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This investigation has been performed by order and for the account of Directorate-General for Environmental Protection, Directorate Environmental Safety and Risk Management, within the framework of 'International and National Environmental Quality Standards for Substances in the Netherlands' (INS).

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Rapport in het kort

Milieurisicogrenzen voor acrylzuur

Dit rapport geeft milieurisicogrenzen voor acrylzuur in (grond)water, bodem en lucht. Milieurisicogrenzen zijn de technisch-wetenschappelijke advieswaarden voor de uiteindelijke milieukwaliteitsnormen in Nederland. De milieurisicogrenzen voor acrylzuur zijn gebaseerd op de uitkomsten van de EU risicobeoordeling voor acrylzuur (Bestaande Stoffen Verordening 793/93). De afleiding van de milieurisicogrenzen sluit tevens aan bij de richtlijnen uit de Kaderrichtlijn Water. Monitoringsgegevens voor acrylzuur in het Nederlandse milieu zijn niet beschikbaar. Hierdoor is geen uitspraak mogelijk of de afgeleide milieurisicogrenzen worden overschreden.

Trefwoorden: milieukwaliteitsnormen; milieurisicogrenzen; acrylzuur; maximaal toelaatbaar risiconiveau; verwaarloosbaar risiconiveau

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Summary

Environmental risk limits (ERLs) are derived using ecotoxicological, physico-chemical, and human toxicological data. They represent environmental concentrations of a substance offering different levels of protection to man and ecosystems. It should be noted that the ERLs are scientifically derived values. They serve as advisory values for the Dutch Steering Committee for Substances, which is appointed to set the Environmental Quality Standards (EQSs) from these ERLs. ERLs should thus be considered as preliminary values that do not have any official status.

This report contains ERLs for acrylic acid in water, groundwater, soil and air. The following ERLs are derived: Negligible Concentration (NC), Maximum Permissible Concentration (MPC), Maximum Acceptable Concentration for ecosystems (MAC_{eco}), and Serious Risk Concentration for ecosystems (SRC_{eco}). The risk limits were solely based on data presented in the Risk Assessment Reports (RAR) for this compound, prepared under the European Existing Substances Regulation (793/93/EEC).

For the derivation of the MPC and MAC_{eco} for water, the methodology used is in accordance with the Water Framework Directive. This methodology is based on the Technical Guidance Document on risk assessment for new and existing substances and biocides (European Commission (Joint Research Centre), 2003). For the NC and the SRC_{eco}, the guidance developed for the project 'International and National Environmental Quality Standards for Substances in the Netherlands' was used (Van Vlaardingen and Verbruggen, 2007). An overview of the derived environmental risk limits is given in Table 1.

Monitoring data for acrylic acid in the Dutch environment are not available. Therefore cannot be estimated if the derived ERLs are being exceeded.

Table 1. Derived MPC, NC, MAC_{eco}, and SRC_{eco} values for acrylic acid.

ERL	**unit**	**value**			
		MPC	NC	MAC_{eco}	SRC_{eco}
water	$\mu g.L^{-1}$	3.0	3.0×10^{-2}	3.0	4.6×10^{2}
drinking water [a]	$mg.L^{-1}$	1.8			
marine	$\mu g.L^{-1}$	0.30	3.0×10^{-3}	0.30	4.6×10^{2}
sediment	$mg.kg_{dwt}^{-1}$	n.d.			
soil	$\mu g.kg_{dwt}^{-1}$	3.4	3.4×10^{-2}		5.2×10^{2}
groundwater	$\mu g.L^{-1}$	3.0	3.0×10^{-2}		4.6×10^{2}
air	$\mu g.m^{-3}$	1.0	1.0×10^{-2}		

[a] The exact way of implementation of the $MPC_{dw, water}$ in the Netherlands is at present under discussion. Therefore, the $MPC_{dw, water}$ is presented as a separate value in this report.

n.d. = not derived.

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1 Introduction

1.1 Project framework

In this report environmental risk limits (ERLs) for surface water (freshwater and marine), soil and groundwater are derived for acrylic acid. The following ERLs are considered:

- Negligible Concentration (NC) – concentration at which effects to ecosystems are expected to be negligible and functional properties of ecosystems must be safeguarded fully. It defines a safety margin which should exclude combination toxicity. The NC is derived by dividing the MPC (see next bullet) by a factor of 100.
- Maximum Permissible Concentration (MPC) – concentration in an environmental compartment at which:
  1. no effect to be rated as negative is to be expected for ecosystems;
  2a no effect to be rated as negative is to be expected for humans (for non-carcinogenic substances);
  2b for humans no more than a probability of 10^{-6} over the whole life (one additional cancer incident in 10^{6} persons taking up the substance concerned for 70 years) can be calculated (for carcinogenic substances) (Lepper, 2005).
- Maximum Acceptable Concentration (MAC_{eco}) – concentration protecting aquatic ecosystems for effects due to short-term exposure or concentration peaks.
- Serious Risk Concentration (SRC_{eco}) – concentration at which serious negative effects in an ecosystem may occur.

It should be noted that ERLs are scientifically derived values, based on (eco)toxicological, fate and physico-chemical data. They serve as advisory values for the Dutch Steering Committee for Substances, which is appointed to set the Environmental Quality Standards (EQSs) from these ERLs. ERLs should thus be considered as preliminary values that do not have any official status.

1.2 Production and use of acrylic acid

The Risk Assessment Report (RAR) (European Commission, 2002) reports that acrylic acid is produced commercially by catalytic oxidation of propylene in two steps via acrolein or from acetylene. In addition, it can be prepared by hydrolysis of acrylonitrile. The main use of acrylic acid is as an industrial intermediate product and it is used as an ingredient and occurs as residual monomer in consumer products like adhesives, paints, binding agents and printing inks. More details can be found in the RAR (European Commission, 2002). In the RAR, a production volume of 830 000 tonnes per year is presumed based on limited information from the industry. In 2008, acrylic acid has been pre-registered under REACH, meaning an expected production volume of at least 1 tonne a year. However, no specific production volumes are given on the ECHA website (echa.europa.eu). Furthermore, it is not known whether the pre-registration will be followed by a definitive registration. No conclusions can be drawn on the current production and import in Europe.

2 Methods

2.1 Data collection

The final Risk Assessment Report (RAR) of acrylic acid (European Commission, 2002) produced in the framework of Existing Substances Regulation (793/93/EEC) was used as only source of physico-chemical and (eco)toxicity data. Information given in the RARs is checked thoroughly by European Union member states (Technical Committee) and afterwards peer-reviewed by the Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE, now the Scientific Committee on Health and Environmental Risk - SCHER). In their opinion, the CSTEE supports the derivation of the PNEC for the aquatic environment. For the soil environment the CSTEE does not support the use of equilibrium partitioning because in this particular case the method extrapolates the toxicity observed to aquatic unicellular algae to terrestrial plants. The large physiological and exposure route (algae surface vs. plant roots) differences would not support this extrapolation. However considering the limited data set for the soil compartment the EU-Technical guidance document (European Commission (Joint Research Centre), 2003) and the INS-guidance (Van Vlaardingen and Verbruggen (2007)) do support the use of equilibrium partitioning for the soil environment. Therefore, in this report equilibrium partitioning is used for the soil environment and no additional evaluation of data is performed for the ERL derivation. Only valid data combined in an aggregated data table are presented in the current report. Occasionally, key studies are discussed when relevant for the derivation of a certain ERL.
In the aggregated data table only one effect value per species is presented. When for a species several effect data are available, the geometric mean of multiple values for the same endpoint is calculated where possible. Subsequently, when several endpoints are available for one species, the lowest of these endpoints (per species) is reported in the aggregated data table.

2.2 Methodology for derivation of environmental risk limits

The methodology for data selection and ERL derivation is described in Van Vlaardingen and Verbruggen (2007) which is in accordance with Lepper (2005). For the derivation of ERLs for air, no specific guidance is available. However, as much as possible the basic principles underpinning the ERL derivation for the other compartments are followed for the atmospheric ERL derivation (if relevant for a chemical).

2.2.1 Drinking water abstraction

The INS-Guidance includes the MPC for surface waters intended for the abstraction of drinking water ($MPC_{dw, water}$) as one of the MPCs from which the lowest value should be selected as the general MPC_{water} (see INS-Guidance, Section 3.1.6 and 3.1.7). According to the proposal for the daughter directive Priority Substances, however, the derivation of the AA-EQS (= MPC) should be based on direct exposure, secondary poisoning, and human exposure due to the consumption of fish. Drinking water was not included in the proposal and is thus not guiding for the general MPC_{water} value. The $MPC_{dw, water}$ is therefore presented as a separate value in this report.

The $MPC_{dw, water}$ is also used to derive the MPC_{gw}. For the derivation of the $MPC_{dw, water}$, a substance specific removal efficiency related to simple water treatment may be needed. Because there is no agreement as yet on how the removal fraction should be calculated, water treatment is not taken into account.

2.2.2 $MAC_{eco, marine}$

In this report, a MAC_{eco} is also derived for the marine environment. The assessment factor for the $MAC_{eco, marine}$ value is based on:

- the assessment factor for the $MAC_{eco, water}$ value when acute toxicity data for at least two specific marine taxa are available, or
- using an additional assessment factor of 5 when acute toxicity data for only one specific marine taxon are available (analogous to the derivation of the MPC according to Van Vlaardingen and Verbruggen (2007)), or
- using an additional assessment factor of 10 when no acute toxicity data are available for specific marine taxa.

If freshwater and marine data sets are not combined the $MAC_{eco, marine}$ is derived on the marine toxicity data using the same additional assessment factors as mentioned above. It has to be noted that this procedure is currently not formalised. Therefore, the $MAC_{eco, marine}$ value needs to be re-evaluated once an agreed procedure is available.

3 Derivation of environmental risk limits for acrylic acid

3.1 Substance identification, physico-chemical properties, fate and human toxicology

3.1.1 Identity

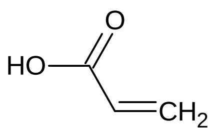

Figure 1. Structural formula of acrylic acid.

Table 2. Identification of acrylic acid.

Parameter	Name or number
Chemical name	2-propenoic acid
Common/trivial/other name	acrylic acid
CAS number	79-10-7
EC number	201-177-9
Molecular formula:	$C_3O_2H_4$
SMILES code	C=CC(=O)O

3.1.2 Physico-chemical properties

Table 3. Physico-chemical properties of acrylic acid.

Parameter	Unit	Value	Remark
Molecular weight	[g.mol^{-1}]	72.06	
Water solubility	[mg.L^{-1}]	1 x 10^6	Miscible in all ratios
log K_{OW}	[-]	0.46	at 25°C
K_{OC}	[L.kg^{-1}]	n.r.	see section 3.1.3
Vapour pressure	[Pa]	380	at 20°C
Melting point	[°C]	14	
Boiling point	[°C]	141	at 1,013 hPa
Henry's law constant	[Pa.m^3.mol^{-1}]	0.027	calculated in the RAR

n.r. = not reported

3.1.3 Behaviour in the environment

Table 4. Selected environmental properties of acrylic acid.

Parameter	Unit	Value	Remark	Reference
Hydrolysis half-life	DT50 [d]	> 28 days	hydrolytically stable	EU-RAR
Photolysis half-life	DT50 [d]	n.r.		
Degradability			readily biodegradable	EU-RAR

n.r. = not reported

The following information on the environmental properties of acrylic acid is cited from the EU-RAR.

When released into the atmosphere, acrylic acid reacts with photochemically produced hydroxyl radicals primarily by addition to the double bond, and with atmospheric ozone, resulting in estimated half-lives of 39.6 hours and 6.5 days, respectively, assuming a hydroxyl radical concentration of 500,000 molecules.cm^{-3} and an ozone concentration of 7.10^{11} molecules.cm^{-3}.

Adsorption and desorption of acrylic acid were examined on five different soils (an aquatic sandy loam sediment, a loamy sand, a clay loam and two loam soils). The Kp values for the adsorption phase ranged from 0.28 L.kg^{-1} to 0.63 L.kg^{-1}. The Kp values for the three desorption phases were scattered more widely with values ranging from 0.38 to 3.85 L.kg^{-1} (Archer and Horvath, 1991). All adsorption and desorption results proved to be independent from the organic matter contents. It can be assumed that the adsorption behaviour of the anionic form of acrylic acid depends primarily on the inorganic fraction of the different soils. Therefore, and due to missing partition coefficients for different types of solid matter, it was preferred to use a uniform value of 1 L.kg^{-1} for all partition coefficients (Kp_{soil}, Kp_{sed}, Kp_{susp}, Kp_{sludge}), which is very close to the value of 1.285 L.kg^{-1}as exactly calculated from the given adsorption and desorption ranges.

3.1.4 Bioconcentration and biomagnification

An overview of the bioaccumulation data for acrylic acid is given in Table 5.

Table 5. Overview of bioaccumulation data for acrylic acid.

Parameter	Unit	Value	Remark	Reference
BCF (fish)	[L.kg^{-1}]	0.49		EU-RAR
BMF	[kg.kg^{-1}]	1	Default value since the BCF is < 2000 L.kg^{-1}.	

In the EU-RAR, no experimental results on bioaccumulation are available. The measured log K_{ow} of 0.46 does not indicate a potential for bioaccumulation though. Based on this value a BCF of 0.49 L.kg^{-1} can be estimated for fish according to the TGD (Chapter 4, Table 6). This calculation implies that the undissociated form of acrylic acid is dominating. For the anionic form, an even much lower BCF has to be expected.

3.1.5 Human toxicological threshold limits and carcinogenicity

Classification and labelling according to the 25th ATP of Directive 67/548/EEC:
Acrylic acid is classified with R10, R20/21/22, R35 and R50. The substance is not a known or suspected carcinogen, mutagen or known or suspected to affect reproduction.

U.S. EPA have evaluated the noncancer oral toxicity data for acrylic acid and derived a reference dose (RfD) of 0.5 $mg.kg^{-1}.day^{-1}$ based on a NOAEL of 53 $mg.kg^{-1}.day^{-1}$ for reduced pup weight observed in a rat reproductive study. EPA applied an uncertainty factor of 100 (10 each for inter- and intra species variability). Since acrylic acid is not a known or suspected carcinogen, the RfD of the US EPA is, after confirmation with RIVM-SIR, taken over as TDI. Therefore, the TDI is 0.5 $mg.kg_{bw}^{-1}.day^{-1}$.

U.S. EPA has evaluated the noncancer inhalation toxicity data for acrylic acid, and derived a reference concentration (RfC) of 0.001 $mg.m^{-3}$ based on a LOAEL(HEC) of 0.33 $mg.m^{-3}$ for degeneration of the nasal olfactory epithelium observed in a subchronic inhalation study in mice. EPA applied an uncertainty factor of 300 (10 for protection of sensitive human subpopulations, 3 for extrapolation from subchronic to chronic duration, and 10 to account for both interspecies extrapolation and use of a LOAEL). The RfC of the US EPA is, after confirmation with RIVM-SIR, taken over as TCA. Therefore, the TCA is 0.001 $mg.m^{-3}$.

3.2 Trigger values

This section reports on the trigger values for ERL_{water} derivation (as demanded in WFD framework).

Table 6. Acrylic acid: collected properties for comparison to MPC triggers.

Parameter	Value	Unit	Method/Source
Log $K_{p,susp-water}$	0 [1]	[-]	
BCF	0.49	[$L.kg^{-1}$]	
BMF	1	[$kg.kg^{-1}$]	
Log K_{OW}	0.46	[-]	
R-phrases	R10, R20/21/22, R35, R50	[-]	
A1 value	n.a.	[$\mu g.L^{-1}$]	
DW standard	n.a.	[$\mu g.L^{-1}$]	

[1] Sorption is independent of organic matter contents, $K_{p,\ susp-water}$ is set to 1 in EU-RAR, see 3.1.3.
n.a. = not available

- Acrylic acid has a log $K_{p,\ susp-water}$ < 3; derivation of $MPC_{sediment}$ is not triggered.
- Acrylic acid has a log $K_{p,\ susp-water}$ < 3; expression of the MPC_{water} as $MPC_{susp,\ water}$ is not required.
- Acrylic acid has a BCF < 100 $L.kg^{-1}$; assessment of secondary poisoning is not triggered.
- Acrylic acid has no classification for which an MPC_{water} for human health via food (fish) consumption ($MPC_{hh\ food,\ water}$) should be derived.

3.3 Toxicity data and derivation of ERLs for water

An overview of the selected freshwater toxicity data for acrylic acid as reported in the RAR is given in Table 7. There are no marine toxicity data available in the EU-RAR for acrylic acid. It is only mentioned that it is obvious that acrylic acid shows a specific toxicity to algae although for marine algae a high natural acrylic acid content is reported.

Table 7. Acrylic acid: selected freshwater toxicity data for ERL derivation.

Chronic Taxonomic group	$NOEC/EC_{10}$ (mg.L^{-1})	Acute Taxonomic group	$L(E)C_{50}$ (mg.L^{-1})
Algae		**Algea**	
Scenedesmus subspicatus	**0.030**	*Scenedesmus subspicatus*	0.130
Crustacea		**Crustacea**	
Daphnia magna	7	*Daphnia magna*	47
		Pisces	
		Leuciscus idus	315
		Brachydanio rerio	222
		Oncorhynchus mykiss	27

3.3.1 Treatment of fresh- and saltwater toxicity data

There are no saltwater toxicity data available. Therefore, ERL derivation is only based on freshwater toxicity data.

3.3.2 Mesocosm studies

There were no mesocosm data available in the EU-RAR.

3.3.3 Derivation of MPC_{water} and MPC_{marine}

3.3.3.1 $MPC_{eco, water}$ and $MPC_{eco, marine}$

Although long-term NOECs/EC_{10}-values are available from only two trophic levels (algae and invertebrates), an assessment factor of 10 can be chosen because it can be assumed that algae represent the potentially most sensitive species group. The acute EC_{50} values for fish are in the same range as those for daphnids and with high probability a NOEC for fish will not be lower than that of algae. Therefore, in the EU-RAR the $PNEC_{aqua}$ derived as 30 µg.L^{-1} / 10 = 3 µg.L^{-1}. This values is taken over as the $MPC_{eco, water}$.
In absence of marine ecotoxicity data, an $MPC_{eco, marine}$ of 0.3 µg.L^{-1} is derived from the $MPC_{eco, water}$, using an assessment factor of 10.

3.3.3.2 $MPC_{sp, water}$ and $MPC_{sp, marine}$

Acrylic acid has a BCF < 100 L.kg^{-1}, thus assessment of secondary poisoning is not triggered.

3.3.3.3 $MPC_{hh\ food, water}$

Derivation of $MPC_{hh\ food, water}$ for acrylic acid is not triggered (Table 6).

3.3.4 Selection of the MPC_{water} and MPC_{marine}

The only MPCs derived are the $MPCs_{eco}$. Therefore, they set the MPC_{water} and MPC_{marine}:
MPC_{water}: 3 µg.L^{-1}
MPC_{marine}: 0.3 µg.L^{-1}

3.3.5 Derivation of $MPC_{dw, water}$

No A1 value and DW standard are available for acrylic acid. With the TDI of 0.5 mg.$kg_{bw}^{-1}$$day^{-1}$ an $MPC_{dw, water, provisional}$ can be calculated with the following formula: $MPC_{dw, water, provisional} = 0.1 \times TL_{hh} \times BW / uptake_{dw}$ where the TL_{hh} is the TDI, BW is a body weight of 70 kg, and $uptake_{dw}$ is a daily uptake of 2 L. As described in section 2.2 water treatment is currently not taken into account. Therefore the $MPC_{dw, water}$ = The $MPC_{dw, water, provisional}$ and becomes: 0.1 x 0.5 x 70 / 2 = 1.75 $mg.L^{-1}$.

3.3.6 Derivation of MAC_{eco}

Based on the lowest LC_{50} (0.13 $mg.L^{-1}$ for algae) and the absence of a bioaccumulation potential, an initial $MAC_{eco, water}$ of 1.3 $\mu g.L^{-1}$ is calculated using an assessment factor of 100. This value is not deemed realistic since this would imply that one expects acute toxic effects at concentrations below the ERL that protects from chronic exposure (van Vlaardingen and Verbruggen 2007). Therefore, the $MAC_{eco, water}$ is set equal to the $MPC_{eco, water}$ at 3 $\mu g.L^{-1}$.

The $MAC_{eco, marine}$ is set a factor 10 lower than the initial $MAC_{eco, water}$ since there are no data for additional marine taxa. Therefore, the $MAC_{eco, marine}$ is initially set to 0.13 $\mu g.L^{-1}$. This value is lower than the $MPC_{eco, marine}$ of 0.3 $\mu g.L^{-1}$. Therefore is the $MAC_{eco, marine}$ set equal to the $MPC_{eco, marine}$: 0.3 $\mu g.L^{-1}$. It has to be noted that this procedure for the $MAC_{eco, marine}$ is currently not formalised. Therefore, the $MAC_{eco, marine}$ needs to be re-evaluated once an agreed procedure is available.

3.3.7 Derivation of NC

According to the RAR, acrylic acid does occur naturally. Since no natural background concentration in water is currently known, the negligible concentrations are derived by dividing the MPCs by a factor 100. This gives an NC_{water} of 30 $ng.L^{-1}$ and an NC_{marine} of 3 $ng.L^{-1}$

3.3.8 Derivation of $SRC_{eco, aquatic}$

As presented in table 7, chronic data are available for only two of the specified taxa (algae, *Daphnia* and fish). The geometric mean of the acute data divided by 10 (2.58 $mg.L^{-1}$) is higher than the geometric mean of the chronic data (0.46 $mg.L^{-1}$). Therefore the $SRC_{eco, aquatic}$ is the geometric mean of the chronic data: 0.46 $mg.L^{-1}$. The $SRC_{eco, aquatic}$ is valid for the marine and the freshwater environment.

3.4 Toxicity data and derivation of ERLs for sediment

The log $K_{p, susp-water}$ of acrylic acid is below the trigger value of 3, therefore, ERLs are not derived for sediment.

3.5 Toxicity data and derivation of ERLs for soil

An overview of the selected soil toxicity data for acrylic acid is given in Table 8.

Table 8. Acrylic acid: selected soil toxicity data for ERL derivation.

Chronic **Taxonomic group**	**$NOEC/EC_{10}$**	**Acute** **Taxonomic group**	**$L(E)C_{50}$**
Respiration inhibition (micro-organisms)	100 $mg.kg_{dwt}^{-1}$		

3.5.1 Derivation of MPC_{soil}

3.5.1.1 $MPC_{eco, soil}$

Based on the above cited soil respiration test a derivation of an MPC is possible. With an assessment factor of 100 on the NOEC, an MPC_{soil} of 1.0 mg.kg^{-1} would result.
According to the guidance, the $MPC_{eco, soil}$ should also be calculated using equilibrium partitioning. With an $MPC_{eco, water}$ of 3 µg.L^{-1} and a Kp_{soil} of 1 L.kg^{-1}, the $MPC_{eco, soil}$ is to 3 µg.kg_{wwt}^{-1}. Conversion to dry soil gives: 3.4 µg.kg_{dwt}^{-1}. As this is the lower value, it will set the $MPC_{eco, soil}$. Conversion to Dutch standard soil is not considered necessary, as the organic content of the soil is not critical for the adsorption behaviour of acrylic acid.

3.5.1.2 $MPC_{sp, soil}$

Acrylic acid has a BCF < 100 L.kg^{-1} therefore secondary poisoning is not triggered.

3.5.1.3 $MPC_{human, soil}$

For the derivation of the $MPC_{human, soil}$, the TDI of 0.5 mg.kg_{bw}^{-1}.day^{-1} can be used as TL_{hh} with the method as described in van Vlaardingen and Verbruggen (2007). The $MPC_{human, soil}$ can be calculated using the K_p of 1 L.kg^{-1}. Specific human intake routes are allowed to contribute 10% of the human toxicological threshold limit. Four different routes contributing to human exposure have been incorporated: consumption of leafy crops, root crops, milk and meat. Uptake via leaf crops was determined to be the critical route. The calculated $MPC_{human, soil}$ is 10.6 mg.kg_{dwt}^{-1}. Conversion to Dutch standard soil is not considered necessary, as the organic content of the soil is not critical for the adsorption behaviour of acrylic acid.

3.5.1.4 Selection of the MPC_{soil}

The lowest MPC_{soil} is the $MPC_{eco, soil}$, this will set the MPC_{soil} at 3.4 µg.kg_{dwt}^{-1}.

3.5.2 Derivation of NC_{soil}

According to the RAR, acrylic acid does occur naturally in some marine algae. Since no natural background concentration in soil is currently known, the NC_{soil} is set a factor of 100 lower than the MPC_{soil}: 3.4 / 100 = 0.034 µg.kg_{dwt}^{-1}.

3.5.3 Derivation of $SRC_{eco, soil}$

The $SRC_{eco, soil}$ can be calculated from the $SRC_{eco, aquatic}$ using equilibrium partitioning. This gives a value of 0.52 mg.kg_{dwt}^{-1}. The $SRC_{eco, soil}$ can also be calculated from the data in Table 8. Since there is only one NOEC this would set the $SRC_{eco, soil}$ at 100 mg.kg_{dwt}^{-1}. The lowest value will set the $SRC_{eco, soil}$, this is the value calculated with equilibrium partitioning: 0.52 mg.kg_{dwt}^{-1}. Conversion to Dutch standard soil is not considered necessary, as the organic content of the soil is not critical for the adsorption behaviour of acrylic acid.

3.6 Derivation of ERLs for groundwater

3.6.1 Derivation of MPC_{gw}

3.6.1.1 $MPC_{eco, gw}$

The $MPC_{eco, gw}$ is set equal to the $MPC_{eco, water}$: 3 µg.L^{-1}.

3.6.1.2 $MPC_{human, gw}$

The $MPC_{human, gw}$ is set equal to the $MPC_{dw, water}$: 1.75 $mg.L^{-1}$.

3.6.1.3 Selection of the MPC_{gw}

The lowest MPC_{gw} is the $MPC_{eco, gw}$. Thus, the MPC_{gw} is 3 $\mu g.L^{-1}$.

3.6.2 Derivation of NC_{gw}

According to the RAR, acrylic acid does occur naturally. Since no natural background concentration in groundwater is currently known, the NC_{gw} is set a factor 100 lower than the MPC_{gw}: 3 / 100 = 0.03 $\mu g.L^{-1}$.

3.6.3 Derivation of $SRC_{eco, gw}$

The $SRC_{eco, gw}$ is set equal to the $SRC_{eco, aquatic}$ at 0.46 $mg.L^{-1}$.

3.7 Derivation of ERLs for air

3.7.1 Derivation of MPC_{air}

3.7.1.1 $MPC_{eco, air}$

No ecotoxicological data is available for the air compartment. Therefore, no $MPC_{eco, air}$ can be derived.

3.7.1.2 $MPC_{human, air}$

The TCA as derived in section 3.1.5 will set the $MPC_{human, air}$: 1 $\mu g.m^{-3}$.

3.7.1.3 Selection of the MPC_{air}

The MPC_{air} is the only value available: 1 $\mu g.m^{-3}$ ($MPC_{human, air}$).

3.7.2 Derivation of NC_{air}

According to the RAR, acrylic acid does occur naturally. Since no natural background concentration in air is currently known, the MPC_{air} divided by 100 is the NC_{air}: 0.01 $\mu g.m^{-3}$.

3.8 Comparison of derived ERLs with monitoring data

The RIWA (Dutch Association of River Water companies) does not report monitoring data for acrylic acid in their annual reports between 2001 and 2007. The Dutch Ministry of Transport, Public Works and Water Management does not present monitoring data for acrylic acid on their website (www.waterbase.nl). Therefore, no comparison of the derived ERLs with monitoring data is possible.

4 Conclusions

In this report, the risk limits Negligible Concentration (NC), Maximum Permissible Concentration (MPC), Maximum Acceptable Concentration for ecosystems (MAC_{eco}), and Serious Risk Concentration for ecosystems (SRC_{eco}) are derived for acrylic acid in water, groundwater, soil and air. The ERLs that were obtained are summarised in Table 9. Monitoring data for acrylic acid in the Dutch environment are not available. Therefore it cannot be judged if the derived ERLs are being exceeded. Considering the large production volumes and the high toxicity of the compound, environmental monitoring may be considered.

Table 9. Derived MPC, NC, MAC_{eco}, and SRC_{eco} values for acrylic acid.

ERL	**unit**	**value**			
		MPC	NC	MAC_{eco}	SRC_{eco}
water	$\mu g.L^{-1}$	3.0	3.0×10^{-2}	3.0	4.6×10^{2}
drinking water [a]	$mg.L^{-1}$	1.8			
marine	$\mu g.L^{-1}$	0.30	3.0×10^{-3}	0.30	4.6×10^{2}
sediment	$mg.kg_{dwt}^{-1}$	n.d.			
soil	$\mu g.kg_{dwt}^{-1}$	3.4	3.4×10^{-2}		5.2×10^{2}
groundwater	$\mu g.L^{-1}$	3.0	3.0×10^{-2}		4.6×10^{2}
air	$\mu g.m^{-3}$	1.0	1.0×10^{-2}		

[a] The exact way of implementation of the $MPC_{dw, water}$ in the Netherlands is at present under discussion. Therefore, the $MPC_{dw, water}$ is presented as a separate value in this report.

n.d. = not derived.

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