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**Letter report 601782024/2009**
R. van Herwijnen

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# Rapport in het kort

**Milieurisicogrenzen voor 2-ethylhexylacrylaat**

Dit rapport geeft milieurisicogrenzen voor 2-ethylhexylacrylaat in (grond)water, bodem en lucht. Milieurisicogrenzen zijn de technisch-wetenschappelijke advieswaarden voor de uiteindelijke milieukwaliteitsnormen in Nederland. De milieurisicogrenzen voor 2-ethylhexylacrylaat zijn gebaseerd op de uitkomsten van de EU risicobeoordeling voor 2-ethylhexylacrylaat (Bestaande Stoffen Verordening 793/93). De afleiding van de milieurisicogrenzen sluit tevens aan bij de richtlijnen uit de Kaderrichtlijn Water. Omdat er geen monitoringsgegevens beschikbaar zijn, kan geen verwachting worden uitgesproken of de afgeleide milieurisicogrenzen overschreden zullen worden.

Trefwoorden: milieukwaliteitsnormen; milieurisicogrenzen; 2-ethylhexylacrylaat; maximaal toelaatbaar risiconiveau; verwaarloosbaar risiconiveau

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# Contents

# 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 2-ethylhexyl acrylate 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). No risk limits were derived for the sediment compartment, because of the relatively low sediment-water partition coefficient.

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.

Since no monitoring data are available, no prediction can be made whether or not the derived ERLs are currently exceeded in the Dutch environment.

Table 1. Derived MPC, NC, $MAC_{eco}$, and $SRC_{eco}$ values for 2-ethylhexyl acrylate.

| **ERL** | **unit** | **value** | | | |
|---|---|---|---|---|---|
| | | MPC | NC | $MAC_{eco}$ | $SRC_{eco}$ |
| water [a] | $\mu g.L^{-1}$ | 1.30 | $1.30*10^{-2}$ | 13.0 | 150 |
| drinking water [b] | $\mu g.L^{-1}$ | 140 | | | |
| marine | $\mu g.L^{-1}$ | 0.130 | $1.30*10^{-3}$ | 1.30 | 150 |
| sediment | $\mu g.kg_{dwt}^{-1}$ | n.d. | | | |
| soil [c] | $\mu g.kg_{dwt}^{-1}$ | 70.5 | 0.705 | | $8.13*10^{3}$ |
| groundwater | $\mu g.L^{-1}$ | 1.30 | $1.30*10^{-2}$ | | 150 |
| air | $\mu g.m^{-3}$ | 375 | 3.75 | | |

[a] From the $MPC_{eco, water}$, $MPC_{sp, water}$ and $MPC_{hh, food, water}$ the lowest one is selected as the 'overall' $MPC_{water}$.

[b] 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.

[c] Expressed on the basis of Dutch standard soil.

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 2-ethylhexyl acrylate. 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 2-ethylhexyl acrylate

The Risk Assessment Report (RAR) (European Commission, 2005) reports that 2-ethylhexyl acrylate is produced from 2-ethyl hexanol and acrylic acid by catalytic dehydratisation in a continuous process. 2-Ethylhexyl acrylate is used as a monomer in the chemical industry for the production of polymers and copolymers, which are mainly processed further to aqueous polymer dispersions. The polymers and polymer dispersions are used in adhesives and as binders for paints. Other applications include coatings of raw materials and uses in the plastics and textiles industries. More details are available in the RAR (European Commission, 2005). From the actual figures available for 1999, a total amount of 90,000 tonnes/annum is estimated to be available on the European market. More recent information obtained from industry confirmed that no significant changes of the tonnages had to be expected for 2000 and 2001. In 2008, 2-ethylhexyl acrylate 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 2-ethylhexyl acrylate (European Commission, 2005) 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 does agree with the derived PNEC values. Therefore, 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.

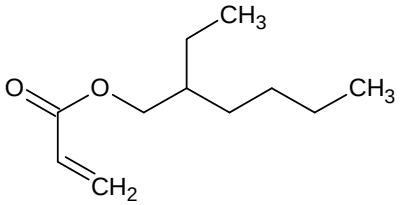
If freshwater and marine data sets are not combined the $MAC_{eco,\ marine}$ is derived on the marine toxicity data using the same additional assessment factors as mentioned above. It has to be noted that this procedure is currently not formalised. Therefore, the $MAC_{eco,\ marine}$ value needs to be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

# 3 Derivation of environmental risk limits for 2-ethylhexyl acrylate

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

### 3.1.1 Identity

Table 2. Identification of 2-ethylhexyl acrylate.

| Parameter | Name or number |
|---|---|
| Chemical name | 2-ethylhexyl acrylate |
| Common/trivial/other name | Acrylic acid 2-ethylhexyl ester, 2-Ethylhexylprop-2-enoate, 2-Propenoic acid 2-ethylhexylester, 2-EHA |
| CAS number | 103-11-7 |
| EC number | 203-080-7 |
| Molecular formula: | $C_{11}H_{20}O_2$ |
| Structural formula |  |



### 3.1.2 Physico-chemical properties

Table 3. Physico-chemical properties of 2-ethylhexyl acrylate.

| Parameter | Unit | Value | Remark |
|---|---|---|---|
| Molecular weight | [g.mol$^{-1}$] | 184.28 | |
| Water solubility | [mg.L$^{-1}$] | 9.6 | 25°C |
| log $K_{OW}$ | [-] | 3.67 | exp. HPLC method |
| | [-] | 4.6 | exp. shake flask |
| | [-] | **3.9** | exp. value used in the RAR method not given |
| | [-] | 4.09 | calculated |
| $K_{OC}$ | [L.kg$^{-1}$] | 914 | |
| Vapour pressure | [Pa] | 5.33 x $10^4$ | at 192.2 °C |
| | [Pa] | 1.33 x $10^4$ | at 50 °C |
| | [Pa] | 1.71 x $10^3$ | at 20 °C |
| | [Pa] | **1.2** x **$10^3$** | at 20 °C, used in the RAR |
| Melting point | [°C] | -90 | |
| Boiling point | [°C] | 216 | at 1013 hPa |
| | [°C] | 134 | at 80 hPa |
| Henry's law constant | [Pa.m$^3$.mol$^{-1}$] | 230 | value estimated in RAR |

n.a. = not available

### 3.1.3 Behaviour in the environment

Table 4. Selected environmental properties of 2-ethylhexyl acrylate.

| Parameter | Unit | Value | Remark |
|---|---|---|---|
| Hydrolysis half-life | DT50 [d] | hydrolytically stable | 17 years estimated in RAR |
| Photolysis half-life | DT50 [d] | 19 hours | value estimated in RAR |
| Degradability | | readily biodegradable | |

### 3.1.4 Bioconcentration and biomagnification

An overview of the bioaccumulation data for 2-ethylhexyl acrylate is given in Table 5.

Table 5. Overview of bioaccumulation data for 2-ethylhexyl acrylate.

| Parameter | Unit | Value | Remark |
|---|---|---|---|
| BCF (fish) | [$L.kg^{-1}$] | 412 | QSAR derived value from the RAR |
| BMF | [$kg.kg^{-1}$] | 1 | default value since the log $K_{ow}$ < 4.5. |

### 3.1.5 Human toxicological threshold limits and carcinogenicity

Classification and labelling according to the 25$^{th}$ ATP of Directive 67/548/EEC:
Classification: R37/38, R43
Labelling: Xi, S2, S36/37, S46

RIVM-SIR has derived oral and inhalation limit values based on data from the RAR. For the inhalation limit value a NOAEC for local effects of 75 $mg.m^{-3}$ in a semichronic inhalation study in rats was used. With this value an inhalation limit value of 375 $\mu g.m^{-3}$ was derived using an assessment factor of 200 (10 for interspecies differences, 10 for intraspecies differences, and 2 to extrapolate from subchronic exposure to chronic exposure).
For the oral limit value a NOAEC for systemic effects of 225 $mg.m^{-3}$ in a semichronic inhalation study in rats, was used. From this value, a daily dose of 40 $mg.kg_{bw}^{-1}$ can be derived (rounded value, based on a respiratory minute volume of 45 $L.kg_{bw}^{-1}.hour^{-1}$ and the experimental exposure time of 30 hours a week)[1]. Dividing by assessment factors of 10 for interspecies differences, 10 for intraspecies differences, 2 to extrapolate from subchronic exposure to chronic exposure, and 5 to account for potential differences in sensitivity after oral exposure yields a value of 40 $\mu g.kg_{bw}^{-1}.day^{-1}$. This value is adopted as oral limit value.

[1] It should be noted that in the RAR a similar recalculation has been performed. In this recalculation an exposure time of 42 hours a week (360 $minutes.day^{-1}$ and 7 days per week) has been used. However the exposure in the rat study was 360 $minutes.day^{-1}$ for only 5 days a week and therefore, in this report, an exposure time of 30 $hours.week^{-1}$ is used.

## 3.2 Trigger values

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

Table 6. 2-Ethylhexyl acrylate: collected properties for comparison to MPC triggers.

| Parameter | Value | Unit | Method/Source |
|---|---|---|---|
| Log $K_{p,susp\text{-}water}$ | 1.96 | [-] | $K_{OC} \times f_{OC,susp}$ [1] |
| BCF | 412 | [L.kg$^{-1}$] | |
| BMF | 1 | [kg.kg$^{-1}$] | |
| Log $K_{OW}$ | 3.9 | [-] | |
| R-phrases | R37/38, R43 | [-] | |
| A1 value | - | [µg.L$^{-1}$] | |
| DW standard | - | [µg.L$^{-1}$] | |

[1] $f_{OC,susp}$ = 0.1 $kg_{OC}.kg_{solid}^{-1}$ ((European Commission (Joint Research Centre), 2003)).

- 2-ethylhexyl acrylate has a log $K_{p,\ susp\text{-}water} <$ 3; derivation of $MPC_{sediment}$ is not triggered.
- 2-ethylhexyl acrylate has a log $K_{p,\ susp\text{-}water} <$ 3; expression of the $MPC_{water}$ as $MPC_{susp,\ water}$ is not required.
- 2-ethylhexyl acrylate has a BCF > 100 L.kg$^{-1}$; assessment of secondary poisoning is triggered.
- 2-ethylhexyl acrylate has an R37/38 and R43 classification. Therefore, an $MPC_{water}$ for human health via food (fish) consumption ($MPC_{hh\ food,\ water}$) does not need to be derived.

## 3.3 Toxicity data and derivation of ERLs for water

An overview of the selected freshwater toxicity data for 2-ethylhexyl acrylate as reported in the RAR is given in Table 7. No acute and chronic data for the marine environment are presented in the RAR.

Table 7. 2-Ethylhexyl acrylate: selected freshwater toxicity data for ERL derivation.

| **Chronic** | | **Acute** | |
|---|---|---|---|
| **Taxonomic group** | **NOEC/$EC_{10}$ (mg.L$^{-1}$)** | **Taxonomic group** | **L(E)$C_{50}$ (mg.L$^{-1}$)** |
| **Algae** | | **Algae** | |
| *Desmodesmus subspicatus* | 0.8 | *Desmodesmus subspicatus* | 1.71 |
| | | **Crustacea** | |
| | | *Daphnia magna* | 1.3 |
| | | **Pisces** | |
| | | *Oncorhynchus mykiss* | 1.8 |

### 3.3.1 Treatment of fresh- and saltwater toxicity data

Since no marine data are available, the MPC derivation is based on freshwater data only.

### 3.3.2 Mesocosm studies

No mesocosm studies were reported in the RAR.

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

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

In the RAR short-term tests for three trophic levels were available and a chronic value for algae. The most sensitive species, based on acute values, was *Daphnia magna* with an EC50 of 1.3 $mg.L^{-1}$. Since the only available chronic endpoint refers to algae, an assessment factor of 1000 was applied resulting in a $PNEC_{aqua}$ of 1.3 $\mu g.L^{-1}$. The $MPC_{eco, water}$ is equal to the $PNEC_{aqua}$, thus: 1.3 $\mu g.L^{-1}$.
In the RAR no assessment for the marine environment has been performed. Following the same reasoning as for the freshwater $MPC_{eco}$ an assessment factor of 10 000 should be applied to the lowest LC50 to derive the marine $MPC_{eco}$. Therefore the $MPC_{eco, marine}$ is: 0.13 $\mu g.L^{-1}$.

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

The substance 2-ethylhexyl acrylate has a BCF > 100 $L.kg^{-1}$, thus assessment of secondary poisoning is triggered.

Table 8. 2-Ethylhexyl acrylate: selected mammal data for ERL derivation.

| Species | Exposure time | Criterion | Effect concentration ($mg.kg_{diet}^{-1}$) | Assessment factor | $MPC_{oral}$ ($mg.kg_{diet}^{-1}$) |
|---|---|---|---|---|---|
| Mice | 24h | NOEC | 2500 | 300 | 8.3 |
| Rat | 90 d | NOEC | 800 | 90 | 8.9 |

The RAR presents only one NOEC which is 2500 $mg.kg^{-1}$ for mice, this value gives an $MPC_{oral}$ of 2500 / 300 = 8.3 $mg.kg^{-1}$ diet. With this value the $MPC_{sp, water}$ is: $MPC_{oral}$ / ($BCF_{fish}$ x BMF) = 8.3 / (412 x 1) = 0.020 $mg.L^{-1}$ = 20 $\mu g.L^{-1}$. The assessment factor of 300 is probably too low since the NOEC used is based on a very short exposure time of 24 h as compared to the minimum exposure of 28 days for mammals in Van Vlaardingen and Verbruggen (2007) to which the assessment factor of 300 refers. No assessment factor is available for studies with an exposure time shorter than 28 days, therefore use of this MPC is not preferred.
A NOEC can also be calculated from the NOAEL of 40 $mg.kg_{bw}^{-1}.day^{-1}$ for rats as calculated in section 3.1.5 from a 90 day inhalatory study According to van Vlaardingen and Verbruggen (2007) this value can be converted into a NOEC in $mg.kg_{diet}^{-1}$ using a conversion factor of 20 resulting in 40 x 20 = 800 $mg.kg_{diet}^{-1}$. With an assessment factor of 90 as used for mammals in 90 day tests, the $MPC_{oral}$ will be 800 / 90 = 8.9 $mg.kg_{diet}^{-1}$. The $MPC_{sp, water}$ is then: 8900 / (412 x 1) = 22 $\mu g.L^{-1}$.
Both derived $MPCs_{sp, water}$ are in the same order of magnitude, the value calculated from the rat study is based on a longer exposure time of 90 days and the conversion from inhalatory to oral toxicity is also performed in the RAR. Therefore, the NOEC from the rat study is preferred for the calculation of the $MPC_{sp, water}$. The $MPC_{sp, water}$ is: 22 $\mu g.L^{-1}$. The $MPC_{sp, marine}$ can be calculated with an extra $BMF_2$ of 1 and becomes 8900 / (412 x 1 x 1) = 22 $\mu g.L^{-1}$.

#### 3.3.3.3 $MPC_{hh\ food, water}$

Derivation of $MPC_{hh\ food, water}$ for 2-ethylhexyl acrylate is not triggered (Table 6).

#### 3.3.3.4 Selection of the $MPC_{water}$ and $MPC_{marine}$

In the Fraunhofer document (Lepper 2005) it is prescribed that the lowest MPC value should be selected as the general MPC. The lowest $MPC_{water}$ of the routes included is 1.3 $\mu g.L^{-1}$ ($MPC_{eco, water}$). The $MPC_{marine}$ is 0.13 $\mu g.L^{-1}$.

### 3.3.4 Derivation of $MPC_{dw, water}$

No A1 value and DW standard are available for 2-ethylhexylacrylate. With the TDI (oral limit value, derived in paragraph 3.1.5) of 40 $\mu g.kg_{bw}^{-1}day^{-1}$, an $MPC_{dw, water, provisional}$ can be calculated with the following formula: $MPC_{dw, water, provisional} = 0.1.TL_{hh}.BW / uptake_{dw}$ 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 $MPC_{dw, water} = MPC_{dw, water, provisional}$ and becomes: 0.1 x 40 x 70 / 2 = 140 $\mu g.L^{-1}$.

### 3.3.5 Derivation of $MAC_{eco}$

The most sensitive species reported was *Daphnia magna* with an EC50 of 1.3 $mg.L^{-1}$. The base set is complete, there is a low interspecies variation, but 2-ethylhexyl acrylate has a potential to bioaccumulate. Therefore an assessment factor of 100 should be applied and the $MAC_{eco, water}$ becomes: 1.3/100 = 13 $\mu g.L^{-1}$.

The $MAC_{eco, marine}$ is set a factor of 10 lower than the $MAC_{eco, water}$ because there are no additional data for marine species. Therefore the $MAC_{eco, marine}$ is 13 / 10 = 1.3 $\mu g.L^{-1}$. 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 official procedure is available.

### 3.3.6 Derivation of NC

The $NC_{water}$ is set to a factor of 100 below the $MPC_{water}$. Therefore the $NC_{water}$ is 1300/100 = 13 $ng.L^{-1}$ and the $NC_{marine}$ is 1.3 $ng.L^{-1}$.

### 3.3.7 Derivation of $SRC_{eco, aquatic}$

For derivation of the $SRC_{eco, aquatic}$ only L(E)C50 values were available (Table 7). The geometric mean of these values has been calculated and an assessment factor of 10 has been applied. The derived $SRC_{eco, aquatic}$ is 0.15 $mg.L^{-1}$. 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 2-ethylhexyl acrylate is below the trigger value of 3, therefore, ERLs are not derived for sediment.

## 3.5 Toxicity data and derivation of ERLs for soil

No data on effects to terrestrial organisms are available according to the RAR.

### 3.5.1 Derivation of $MPC_{soil}$

#### 3.5.1.1 $MPC_{eco, soil}$

The equilibrium partitioning method is used to calculate a $PNEC_{terrestrial}$. Application of this method and using the $MPC_{water}$ of 1.3 $\mu g.L^{-1}$ and $K_{oc}$ of 914 $L.kg^{-1}$ the equilibrium partitioning method gives an $MPC_{eco, soil, dw}$ of 24.0 $\mu g.kg_{dwt}^{-1}$. Conversion to Dutch standard soil gives an $MPC_{eco, soil}$ of 70.5 $\mu g.kg_{dwt}^{-1}$.

#### 3.5.1.2 $MPC_{sp, soil}$

The substance 2-ethylhexyl acrylate has a BCF > 100 and therefore secondary poisoning is triggered. The $MPC_{sp, soil}$ can be calculated from the $MPC_{oral}$ of 8.9 $mg.kg_{diet}^{-1}$ as given in table 8. The $MPC_{sp, soil, TGD}$ can be calculated with the method as described in Van Vlaardingen and Verbruggen (2007). The calculated $MPC_{sp, soil, TGD}$ is: 1.86 $mg.kg_{dwt}^{-1}$. Conversion to Dutch standard soil gives 5.47 $mg.kg_{dwt\ st\ soil}^{-1}$.

#### 3.5.1.3 $MPC_{human, soil}$

For the derivation of the $MPC_{human, soil}$, the TDI of 40 $\mu g.kg_{bw}^{-1}day^{-1}$ can be used as $TL_{hh}$ to calculate the $MPC_{human, soil}$ with the method as described in Van Vlaardingen and Verbruggen (2007). 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 root crops was determined to be the critical route. The calculated $MPC_{human, soil}$ is 345 $\mu g.kg_{dwt}^{-1}$ for Dutch standard soil.

#### 3.5.1.4 Selection of the $MPC_{soil}$

The $MPC_{soil}$ is set to the $MPC_{eco, soil}$ of 70.5 $\mu g.kg_{dwt}^{-1}$ for Dutch standard soil.

### 3.5.2 Derivation of $NC_{soil}$

The $NC_{soil}$ is set a factor of 100 lower than the $MPC_{soil}$: $NC_{soil}$ = 0.705 $\mu g.kg_{dwt}^{-1}$ Dutch standard soil.

### 3.5.3 Derivation of $SRC_{eco, soil}$

No data are available on effects to terrestrial organisms that can be used for calculation of the $SRC_{eco, soil}$. The equilibrium partitioning method can be used to calculate an $SRC_{eco, soil}$ from the $SRC_{eco, aquatic}$ (0.15 $mg.L^{-1}$). This method gives an $SRC_{eco, soil, dwt}$ of 2.76 $mg.kg_{dwt}^{-1}$. Conversion to Dutch standard soil gives an $SRC_{eco, soil}$ of 8.13 $mg.kg_{dwt}^{-1}$.

## 3.6 Derivation of ERLs for groundwater

### 3.6.1 Derivation of $MPC_{gw}$

#### 3.6.1.1 Derivation of $MPC_{eco, gw}$

Since groundwater-specific ecotoxicological data for the groundwater compartment are absent, the surface water $MPC_{eco, water}$ is taken as a substitute. Thus, $MPC_{eco, gw} = MPC_{eco, water}$ = 1.3 $\mu g.L^{-1}$.

#### 3.6.1.2 Derivation of $MPC_{human, gw}$

The $MPC_{human, gw}$ is set equal to the $MPC_{dw, water}$. Therefore the $MPC_{human, gw} = MPC_{dw, water}$ = 140 $\mu g.L^{-1}$.

#### 3.6.1.3 Selection of the $MPC_{gw}$

The lowest available MPC is the $MPC_{eco, gw}$ of 1.3 $\mu g.L^{-1}$. Thus, the final $MPC_{gw}$ is 1.3 $\mu g.L^{-1}$.

### 3.6.2 Derivation of $NC_{gw}$

The $NC_{gw}$ is set a factor of 100 lower than the $MPC_{gw}$. Thus, $NC_{gw}$ = 1.3/100 = 0.013 µg.$L^{-1}$ = 13 ng.$L^{-1}$.

### 3.6.3 Derivation of $SRC_{eco, gw}$

The $SRC_{eco, gw}$ is set equal to the $SRC_{eco, aquatic}$. Thus, the $SRC_{eco, gw}$ is 0.15 mg.$L^{-1}$.

## 3.7 Derivation of ERLs for air

### 3.7.1 Derivation of $MPC_{eco, air}$

The RAR reports that no ecotoxicological data are available for the atmospheric compartment. Therefore no $MPC_{eco, air}$ can be derived.

### 3.7.2 Derivation of $MPC_{human, air}$

The $MPC_{human, air}$ is set by the TCA derived in section 3.1.5: 375 µg.$m^{-3}$.

### 3.7.3 Selection of the $MPC_{air}$

The only $MPC_{air}$ available is the $MPC_{human, air}$: 375 µg.$m^{-3}$.

### 3.7.4 Derivation of $NC_{air}$

The $MPC_{air}$ divided by 100 is the $NC_{air}$: 3.75 µg.$m^{-3}$.

## 3.8 Comparison of derived ERLs with monitoring data

The RIWA (Dutch Association of River Water companies, www.riwa.org) does not present any monitoring data for 2-ethylhexyl acrylate in their annual reports between 2001 and 2006. Also, the Dutch Ministry of Transport, Public Works and Water Management does not present any monitoring data for 2-ethylhexyl acrylate on their website (www.waterbase.nl).

# 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 2-ethylhexyl acrylate in water, groundwater and soil. No risk limits were derived for the sediment compartment because the triggers to derive such limits are not exceeded. Since no monitoring data are available no prediction can be made whether the derived ERLs are currently exceeded in the Dutch environment. Considering the large production volumes and the high toxicity of the compound, environmental monitoring may be considered.

The ERLs that were obtained are summarised in the table below.

Table 9. Derived MPC, NC, $MAC_{eco}$, and $SRC_{eco}$ values for 2-ethylhexyl acrylate.

| **ERL** | **unit** | **value** | | | |
|---|---|---|---|---|---|
| | | MPC | NC | $MAC_{eco}$ | $SRC_{eco}$ |
| water [a] | $\mu g.L^{-1}$ | 1.30 | $1.30*10^{-2}$ | 13.0 | 150 |
| drinking water [b] | $\mu g.L^{-1}$ | 140 | | | |
| marine | $\mu g.L^{-1}$ | 0.130 | $1.30*10^{-3}$ | 1.30 | 150 |
| sediment | $\mu g.kg_{dwt}^{-1}$ | n.d. | | | |
| soil [c] | $\mu g.kg_{dwt}^{-1}$ | 70.5 | 0.705 | | $8.13*10^{3}$ |
| groundwater | $\mu g.L^{-1}$ | 1.30 | $1.30*10^{-2}$ | | 150 |
| air | $\mu g.m^{-3}$ | 375 | 3.75 | | |

[a] From the $MPC_{eco, water}$, $MPC_{sp, water}$ and $MPC_{hh, food, water}$ the lowest one is selected as the 'overall' $MPC_{water}$.

[b] 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.

[c] Expressed on the basis of Dutch standard soil.

n.d. = not derived.

# References

European Commission (2005) 2-ethylhexyl acrylate. Risk Assessment Report, Vol. 61. Luxembourg: Office for Official Publications of the European Communities. EUR 21641 EN.

European Commission (Joint Research Centre) (2003) Technical Guidance Document in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances, Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances and Directive 98/9/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. Part II. Ispra, Italy: European Chemicals Bureau, Institute for Health and Consumer Protection. Report no. EUR 20418 EN/2.

Lepper P. (2005) Manual on the Methodological Framework to Derive Environmental Quality Standards for Priority Substances in accordance with Article 16 of the Water Framework Directive (2000/60/EC). 15 September 2005 (unveröffentlicht) ed. Schmallenberg, Germany: Fraunhofer-Institute Molecular Biology and Applied Ecology.

Van Vlaardingen PLA, Verbruggen EMJ. (2007) Guidance for the derivation of environmental risk limits within the framework of the project 'International and National Environmental Quality Standards for Substances in the Netherlands' (INS). Bilthoven, The Netherlands: National Institute for Public Health and the Environment (RIVM). Report no. 601782001. 146 pp.

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