)	0	number/100 ml	Note 2
Colour	Acceptable to consumers and no abnormal change		
Conductivity	2 500	$\mu\text{S cm}^{-1}$ at 20 °C	Note 1
Hydrogen ion concentration	$\geq 6,5$ and $\leq 9,5$	pH units	Notes 1 and 3
Iron	200	$\mu\text{g/l}$	
Manganese	50	$\mu\text{g/l}$	
Odour	Acceptable to consumers and no abnormal change		

# Drinking Water Part C Indicator parameters (98/83/EC and BGBl.304/2001)



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Oxidisability	5,0	mg/l O <sub>2</sub>	Note 4
Sulphate	250	mg/l	Note 1
Sodium	200	mg/l	
Taste	Acceptable to consumers and no abnormal change		
Colony count 22°	No abnormal change		
Coliform bacteria	0	number/100 ml	Note 5
Total organic carbon (TOC)	No abnormal change		Note 6
Turbidity	Acceptable to consumers and no abnormal change		Note 7
Tritium	100	Bq/l	Notes 8 and 10
Total indicative dose	0,10	mSv/year	Notes 9 and 10

# Drinking Water Part C Indicator parameters (98/83/EC and BGBl.304/2001)



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- Note 1:* The water should not be aggressive.
- Note 2:* This parameter need not be measured unless the water originates from or is influenced by surface water. In the event of non-compliance with this parametric value, the Member State concerned must investigate the supply to ensure that there is no potential danger to human health arising from the presence of pathogenic micro-organisms, e.g. cryptosporidium. Member States must include the results of all such investigations in the reports they must submit under Article 13(2).
- Note 3:* For still water put into bottles or containers, the minimum value may be reduced to 4,5 pH units.  
For water put into bottles or containers which is naturally rich in or artificially enriched with carbon dioxide, the minimum value may be lower.
- Note 4:* This parameter need not be measured if the parameter TOC is analysed.
- Note 5:* For water put into bottles or containers the unit is number/250 ml.
- Note 6:* This parameter need not be measured for supplies of less than 10 000 m<sup>3</sup> a day.
- Note 7:* In the case of surface water treatment, Member States should strive for a parametric value not exceeding 1,0 NTU (nephelometric turbidity units) in the water ex treatment works.
- Note 8:* Monitoring frequencies to be set later in Annex II.
- Note 9:* Excluding tritium, potassium -40, radon and radon decay products; monitoring frequencies, monitoring methods and the most relevant locations for monitoring points to be set later in Annex II.
- Note 10:*
1. The proposals required by Note 8 on monitoring frequencies, and Note 9 on monitoring frequencies, monitoring methods and the most relevant locations for monitoring points in Annex II shall be adopted in accordance with the procedure laid down in Article 12. When elaborating these proposals the Commission shall take into account *inter alia* the relevant provisions under existing legislation or appropriate monitoring programmes including monitoring results as derived from them. The Commission shall submit these proposals at the latest within 18 months following the date referred to in Article 18 of the Directive.
  2. A Member State is not required to monitor drinking water for tritium or radioactivity to establish total indicative dose where it is satisfied that, on the basis of other monitoring carried out, the levels of tritium of the calculated total indicative dose are well below the parametric value. In that case, it shall communicate the grounds for its decision to the Commission, including the results of this other monitoring carried out.

# Drinking Water ANNEX II

(98/83/EC and BGBl.304/2001)



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## Monitoring:

- Check monitoring
- Audit monitoring

# Check monitoring



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Aluminium (Note 1)

Ammonium

Colour

Conductivity

*Clostridium perfringens* (including spores) (Note 2)

*Escherichia coli* (*E. coli*)

Hydrogen ion concentration

Iron (Note 1)

Nitrite (Note 3)

Odour

*Pseudomonas aeruginosa* (Note 4)

Taste

Colony count 22 °C and 37 °C (Note 4)

Coliform bacteria

Turbidity

*Note 1:* Necessary only when used as flocculant (\*).

*Note 2:* Necessary only if the water originates from or is influenced by surface water (\*).

*Note 3:* Necessary only when chloramination is used as a disinfectant (\*).

*Note 4:* Necessary only in the case of water offered for sale in bottles or containers.

# Drinking Water Minimum frequency of sampling and analyses (98/83/EC and BGBl.304/2001)



Volume of water distributed or produced each day within a supply zone (Notes 1 and 2) $m^3$	Check monitoring number of samples per year (Notes 3, 4 and 5)	Audit monitoring number of samples per year (Notes 3 and 5)
$\leq 100$	(Note 6)	(Note 6)
$> 100 \leq 1\,000$	4	1
$> 1\,000 \leq 10\,000$	4 + 3 for each 1 000 $m^3/d$ and part thereof of the total volume	1 + 1 for each 3 300 $m^3/d$ and part thereof of the total volume
$> 10\,000 \leq 100\,000$		3 + 1 for each 10 000 $m^3/d$ and part thereof of the total volume
$> 100\,000$		10 + 1 for each 25 000 $m^3/d$ and part thereof of the total volume



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# Drinking Water Minimum frequency of sampling and analyses

(98/83/EC and BGBl.304/2001)



*Note 1:* A supply zone is a geographically defined area within which water intended for human consumption comes from one or more sources and within which water quality may be considered as being approximately uniform.

*Note 2:* The volumes are calculated as averages taken over a calendar year. A Member State may use the number of inhabitants in a supply zone instead of the volume of water to determine the minimum frequency, assuming a water consumption of 200 l/day/capita.

*Note 3:* In the event of intermittent short-term supply the monitoring frequency of water distributed by tankers is to be decided by the Member State concerned.

*Note 4:* For the different parameters in Annex I, a Member State may reduce the number of samples specified in the table if:

(a) the values of the results obtained from samples taken during a period of at least two successive years are constant and significantly better than the limits laid down in Annex I, and

(b) no factor is likely to cause a deterioration of the quality of the water.

The lowest frequency applied must not be less than 50 % of the number of samples specified in the table except in the particular case of note 6.

*Note 5:* As far as possible, the number of samples should be distributed equally in time and location.

*Note 6:* The frequency is to be decided by the Member State concerned.



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# Limitation for substances (indicating parameter), without regulation in the Drinking Water Regulation (Codex, 2002):

Substance	Value (? assessment tolerance) <sup>1)</sup>	Unit
Aliphatic hydrocarbons	0.1 (+/- 0.03)	mg/l
Barium	1 (+/- 0.2)	mg/l
Calcium	400 (+/- 40)	mg/l
Chlorite <sup>3)</sup>	0.2 (+/- 0.04)	mg/l
Potassium	50 (+/- 5)	mg/l
Volatile chlorinated aliphatic hydrocarbons except those of the DWD (e.g. Trichlorofluoromethane, dichlorodifluoromethane, 1,1,1-trichloromethane <sup>2)</sup> )	30 (+/- 7.5)	µg/l
1,1-dichloroethane	0.3 (+/- 0.1)	µg/l
Tetrachloromethane	3 (+/- 1)	µg/l

1) Corresponding to § 8.10

2) If other volatile chlorinated aliphatic hydrocarbons that are listed in Appendix 1 are detected the sum parameter limit value is 30 µg/l.

3) For disinfection with chlorine dioxide

# Limitation for substances (indicator parameter), without regulation in the Drinking Water Regulation (Codex, 2002):



Magnesium	150 (+/- 15)	mg/l
Phosphate (PO <sub>4</sub> )	0.3 (+/- 0.1)	mg/l
Total phosphate after addition	6.7 (1.0)	mg/l
Silver <sup>2)</sup>	0.08 (+/- 0.02)	mg/l
Silicate after addition (SiO <sub>2</sub> )	40 (+/- 4.0)	mg/l
Zinc at the effluent of the water work	0.1 (+/- 0.01)	mg/l
Zinc in water out off the pipe	5 (+/- 0.5)	mg/l
Dissolved O <sub>2</sub> (min. value)	3 (+/- 0.5)	mg/l
Hydrogen sulfide	Organoleptic not detectable	

2) For water with as use under giver conditions that is conserved with silver (§ 9 of this chapter)

# Drinking water disinfection procedure

(Codex B1, 2002)



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- Chlorination with sodium, calcium or magnesium hypochlorite
  - (Reaction time at least 30 minutes: residual concentration of free chlorine (given as  $\text{Cl}_2$ )  $> 0.3$  (0.05) mg/l und  $< 0.5$  mg/l;
  - At the consumer max. 0.3 mg/l.
- Chlorination with chlorine gas (see above)
- Treatment with chlorine dioxide
  - 15 minutes minimal reaction time of: minimum addition of chlorine dioxide 0.2 mg/l; maximum 0.4 mg/l (given as  $\text{ClO}_2$ ). Residual concentration max. 0.05 mg/l  $\text{ClO}_2$
- Ozonation
  - Minimal reaction time of 4 minutes: residual concentration of min. 0.1 mg/l Ozone ( $\text{O}_3$ )
- UV-irradiation
  - Reduction equivalents fluence (dose) of min. 400 J/m<sup>2</sup> at a wavelength of 253.7 nm



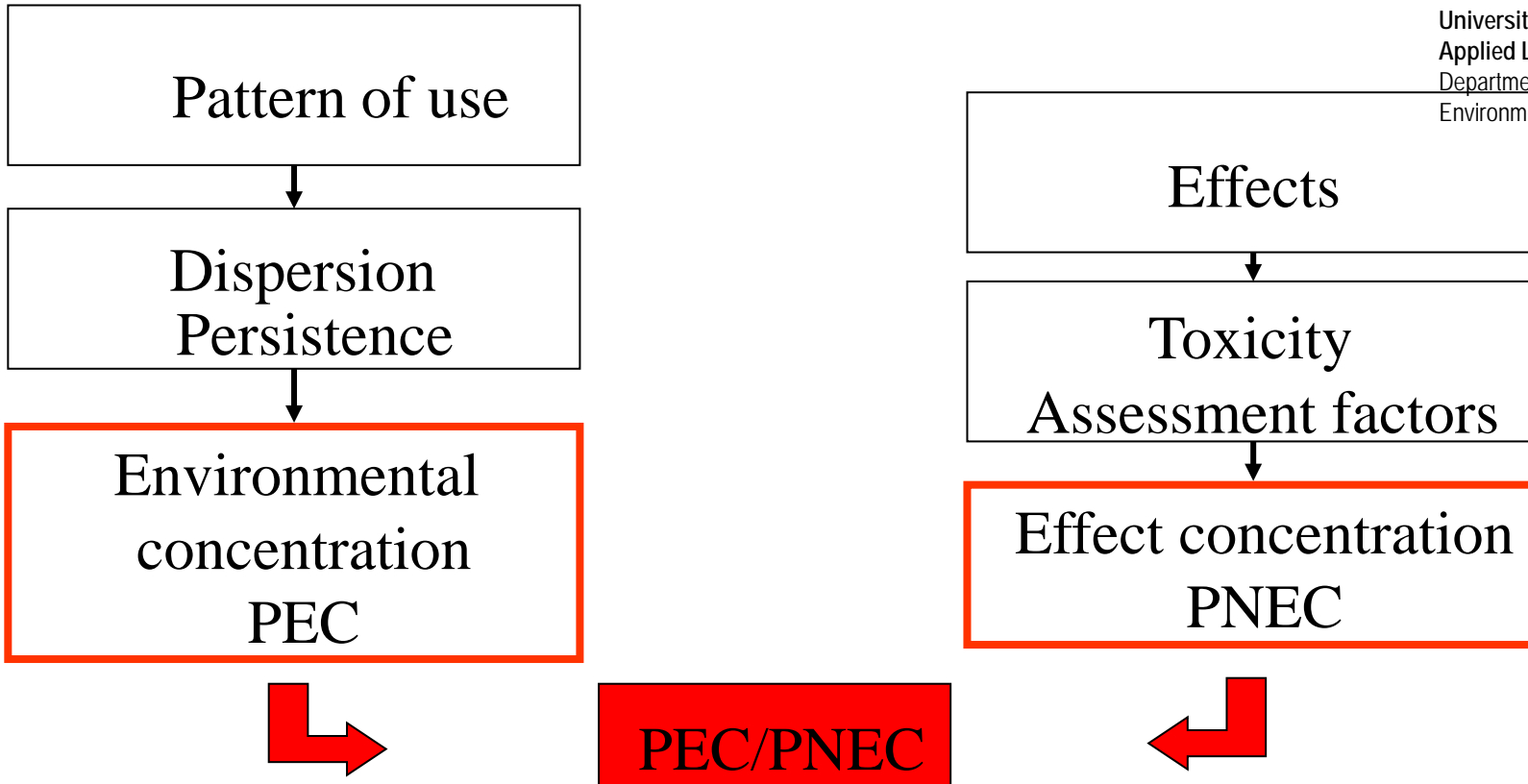
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- Water Framework Directive (good chemical status)

# Concept of the ecotoxicological risk analysis



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>1 risk assessment required  
< 1 no risk assessment needed

# Elements of „good status“ of surface waters

**Biological quality components  
Supported by  
Hydromorphological quality  
components  
and**

**general chemical quality  
components (pH, T, conductivity)  
+ specific pollutants**

**Priority substances  
and „relevant“  
substances of other  
directives**

**good ecological status**

**Good chemical  
status**

**good status**

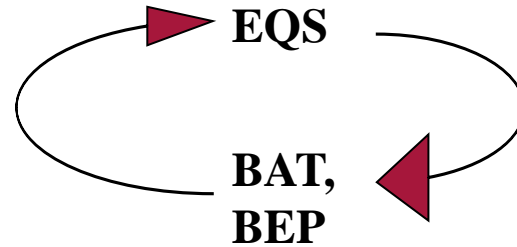
# Measures in the WFD



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**Point sources: best available techniques (BAT)**

**Diffuse sources: best environmental practice (BEP)**



EQS.. Environmental quality standards



**„combined approach“**

**(Article 10 of WFD)**

# Priority (PS) or priority hazardous (PHS)?- The approach



- PS and PHS in the WFD:

PS: quality standards are defined (QS) .. minimization is required

PHS: phase out within 20 years !!!

**P...persistent, T... toxic, B... bioaccumulative**

- PHS must fulfill the P, T and B criteria or „*equivalent level of concern*“

(1)	(2)	(3)	(4)	(5)	(6)	(7)
No	Name of substance	CAS number (1)	AA-EQS (2) Inland surface waters (2)	AA-EQS (2) Other surface waters	MAC-EQS (4) Inland surface waters (2)	MAC-EQS (4) Other surface waters
(1)	Alachlor	15972-60-8	0,3	0,3	0,7	0,7
(2)	Anthracene	120-12-7	0,1	0,1	0,4	0,4
(3)	Atrazine	1912-24-9	0,6	0,6	2,0	2,0
(4)	Benzene	71-43-2	10	8	50	50
(5)	Brominated diphenylether (5)	32534-81-9	0,0005	0,0002	not applicable	not applicable
(6)	Cadmium and its compounds (depending on water hardness classes) (9)	7440-43-9	≤ 0,08 (Class 1) 0,08 (Class 2) 0,09 (Class 3) 0,15 (Class 4) 0,25 (Class 5)	0,2	≤ 0,45 (Class 1) 0,45 (Class 2) 0,6 (Class 3) 0,9 (Class 4) 1,5 (Class 5)	≤ 0,45 (Class 1) 0,45 (Class 2) 0,6 (Class 3) 0,9 (Class 4) 1,5 (Class 5)
(6a)	Carbon-tetrachloride (7)	56-23-5	12	12	not applicable	not applicable
(7)	C10-13 Chloroalkanes	85535-84-8	0,4	0,4	1,4	1,4
(8)	Chlorfenvinphos	470-90-6	0,1	0,1	0,3	0,3
(9)	Chlorpyrifos (Chlorpyrifos-ethyl)	2921-88-2	0,03	0,03	0,1	0,1
(9a)	Cyclodiene pesticides: Aldrin (7) Dieldrin (7) Endrin (7) Isodrin (7)	309-00-2 60-57-1 72-20-8 465-73-6	Σ = 0,01	Σ = 0,005	not applicable	not applicable
(9b)	DDT total (7) (8)	not applicable	0,025	0,025	not applicable	not applicable
	para-para-DDT (7)	50-29-3	0,01	0,01	not applicable	not applicable
(10)	1,2-Dichloroethane	107-06-2	10	10	not applicable	not applicable
(11)	Dichloromethane	75-09-2	20	20	not applicable	not applicable
(12)	Di(2-ethylhexyl)-phthalate (DEHP)	117-81-7	1,3	1,3	not applicable	not applicable
(13)	Diuron	330-54-1	0,2	0,2	1,8	1,8
(14)	Endosulfan	115-29-7	0,005	0,0005	0,01	0,004
(15)	Fluoranthene	206-44-0	0,1	0,1	1	1
(16)	Hexachloro-benzene	118-74-1	0,01 (9)	0,01 (9)	0,05	0,05
(17)	Hexachloro-butadiene	87-68-3	0,1 (9)	0,1 (9)	0,6	0,6
(18)	Hexachloro-cyclohexane	608-73-1	0,02	0,002	0,04	0,02



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Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council



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(1)	(2)	(3)	(4)	(5)	(6)	(7)
No	Name of substance	CAS number (1)	AA-EQS (2) Inland surface waters (2)	AA-EQS (2) Other surface waters	MAC-EQS (4) Inland surface waters (2)	MAC-EQS (4) Other surface waters
(19)	Isoproturon	34123-59-6	0,3	0,3	1,0	1,0
(20)	Lead and its compounds	7439-92-1	7,2	7,2	not applicable	not applicable
(21)	Mercury and its compounds	7439-97-6	0,05 (2)	0,05 (2)	0,07	0,07
(22)	Naphthalene	91-20-3	2,4	1,2	not applicable	not applicable
(23)	Nickel and its compounds	7440-02-0	20	20	not applicable	not applicable
(24)	Nonylphenol (4-Nonylphenol)	104-40-5	0,3	0,3	2,0	2,0
(25)	Octylphenol ((4-(1,1',3,3'-tetramethylbutyl)-phenol))	140-66-9	0,1	0,01	not applicable	not applicable
(26)	Pentachloro-benzene	608-93-5	0,007	0,0007	not applicable	not applicable
(27)	Pentachloro-phenol	87-86-5	0,4	0,4	1	1
(28)	Polyaromatic hydrocarbons (PAH) (10)	not applicable	not applicable	not applicable	not applicable	not applicable
	Benz.α(a)pyrene	50-32-8	0,05	0,05	0,1	0,1
	Benz.α(b)fluor-anthene	205-99-2	Σ = 0,03	Σ = 0,03	not applicable	not applicable
	Benz.α(k)fluor-anthene	207-08-9				
	Benz.α(g,h,i)-perylene	191-24-2	Σ = 0,002	Σ = 0,002	not applicable	not applicable
	Indeno(1,2,3-cd)-pyrene	193-39-5				
(29)	Simazine	122-34-9	1	1	4	4
(29a)	Tetrachloro-ethylene (7)	127-18-4	10	10	not applicable	not applicable
(29b)	Trichloro-ethylene (7)	79-01-6	10	10	not applicable	not applicable
(30)	Tributyltin compounds (Tributyltin-cation)	36643-28-4	0,0002	0,0002	0,0015	0,0015
(31)	Trichloro-benzenes	12002-48-1	0,4	0,4	not applicable	not applicable
(32)	Trichloro-methane	67-66-3	2,5	2,5	not applicable	not applicable
(33)	Trifluralin	1582-09-8	0,03	0,03	not applicable	not applicable

Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council

# SUBSTANCES SUBJECT TO REVIEW FOR POSSIBLE IDENTIFICATION AS PRIORITY SUBSTANCES OR PRIORITY HAZARDOUS SUBSTANCES



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CAS number	EU number	Name of substance
1066-51-9	—	AMPA
25057-89-0	246-585-8	Bentazon
80-05-7		Bisphenol-A
115-32-2	204-082-0	Dicofol
60-00-4	200-449-4	EDTA
57-12-5		Free cyanide
1071-83-6	213-997-4	Glyphosate
7085-19-0	230-386-8	Mecoprop (MCP)
81-15-2	201-329-4	Musk xylene
1763-23-1		Perfluorooctane sulphonic acid (PFOS)
124495-18-7	—	Quinoxifen (5,7-dichloro-4-(p-fluorophenoxy)quinoline) Dioxins PCB

# POPs (persistent organic pollutants)



Group of toxic and persistent compounds

Health and environmental hazardous

Goal of the environmental programmes

(UNEP) → reduction of:

- |              |                    |
|--------------|--------------------|
| * Aldrin     | * Mirex            |
| * Chlordan   | * Toxaphen         |
| * DDT        | * Hexachlorbenzol  |
| * Dieldrin   | * PCB              |
| * Endrin     | * Dioxine (PCBB/F) |
| * Heptachlor | * Furane           |

## New POPs under review:

- SCCP-Short-chained chlorinated paraffins
- Endosulfan

- Hexabromocyclododecane

## Reviewed chemicals

- Pentabromodiphenyl Ether
- Chlordecone
- Hexabromobiphenyl
- Lindane
- Perfluorooctane sulfonate
- Octabromodiphenyl ether
- Pentachlorobenzene
- Alpha hexachlorocyclohexane
- Beta hexachlorocyclohexane

## Under discussion:

- \* carcinogenic PAHs
- \* certain brominated flame retardants,
- \* organometal compounds such as tributyltin (TBT).

# Reference values for surface water



- ÖNORM M6231 GL for the ecological assessment of stationary water

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Sampling period and parameters		Oligotrophic	mesotrophic	Weak eutrophic	Strong eutrophic	Hypertrophic
P <sub>total</sub> in spring	(µg/l)	<10	<20	20 to 30	30 to 50	>50
Chlorophyll-a in summerly epilimnion	(µg/l)	<4	4 to 12	12 to 35		>35
O <sub>2</sub> -saturation in summer above ground	(%)	>30	>10	0	0	0
P <sub>total</sub> in autumn	(µg/l)	<10	<20	20 to 30	30 to 50	>50
P <sub>total</sub> annual mean (from 4 analyses)	(µg/l)	<10	<20	20 to 40	40 to 60	>60

# Bathing water quality



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- Physical, chemical parameters

Parameter		Ö-NORM M 6230-1	EU-Richtlinie 2006/7/EC	Badehygieneverordnung, BhygV	
				Kleinbadeteiche	Badestellen
pH value		5,5 to 9,0			6,0 to 9,0
Visibility	m	min. 1,5		Min. 2	min. 2, not <1
Conc. dissolved oxygen	% saturation O <sub>2</sub>	min. 80%		Min. 80%	80% to 120%
Oxygen demand	mg/l	3			
Total phosphorus <b>P</b>	mg/l	max. 0,02			
Ammonium <b>NH<sub>4</sub><sup>+</sup></b>	mg/l	max. 0,2			

# Requirements for waste water to be emitted



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- EU Urban Waste Water Directive (Directive 91/271/EEG)
- A: general requirements (AAEVO), specific for economical sectors (branchenspezifische VO)
- A: Municipal Waste Water Directive (Begrenzung von Abwasseremissionen aus Abwasserreinigungsanlagen für Siedlungsgebiete (1. AEW für kommunales Abwasser) BGBl 210/1996)
- <http://ris1.bka.gv.at/bgbl-pdf/RequestDoc.aspx?path=bgblpdf/1996/1996a067.pdf&docid=1996a067.pdf>

# Requirements for discharges from urban waste water treatment plants: Values for concentration or for the percentage of reduction (Directive 91/271/EEG)

Parameters	Concentration	Minimum percentage of reduction (1)	Reference method of measurement
Biochemical oxygen demand (BOD <sub>5</sub> at 20 °C) without nitrification (2)	25 mg/l O <sub>2</sub>	70-90 40 under Article 4 (2)	Homogenized, unfiltered, undecanted sample. Determination of dissolved oxygen before and after five-day incubation at 20 °C ± 1 °C, in complete darkness. Addition of a nitrification inhibitor
Chemical oxygen demand (COD)	125 mg/l O <sub>2</sub>	75	Homogenized, unfiltered, undecanted sample Potassium dichromate
Total suspended solids	35 mg/l 35 under Article 4 (2) (more than 10 000 p.e.) 60 under Article 4 (2) (2 000-10 000 p.e.)	90 (3) 90 under Article 4 (2) (more than 10 000 p.e.) 70 under Article 4 (2) (2 000-10 000 p.e.)	- Filtering of a representative sample through a 0,45 µm filter membrane. Drying at 105 °C and weighing - Centrifuging of a representative sample (for at least five mins with mean acceleration of 2 800 to 3 200 g), drying at 105 °C and weighing

(1) Reduction in relation to the load of the influent.

(2) The parameter can be replaced by another parameter: total organic carbon (TOC) or total oxygen demand (TOD) if a relationship can be established between BOD<sub>5</sub> and the substitute parameter.

(3) This requirement is optional. Analyses concerning discharges from lagooning shall be carried out on filtered samples; however, the concentration of total suspended solids in unfiltered water samples shall not exceed 150 mg/l.

## Requirements for discharges from urban waste water treatment plants to sensitive areas which are subject to eutrophication as identified in Annex II.A (a). (Directive 91/271/EEG)

<b>Parameters</b>	<b>Concentration</b>	<b>Minimum percentage of reduction (1)</b>	<b>Reference method of measurement</b>
Total phosphorus	2 mg/l P (10 000 - 100 000 p. e.) 1 mg/l P (more than 100 000 p. e.)	80	Molecular absorption spectrophotometry
Total nitrogen (2)	15 mg/l N (10 000 - 100 000 p. e.) 10 mg/l N (more than 100 000 p. e.) (3)	70-80	Molecular absorption spectrophotometry

(1) Reduction in relation to the load of the influent.

(2) Total nitrogen means: the sum of total Kjeldahl-nitrogen (organic N + NH<sub>3</sub>), nitrate (NO<sub>3</sub>)-nitrogen and nitrite (NO<sub>2</sub>)-nitrogen.

(3) Alternatively, the daily average must not exceed 20 mg/l N. This requirement refers to a water temperature of 12° C or more during the operation of the biological reactor of the waste water treatment plant. As a substitute for the condition concerning the temperature, it is possible to apply a limited time of operation, which takes into account the regional climatic conditions. This alternative applies if it can be shown that paragraph 1 of Annex I.D is fulfilled.