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C.T.A. Moermond | E.H.W. Heugens

# Environmental risk limits for 2,4-dichlorophenol

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C.T.A. Moermond
E.H.W. Heugens

Contact:
Caroline Moermond
Expertise Centre for Substances
caroline.moermond@rivm.nl

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# Abstract


**Environmental risk limits for 2,4-dichlorophenol**

The National Institute for Public Health and the Environment (RIVM) has derived Environmental Risk Limits (ERLs) for 2,4-dichlorophenol in fresh and marine surface waters. ERLs represent environmental concentrations of a substance offering different levels of protection to man and ecosystems. They serve as advisory values for the Dutch Steering Committee for Substances, which is appointed to set the final environmental quality standard.

Four different ERLs are distinguished in the Netherlands: a concentration at which effects are considered negligible (NC); a concentration at which no harmful effects are to be expected (maximum permissible concentration, MPC); a maximum acceptable concentration for ecosystems specifically for short-term exposure ($MAC_{eco}$), and a concentration at which possible serious effects are to be expected (serious risk concentration, $SRC_{eco,\ water}$). Based on a preliminary screening of monitoring data, there is no indication that any of the newly derived ERLs is exceeded.

RIVM used the methodology as required by the European Water Framework Directive for derivation and selection of the ERLs. Potential risks for humans as well as effects on the aquatic ecosystem are taken into account.

The environmental quality standards are to be set by the Steering Committee for Substances. The ERLs as presented in this report are thus preliminary values that do not have an official status.

This report is part of a series. The ERLs for 2-, 3-, and 4-chlorophenol, 4-chloro-methylphenol and aminochlorophenol and for trichlorophenols are reported separately.



Key words:
environmental risk limits, 2,4-dichlorophenol, maximum permissible concentration, maximum acceptable concentration

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# Rapport in het kort


**Milieurisicogrenzen voor 2,4-dichloorfenol**

Het RIVM heeft milieurisicogrenzen afgeleid voor 2,4-dichloorfenol in zoet en zout oppervlaktewater. Deze dienen als advieswaarden voor de Nederlandse Interdepartementale Stuurgroep Stoffen. De stuurgroep stelt de uiteindelijke milieukwaliteitsnormen vast.

Milieurisicogrenzen zijn maximale concentraties van een stof in het milieu om mens en ecosysteem op verschillende niveaus te beschermen tegen nadelige effecten. Nederland onderscheidt hierbij vier milieurisicogrenzen: een niveau waarbij het risico verwaarloosbaar wordt geacht (VR), een niveau waarbij geen schadelijke effecten zijn te verwachten (maximaal toelaatbaar risiconiveau, MTR), de maximaal aanvaardbare concentratie voor ecosystemen, specifiek voor kortdurende blootstelling ($MAC_{eco}$) en een niveau waarbij mogelijk ernstige effecten voor ecosystemen zijn te verwachten ($ER_{eco}$). De nu afgeleide risicogrenzen lijken op basis van een eerste vergelijking met monitoringsgegevens niet te worden overschreden.

Het RIVM heeft de afleiding en selectie van de milieurisicogrenzen uitgevoerd volgens de methodiek die is voorgeschreven door de Europese Kaderrichtlijn Water. Hierbij is zowel rekening gehouden met mogelijke risico's voor de mens als met eventuele effecten op het ecosysteem.

Omdat de uiteindelijke milieukwaliteitsnormen worden vastgesteld door de Nederlandse Interdepartementale Stuurgroep Stoffen, zijn de milieurisicogrenzen zoals afgeleid in dit rapport voorlopige waarden zonder officiële status.

Dit rapport is onderdeel van een serie. De milieurisicogrenzen voor 2-, 3- en 4-chloorfenol, 4-chloor-3-methylfenol en aminochloorfenol en voor trichloorfenolen zijn in afzonderlijke rapporten opgenomen.



Trefwoorden:
milieurisicogrenzen, 2,4-dichloorfenol, maximaal toelaatbaar risiconiveau, maximaal aanvaardbare concentratie

# Preface

The goal of this report is to derive risk limits that protect both man and the environment. This is done in accordance with the methodology of the Water Framework Directive (WFD) that is incorporated in the methodology for the project 'International and National Environmental Quality Standards for Substances in the Netherlands' (INS), following the Guidance for the derivation of environmental risk limits within the INS framework (Van Vlaardingen and Verbruggen, 2007).

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The results of the present report have been discussed in the scientific advisory group INS (WK INS). The members of this group are acknowledged for their contribution.

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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 an official status.

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 2,4-dichlorophenol in water. No risk limits were derived for the sediment compartment because the trigger value to derive such risk limits is not reached.

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, 2003), and is incorporated in the guidance for the project 'International and National Environmental Quality Standards for Substances in the Netherlands' (Van Vlaardingen and Verbruggen, 2007). An overview of the derived ERLs given in Table 1.

Based on a preliminary screening of monitoring data, there is no indication that any of the newly derived risk limits is exceeded.


**Table 1. Derived MPC, $MAC_{eco}$, NC, and $SRC_{eco}$ values for 2,4-dichlorophenol (in µg/L).**

| | Unit | MPC | $MAC_{eco}$ | NC | $SRC_{eco}$ |
|---|---|---|---|---|---|
| Freshwater | µg/L | 0.54 | 70 | $5.4 \times 10^{-3}$ | $1.1 \times 10^{3}$ |
| Drinking water | µg/L | 1 | n.a.[a] | n.a.[a] | n.a.[a] |
| Marine water | µg/L | 0.16 | 7 | $1.6 \times 10^{-3}$ | $1.1 \times 10^{3}$ |

[a] n.a. = not applicable.

# 1 Introduction

## 1.1 Project framework

In this report, environmental risk limits (ERLs) for surface water (freshwater and marine) are derived for 2,4-dichlorophenol for the project ‘Standard setting for other relevant substances within the WFD’, which is closely related to the project INS (International and national environmental quality standards for substances in the Netherlands). 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 $10^{-6}$ per year of death can be calculated (for carcinogenic substances). Within the scope of the Water Framework Directive, a probability of $10^{-6}$ on a life-time basis is used.

  Within the scope of the Water Framework Directive the MPC is specifically referring to long-term exposure.
- 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 possibly serious ecotoxicological effects are to be expected.

The results presented in this report have been discussed by the members of the scientific advisory group for the INS-project (WK-INS). It should be noted that the Environmental Risk Limits (ERLs) in this report 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). ERLs should thus be considered as preliminary values that do not have any official status.

## 1.2 Selection of substances

ERLs are derived for 2,4-dichlorophenol (CAS number 120-83-2), which was selected by the Netherlands in the scope of the Water Framework Directive (WFD; 2000/60/EC). The derivation of environmental risk limits for monochlorophenols, trichlorophenols, aminochlorophenol and 4-chloro-3-methylphenol is reported in separate reports (Moermond and Heugens, 2009ab).
A current standard for 2,4-dichlorophenol is not available, the only standard available refers to unspecified individual dichlorophenols. Thus, a quantitative comparison with the newly derived standards is not possible.

# 2 Methods

The methodology for the data selection and derivation of ERLs is described in detail in Van Vlaardingen and Verbruggen (2007), further referred to as the 'INS-Guidance'. This guidance is in accordance with the guidance of the Fraunhofer Institute (FHI; Lepper, 2005) and prepared within the context of the WFD.

The process of ERL-derivation contains the following steps: data collection, data evaluation and selection, and derivation of the ERLs on the basis of the selected data. Specific items will be discussed below.

## 2.1 Data collection, evaluation and selection

In accordance with the WFD, data of existing evaluations were used as a starting point. An on-line literature search was performed on TOXLINE (literature from 1985 to 2001) and Current Contents (literature from 1997 to 2007). In addition to this, all potentially relevant references in the RIVM e-tox base and EPA's ECOTOX database were checked.

Ecotoxicity studies were screened for relevant endpoints (i.e. those endpoints that have consequences at the population level of the test species). All ecotoxicity and bioaccumulation tests were then thoroughly evaluated with respect to the validity (scientific reliability) of the study. A detailed description of the evaluation procedure is given in the INS-Guidance (see section 2.2.2 and 2.3.2).

After data collection and validation, toxicity data were combined into an aggregated data table with one effect value per species according to section 2.2.6 of the INS-Guidance. When for a species several effect data were available, the geometric mean of multiple values for the same endpoint was calculated where possible. Subsequently, when several endpoints were available for one species, the lowest of these endpoints (per species) is reported in the aggregated data table.

## 2.2 Derivation of ERLs

### 2.2.1 Drinking water

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 exact way of implementation of the $MPC_{dw,\ water}$ in the Netherlands is at present under discussion within the framework of the 'AMvB Kwaliteitseisen en Monitoring Water'. No policy decision has been taken yet, and the $MPC_{dw,\ water}$ is therefore presented as a separate value in this report. The $MPC_{water}$ is thus derived considering the individual MPCs based on direct exposure ($MPC_{eco,\ water}$), secondary poisoning ($MPC_{sp,\ water}$) or human consumption of fishery products ($MPC_{hh\ food,\ water}$); the need to derive the latter two depends on the characteristics of the compound. Although the $MPC_{dw, water}$ is not taken into account for the derivation of the $MPC_{water}$, it is used for the derivation of the groundwater risk limit, $MPC_{gw}$.

### 2.2.2 $MAC_{eco, marine}$

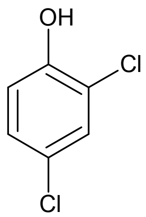
In this report, the $MAC_{eco, marine}$ value is based on the $MAC_{eco,water}$ value when acute toxicity data for at least two specific marine taxa are available, using an additional assessment factor of 5 when acute toxicity data for only one specific marine taxon is available and an additional assessment factor of 10 when no acute toxicity data is available for specific marine taxa (analogous to the derivation of the MPC according to Van Vlaardingen and Verbruggen, 2007). It has to be noted that this procedure is currently not agreed upon. Therefore, the $MAC_{eco, marine}$ value needs to be re-evaluated once an agreed procedure is availabe.

# 3 Derivation of environmental risk limits for 2,4-dichlorophenol

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

### 3.1.1 Identity

**Table 2. Identification of 2,4-dichlorophenol.**

| Chemical name | 2,4-dichlorophenol |
|---|---|
| CAS number | 120-83-2 |
| EC number | 204-429-6 |
| Annex I Index number | 604-011-00-7 |
| Structural formula |  |
| Molecular formula | $C_6H_3Cl_2OH$ |
| SMILES code | Oc1ccc(Cl)cc1Cl |

### 3.1.2 Use

The main use of chlorophenols in general, is as an intermediate for manufacturing pesticides, biocides, dyes and pharmaceuticals (Muller, 2008), but they have also been used as mothproofing agents, miticides, germicides, algicides, fungicides, biocides, and wood preservatives (National Pollutant Inventory, 2005). 2,4-dichlorophenol is a chemical intermediate used principally in the manufacture of the herbicide 2,4-dichlorophenoxyacetic acid (Muller, 2008).

### 3.1.3 Physico-chemical properties

**Table 3. Physico-chemical properties of 2,4-dichlorophenol. Bold values are used for ERL derivation.**

| Parameter | Unit | Value | Remark | Reference |
|---|---|---|---|---|
| Molecular weight | [g/mol] | 163.0 | | |
| Water solubility | [mg/L] | **4500** | 25 ºC; recommended by reference | Mackay et al., 2000 |
| | | **4500** | 20 ºC | EC, 2000 |
| p$K_a$ | [-] | 7.68 | Recommended by reference | Mackay et al., 2007 |
| | | 7.85 | Recommended by reference | BioByte, 2006 |
| | | 7.85 | 25 ºC | EC, 2000 |

| Parameter | Unit | Value | Remark | Reference |
|---|---|---|---|---|
| log $K_{OW}$ | [-] | 3.20 | Recommended by reference | Mackay et al., 2007 |
| | | **3.06** | MlogP; recommended by reference) | BioByte, 2006 |
| | | 2.97 | ClogP (calculated) | BioByte, 2006 |
| | | **3.06**, 3.08 | | EC, 2000 |
| | | 2.80 | EpiWin | US EPA, 2007 |
| log $K_{OC}$ | [-] | 3.48 | Geometric mean of reported values for sediment | Mackay et al., 2007 |
| | | 2.69 | Geometric mean of reported values for sediment | EC, 2000 |
| | | **3.09** | Average of the above | |
| | | 2.83 | Calculated using log $K_{OW}$ = 3.06 (QSAR for phenols) | According to Sabljic et al., 1995 |
| Vapour pressure | [Pa] | 12 | 25 ºC, solid; recommended by reference | Mackay et al., 2000 |
| | | 18.5 | 25 ºC, liquid; recommended by reference | Mackay et al., 2000 |
| | | 133 | 53 ºC | EC, 2000 |
| | | 2.31 | EpiWin | US EPA, 2007 |
| Melting point | [°C] | 44 | recommended by reference | Mackay et al., 2000 |
| | | 45 | | EC, 2000 |
| | | 46.8 | EpiWin | US EPA, 2007 |
| | | 45 | | Muller, 2008 |
| Boiling point | [°C] | 209-210 | recommended by reference | Mackay et al., 2000 |
| | | 210 | | EC, 2000 |
| | | 234 | EpiWin | US EPA, 2007 |
| | | 210 | | Muller, 2008 |
| Henry's law constant | [Pa.m$^3$/mol] | 0.4347 | Calculated-P/C by Mackay | Mackay et al., 2000 |
| | | 0.612 | EpiWin | US EPA, 2007 |

### 3.1.4 Behaviour in the environment

**Table 4. Selected environmental properties of 2,4-dichlorophenol.**

| Parameter | Unit | Value | Remark | Reference |
|---|---|---|---|---|
| Hydrolysis half-life | DT50 [d] | No hydrolysable groups | | Mackay et al., 2000 |
| Photolysis half-life | DT50 | 0.8h -14d | | Mackay et al., 2000 |
| Biodegradablity | DT50 [d] | 2.8-8.3 | Aerobic lake die-away | Mackay et al., 2000 |
| | | 13.5-43 | Anaerobic lake die-away | Mackay et al., 2000 |
| Relevant metabolites | | Unknown | | |

Biodegradation of chlorophenols must be induced, because the antimicrobial activities of these products require that the bacteria adapt. Biodegradation is rapid when adapted bacteria are present (Muller, 2008).

### 3.1.5 Bioconcentration and biomagnification

Bioaccumulation data for 2,4-dichlorophenol are tabulated in Table 5. Detailed bioaccumulation data for 2,4-dichlorophenol are tabulated in Appendix 1.

**Table 5. Overview of bioaccumulation data for 2,4-dichlorophenol.**

| Parameter | Unit | Value | Remark | Reference |
|---|---|---|---|---|
| BCF (fish) | [L/kg] | 340 | Based on edible parts | Kondo et al., 2005 |
| BCF (mussel) | [L/kg] | 5.8 | | Verrengia Guerrero et al., 2007 |
| BMF | [kg/kg] | 1 | Default value for compounds with BCF < 2000 L/kg | |

### 3.1.6 Human toxicological treshold limits and carcinogenicity

2,4-dichlorophenol has the following R-phrases: R22, R24, R35, R51/53. Polychlorophenols in general are classified as being possibly carcinogenic to humans (group 2B) by the IARC (IARC, 1999). The TDI for 2,4-dichlorophenol of 3 μg/$kg_{bw}$/day (US EPA, 1986) was considered to be valid for all mono-, di-, tri-, and tetrachlorophenol compounds (Baars et al., 2001).

## 3.2 Trigger values

This section reports on the trigger values for ERLwater derivation (as demanded in WFD framework).

**Table 6. 2,4-dichlorophenol: collected properties for comparison to MPC triggers.**

| Parameter | Value | Unit | Method/Source | Derived at section |
|---|---|---|---|---|
| Log $K_{p,susp-water}$ | 2.09 | [-] | $K_{OC} \times f_{OC,susp}$ [1] | $K_{OC}$: 3.1.3 |
| BCF | 340 | [L/kg] | | 3.1.5 |
| BMF | 1 | [kg/kg] | | 3.1.5 |
| Log $K_{OW}$ | 3.06 | [-] | | 3.1.3 |
| R-phrases | R22, R24, R35, R51/53. | [-] | | 3.1.6 |
| A1 value | 1 | [μg/L] | Mandatory for phenols | |
| DW standard | - | [μg/L] | | |

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

- 2,4-dichlorophenol has a log $K_{p,\ susp-water} < 3$; derivation of $MPC_{sediment}$ is not triggered.
- 2,4-dichlorophenol has a log $K_{p,\ susp-water} < 3$; expression of the $MPC_{water}$ as $MPC_{susp,\ water}$ is not required.
- 2,4-dichlorophenol has a BCF > 100 L/kg; assessment of secondary poisoning is triggered.
- 2,4-dichlorophenol has a BCF > 100 L/kg and the R-phrases R22, R24, R35, R51/53, and is classified as a possible carcinogenic. Therefore, an $MPC_{water}$ for human health via food (fish) consumption ($MPC_{hh\ food,\ water}$) has to be derived.
- For 2,4-dichlorophenol, no compound-specific A1 value or Drinking Water value standard is available from Council Directives 75/440, EEC and 98/83/EC, respectively. Therefore, the general mandatory A1 value of 1 μg/L for phenols applies.

## 3.3 Aquatic toxicity data

### 3.3.1 Toxicity data

An overview of the selected freshwater toxicity data for 2,4-dichlorophenol is given in Table 7. Marine toxicity data are given in Table 8. Detailed toxicity data for 2,4-dichlorophenol are tabulated in Appendix 2.

**Table 7. 2,4-dichlorophenol: selected freshwater toxicity data for ERL derivation.**

| **Chronic**[a] **Taxonomic group** | **NOEC/EC10 (mg/L)** | **Acute**[a] **Taxonomic group** | **L(E)C50 (mg/L)** |
|---|---|---|---|
| Bacteria | 12 | Bacteria | 75 |
| Bacteria | 22 | Bacteria | 11 |
| Bacteria | 2 | Bacteria | 15[i] |
| Algae | 0.67 | Bacteria | 25[j] |
| Algae | 3.6 | Bacteria | 20 |
| Algae | 6.3[b] | Cyanobacteria | 2.0 |
| Protozoa | 1.5[c] | Algae | 9.2 |
| Crustacea | 0.39[d] | Algae | 8.2[k] |
| Pisces | 0.12[e] | Algae | 3.6 |
| Pisces | 1.5[f] | Algae | 12 |
| Pisces | **0.016**[g] | Protozoa | 8.7[l] |
| Pisces | 3.3 | Fungi | 43 |
| Pisces | 0.29[h] | Fungi | 17 |
| | | Crustacea | 3.6 |
| | | Crustacea | 1.6 |
| | | Crustacea | 1.9[m] |
| | | Pisces | 7.8 |
| | | Pisces | 4.3[n] |
| | | Pisces | 2 |
| | | Pisces | 4.7 |
| | | Pisces | 1.8 |
| | | Pisces | 2.6 |
| | | Pisces | 3.4[o] |
| | | Pisces | 6.8[p] |
| | | Pisces | 3.4[q] |
| | | Pisces | 1.7 |
| | | Pisces | 2.3 |
| | | Amphibia | 17 |

[a] For detailed information see Appendix 2. Bold values are used for ERL-derivation.
[b] Preferred endpoint (growth) for *Scenedesmus subspicatus.*
[c] Geometric mean of 1.5 and 1.6 mg/L, parameter growth inhibition of *Uronema parduczi.*
[d] Most sensitive endpoint, geometric mean of 0.79, 0.78, 0.74, and 0.052 mg/L, parameter reproduction for *Daphnia magna.*
[e] Most sensitive endpoint (larval mortality) and most sensitive exposure duration (8 d), geometric mean of 0.14 and 0.10 mg/L for *Carassius auratus.*
[f] Most sensitive endpoint (larval mortality) and most sensitive exposure duration (8.5 d), geometric mean of 1.57 and 1.48 mg/L for *Ictalurus punctatus.*
[g] Most sensitive endpoint (larval mortality) and most sensitive exposure duration (27 d), geometric mean of 0.020 and 0.017 mg/L for *Oncorhynchus mykiss.*
[h] Most sensitive endpoint, parameter survival for *Pimephales promelas.*
[i] Most sensitive pH (< 6), geometric mean of 19.6, 12.1, and 15.9 mg/L, parameter bioluminescence for *Escherichia coli.*
[j] Geometric mean of 27.7, 38.3, and 14.7 mg/L, parameter bioluminescence for *Pseudomonas fluorescens.*
[k] Geometric mean of 14 and 4.8 mg/L; most relevant exposure duration, preferred endpoint, parameter growth rate for *Pseudokirchneriella subcapitata.*

[l] Most sensitive endpoint, parameter population growth, geomean of 14.9, 14.1, 4.28, 4.47, 11.2, 4.93, 8.05, 17.1, 6.41, 9.37, 14.4, 6.13, 6.06, 14.3, and 9.21 mg/L for *Tetrahymena pyriformis.*
[m] Most relevant and sensitive exposure duration (48 h), geometric mean of 2.6, 1.4, 2.61, 5.1, 2.85, 2.85, 3.68, and 2.2 mg/L, parameter immobility/mortality for *Daphnia magna*.
[n] Geometric mean of 3.9 and 4.75 mg/L, parameter mortality for *Danio rerio.*
[o] Most relevant exposure duration (96 h), parameter mortality for *Oryzias latipes.*
[p] Geometric mean of 6.5, 6.5, 3.82, 11.6, and 7.75 mg/L, parameter mortality for *P. promelas.*
[q] Most sensitive pH (6), geometric mean of 3.25 and 3.48 mg/L, parameter mortality for *Poecilia reticulata.*

**Table 8. 2,4-dichlorophenol: selected marine toxicity data for ERL derivation.**

| **Chronic** [a] <br> **Taxonomic group** | **NOEC/EC10 (mg/L)** | **Acute** [a] <br> **Taxonomic group** | **L(E)C50 (mg/L)** |
|---|---|---|---|
| Algae | 4.7[b] | Bacteria | 4.8[e] |
| Algae | 0.18[c] | Algae | 12[f] |
| Algae | 0.42[d] | Algae | 8.8 |
| Algae | 1.6 | Algae | **0.70**[g] |
| | | Algae | 1.5[h] |
| | | Algae | 5.2 |
| | | Crustacea | 0.70[i] |
| | | Crustacea | 16 |
| | | Crustacea | 2.2[j] |

[a] For detailed information see Appendix 2. Bold values are used for ERL-derivation.
[b] Most sensitive endpoint, parameter photosynthesis for *Dunaliella bioculata.*
[c] Most sensitive endpoint, parameter growth for *Phaeodactylum tricornutum.*
[d] Most sensitive endpoint, geometric mean of 0.93 and 0.19 mg/L, parameter photosynthesis for *Skeletonema costatum.*
[e] Most relevant exposure duration (15-30 min.), geometric mean of 4.06, 5.52, 12.72, 1.55, 1.78, 3.00, 5.92, 21.02, 3.55, and 5.78 mg/L, parameter bioluminescence for *Vibrio fisheri.*
[f] Most sensitive endpoint, parameter photosynthesis for *Dunaliella bioculata.*
[g] Most sensitive endpoint, parameter growth for *Phaeodactylum tricornutum.*
[h] Most sensitive endpoint, geometric mean of 1.71 and 1.36 mg/L, parameter photosynthesis for *Skeletonema costatum.*
[i] Most sensitive life-stage (12 mm), parameter mortality for *Allorchestes compressa.*
[j] Most sensitive life-stage (molting), parameter mortality for *Palaemonetes pugio.*

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

Following Lepper (2005), freshwater and marine datasets can be combined if it can not be shown that marine species are more sensitive than freshwater species. Thus, freshwater and marine datasets for 2,4-dichlorophenol are combined.

# 3.4 Derivation of Environmental Risk Limits

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

### 3.4.1.1 $MPC_{eco,\ water}$ and $MPC_{eco,\ marine}$

Acute toxicity data are available for eight taxonomic groups, amongst which algae, crustacea (Daphnia) and fish. Thus, the base set is complete. Chronic toxicity data are available for algae, crustacea and fish. The lowest NOEC for MPC derivation is 0.016 mg/L for the fish *Oncorhynchus mykiss*.

For the freshwater environment, an assessment factor of 10 can be used on the lowest NOEC, which results in an $MPC_{eco,\ water}$ of 0.016 / 10 = $1.6 \times 10^{-3}$ mg/L = 1.6 µg/L.

No chronic toxicity data are available for specific marine taxa. With an assessment factor of 100 the $MPC_{eco,\ marine}$ becomes 0.016 / 100 = $1.6 \times 10^{-4}$ mg/L = 0.16 µg/L.

### 3.4.1.2 $MPC_{sp,\ water}$ and $MPC_{sp,\ marine}$

2,4-dichlorophenol has a BCF > 100 L/kg, thus assessment of secondary poisoning is triggered. The lowest $MPC_{oral}$ is 2.8 mg/kg (see Table 9). Subsequently, the $MPC_{sp,\ water}$ can be calculated using a BCF of 340 L/kg and a BMF of 1 kg/kg (section 3.1.5) and becomes 2.8 / (340 × 1) = 0.0083 mg/L = 8.3 µg/L.

For the marine environment, an extra biomagnification factor should be used. But since this factor is 1 by default for compounds with log $K_{OW}$ < 4.5, the $MPC_{sp,\ marine}$ equals the $MPC_{sp,\ water}$ and is also 8.3 µg/L.

**Table 9. 2,4-dichlorophenol: selected mammal data for ERL derivation.**

| Species[a] | Exposure time | Criterion | Effect concentration (mg/kg diet) | Assessment factor | $MPC_{oral}$ (mg/kg diet) |
|---|---|---|---|---|---|
| Rat | 90 days | NOAEL | 15000[b] | 90 | 167 |
| Rat | 90 days | NOAEL | 12000[c] | 90 | 133 |
| Rat | 2 years | NOAEL | 2100[d] | 30 | 70 |
| Rat | 2 years | NOAEL | 1200[e] | 30 | 40 |
| Rat | 1 generation | NOAEL | 85[f] | 30 | **2.8** |

[a] For detailed information see Appendix 3.
[b] based on a NOAEL of 1500 $mg/kg_{bw}/day$ with a conversion factor of 10.
[c] based on a NOAEL of 1200 $mg/kg_{bw}/day$ with a conversion factor of 10.
[d] based on a NOAEL of 210 $mg/kg_{bw}/day$ with a conversion factor of 10.
[e] based on a NOAEL of 120 $mg/kg_{bw}/day$ with a conversion factor of 10.
[f] based on a NOAEL of 30 mg/L (drinking water), which corresponds to 2-15 (average 8.5) $mg/kg_{bw}/day$, which is calculated into a diet-based effect concentration using a conversion factor of 10.

#### 3.4.1.3 $MPC_{hh\ food,\ water}$ and $MPC_{hh\ food,\ marine}$

Derivation of MPC $_{hh\ food,\ water}$ for 2,4-dichlorophenol is triggered (Table 6). With an ADI of 0.003 mg/$kg_{bw}$/d for 2,4-dichlorophenol, a BCF of 340 L/kg and a BMF of 1 kg/kg (section 3.1.5), the $MPC_{hh\ food}$ becomes (0.1 × 0.003 × 70) / 0.115 = 0.183 mg/kg. Subsequently, the $MPC_{hh\ food,\ water}$ and $MPC_{hh\ food,\ marine}$ become 0.183 / (340 × 1) = 0.00054 mg/L = 0.54 µg/L.

#### 3.4.1.4 $MPC_{dw,\ water}$

The $MPC_{dw,\ water}$ is 1 µg/L according to the general A1 value for phenols.

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

For the freshwater environment, the lowest MPC value is the value for human consumption of fishery products of 0.54 µg/L. Thus, the overall $MPC_{water}$ is 0.54 µg/L.

For the marine environment, the lowest MPC value is the value for ecotoxicity of 0.16 µg/L. Thus, the overall $MPC_{marine}$ is 0.16 µg/L.

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

The base set is complete. LC50s are available for a large number of taxa. However, because the insects are missing, the requirements to perform an SSD are not met. For informative reasons, an SSD was calculated, which resulted in a HC5 of 0.9 mg/L.

The lowest LC50 is 0.7 mg/L for the alga *Phaeodactylum tricornutum*. Given the following arguments:
- the bioconcentration factor is higher than 100 but for algae bioconcentration plays no role;
- the mode of action (narcosis) is non-specific;
- the variation is not too high in view of the large number of data;

an assessment factor of 10 is used and the $MAC_{eco,\ water}$ becomes 0.7 / 10 = 0.07 mg/L = 70 µg/L.

For the marine environment, no additional specific marine taxa are present and thus an additional assessment factor of 10 is used. The $MAC_{eco,\ marine}$ then becomes 7 µg/L.

### 3.4.3 Derivation of NC

The NC is derived by dividing the final MPC by a factor of 100.

$NC_{water} = 5.4 \times 10^{-3}$ µg/L.
$NC_{marine} = 1.6 \times 10^{-3}$ µg/L.

### 3.4.4 Derivation of $SRC_{eco}$

The geometric mean of all chronic data is 1.13 mg/L. These data are normally distributed (significant at all levels using the Anderson-Darling test for normality). Because more than three NOECs are available, no comparison has to be made with the geometric mean of the acute data. Thus, the $SRC_{eco,\ water}$ and $SRC_{eco,\ marine}$ are set at 1.13 mg/L = 1130 µg/L.

## 3.5 Sediment compartment

The log $K_{p,\ susp\text{-}water}$ of 2,4-dichlorophenol is below the trigger value of 3, therefore, ERLs are not derived for sediment.

## 3.6 Comparison of derived ERLs with monitoring data

An overview of the derived ERLs is given in Table 10.

**Table 10. Derived MPC, NC, $MAC_{eco}$, and $SRC_{eco}$ values for 2,4-dichlorophenol (in µg/L).**

| ERL | Unit | MPC | $MAC_{eco}$ | NC | $SRC_{eco}$ |
|---|---|---|---|---|---|
| Freshwater | µg/L | 0.54 | 70 | $5.4 \times 10^{-3}$ | $1.1 \times 10^{3}$ |
| Drinking water | µg/L | 1 | n.a.[a] | n.a.[a] | n.a.[a] |
| Marine water | µg/L | 0.16 | 7 | $1.6 \times 10^{-3}$ | $1.1 \times 10^{3}$ |

[a] n.a. = not applicable.

Monitoring data for the river Rhine from the years 2001-2006 were obtained from RIWA (Association of River Waterworks). These data show that at all sampling occasions and locations, the concentration of 2,4-dichlorophenol in water was below detection limits (0.02 µg/L), except for one time in 2001 near Enschede where 0.25 µg/L was measured. This value should be compared with $MAC_{eco, water}$, and is well below the $MAC_{eco, water}$.

# 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 2,4-dichlorophenol in water. No risk limits were derived for the sediment compartment because the trigger value to derive such risk limits is not reached.

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

**Table 11. Derived MPC, $MAC_{eco}$, NC, and $SRC_{eco}$ values (in µg/L) for 2,4-dichlorophenol.**

| ERL | Unit | MPC | $MAC_{eco}$ | NC | $SRC_{eco}$ |
|---|---|---|---|---|---|
| Freshwater | µg/L | 0.54 | 70 | $5.4 \times 10^{-3}$ | $1.1 \times 10^{3}$ |
| Drinking water | µg/L | 1 | n.a.[a] | n.a.[a] | n.a.[a] |
| Marine water | µg/L | 0.16 | 7 | $1.6 \times 10^{-3}$ | $1.1 \times 10^{3}$ |

[a] n.a. = not applicable.

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# Appendix 1. Information on bioconcentration

**Table A1.1 Bioconcentration data for 2,4-dichlorophenol.**

| Species | Species properties | Substance purity | Analysed | Test type | Test water | pH | Hardness $CaCO_3$ [mg /L] | Temp. [ºC] | Exposure time | Exposure conc. [mg/L] | BCF [L/kg] | BCF type | Calculation method | Ri[a] | Notes | Reason Ri | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Annelida** | | | | | | | | | | | | | | | | | |
| *Nephelopsis obscura* | field collected, 0.826 ± 0.214g | | deriv GC-ECD | R | rw | 7 | 60 | 4 | 7 d | 0.01 | 282 | whole body ww | Cbiota/Cw | 2 | 1 | 1 | Hall and Jacob, 1988 |
| *Nephelopsis obscura* | field collected, 0.669 ± 0.160g | | deriv GC-ECD | R | rw | 7 | 60 | 12 | 7 d | 0.01 | 424 | whole body ww | Cbiota/Cw | 2 | 1 | 1 | Hall and Jacob, 1988 |
| *Nephelopsis obscura* | field collected, 0.845 ± 0.271g | | deriv GC-ECD | R | rw | 7 | 60 | 22 | 7 d | 0.01 | 980 | whole body ww | Cbiota/Cw | 3 | 1 | 2 | Hall and Jacob, 1988 |
| *Percymoorensis marmorata or Nephelopsis obscura* | field collected, 1.35±0.37 g | | deriv GC-ECD | R | rw | 7 | 60 | 22 | 24 h | 0.01 | 40 | whole body ww | Cbiota/Cw | 3 | 1 | 3 | Hall and Jacob, 1988 |
| *Percymoorensis marmorata or Nephelopsis obscura* | field collected, 1.35±0.37 g | | deriv GC-ECD | R | rw | 7 | 60 | 22 | 24 h | 0.02 | 40 | whole body ww | Cbiota/Cw | 3 | 1 | 3 | Hall and Jacob, 1988 |
| *Percymoorensis marmorata or Nephelopsis obscura* | field collected, 1.35±0.37 g | | deriv GC-ECD | R | rw | 7 | 60 | 22 | 24 h | 0.03 | 54 | whole body ww | Cbiota/Cw | 3 | 1 | 3 | Hall and Jacob, 1988 |
| *Percymoorensis marmorata or Nephelopsis obscura* | field collected, 0.079±0.006 g | | deriv GC-ECD | R | rw | 5 | 60 | 4 | 24 h | 0.01 | 73 | whole body ww | Cbiota/Cw | 3 | 1 | 3 | Hall and Jacob, 1988 |
| *Percymoorensis marmorata or Nephelopsis obscura* | field collected, 0.079±0.006 g | | deriv GC-ECD | R | rw | 7.5 | 60 | 4 | 24 h | 0.01 | 88 | whole body ww | Cbiota/Cw | 3 | 1 | 3 | Hall and Jacob, 1988 |
| *Percymoorensis marmorata or Nephelopsis obscura* | field collected, 0.079±0.006 g | | deriv GC-ECD | R | rw | 9.2 | 60 | 4 | 24 h | 0.01 | 42 | whole body ww | Cbiota/Cw | 3 | 1 | 3 | Hall and Jacob, 1988 |
| **Mollusca** | | | | | | | | | | | | | | | | | |
| *Mytilus edulis* | obtained from fish market | ag | GC-MS | R | nw (sea) | | | 15 | 7 d | 0.1 | 59.6 | Soft tissue body ww | (equilibrium) Cbiota/Cw or kinetic | 2 | | 4 | Jennings et al, 1996 |
| *Sphaerium corneum* | 0.5±0.1 cm | >98 | LSC | S | dtw | | | 8.5 | 64 h | 0.00815 | 5.8 | whole body ww | Cbiota/Cw | 3 | 2 | 5 | Verrengia Guerrero et al., 2007 |
| **Pisces** | | | | | | | | | | | | | | | | | |
| *Carassius auratus* | 2.2 g | 100 | deriv GC/ECD (not in water) | S | tw | 6 | | 20-21 | 5 h | 0.5 | 40 | whole body | Cbiota/Cw | 3 | | 6 | Kishino and Kobayashi, 1995 |
| *Carassius auratus* | 2.2 g | 100 | deriv GC/ECD (not in water) | S | tw | 8 | | 20-21 | 5 h | 0.5 | 33 | whole body | Cbiota/Cw | 3 | | 6 | Kishino and Kobayashi, 1995 |
| *Carassius auratus* | 2.2 g | 100 | deriv GC/ECD (not in water) | S | tw | 10 | | 20-21 | 5 h | 0.5 | 2.4 | whole body | Cbiota/Cw | 3 | | 6 | Kishino and Kobayashi, 1995 |
| *Carassius auratus* | 2 g | | colorimetric | R | | | | 20 | 12- 24 h | 8 | 34 | whole body | Cbiota/Cw | 3 | | 6 | Kobayashi et al., 1979 |
| *Carassius auratus* | | | | | | | | | 25 h | 7.8 | 34 | | | 4 | 3 | 7 | EC, 2000 |
| *Cyprinus carpio* | | | | | | | | 25 | 25 d | 0.03 | 7.1 - 69 | | | 2 | 3 | 8 | EC, 2000 |
| *Cyprinus carpio* | | | | | | | | 25 | 25 d | 0.003 | 13 - 55 | | | 2 | 3 | 8 | EC, 2000 |
| *Oryzias latipes* | eggs to 60.4-102.8 mg (edible parts) 4.3±2.2% lipid | >98 | deriv GC-MS (fish) HPLC-UV (water) | CF | | 7.5±0.5 | | 24±1 | 60 d | 0.000235 | 340 | edible parts ww | Cbiota/Cw | 2 | 4 | | Kondo et al., 2005 |
| *Oryzias latipes* | eggs to 60.4-102.8 mg | >98 | deriv GC-MS (fish) | CF | | 7.5±0.5 | | 24±1 | 60 d | 0.000756 | 210 | edible parts | Cbiota/Cw | 2 | 4 | | Kondo et al., 2005 |

| Species | Species properties | Substance purity | Analysed | Test type | Test water | pH | Hardness $CaCO_3$ [mg /L] | Temp. [ºC] | Exposure time | Exposure conc. [mg/L] | BCF [L/kg] | BCF type | Calculation method | Ri[a] | Notes | Reason Ri | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (edible parts) 4.3±2.2% lipid | | HPLC-UV (water) | | | | | | | | | ww | | | | | |
| *Oryzias latipes* | eggs to 60.4-102.8 mg (edible parts) 4.3±2.2% lipid | >98 | deriv GC-MS (fish) HPLC-UV (water) | CF | | 7.5±0.5 | | 24±1 | 60 d | 0.00284 | 150 | edible parts ww | Cbiota/Cw | 2 | 4 | | Kondo et al., 2005 |
| *Oryzias latipes* | eggs to 60.4-102.8 mg (edible parts) 4.3±2.2% lipid | >98 | deriv GC-MS (fish) HPLC-UV (water) | CF | | 7.5±0.5 | | 24±1 | 60 d | 0.00892 | 130 | edible parts ww | Cbiota/Cw | 2 | 4 | | Kondo et al., 2005 |
| *Oryzias latipes* | eggs to 60.4-102.8 mg (edible parts) 4.3±2.2% lipid | >98 | deriv GC-MS (fish) HPLC-UV (water) | CF | | 7.5±0.5 | | 24±1 | 60 d | 0.0273 | 92 | edible parts ww | Cbiota/Cw | 2 | 4 | | Kondo et al., 2005 |
| *Pimephales promelas* | 9-11 mo; 0.68±0.31 g; 4.4±2.5% lipid | >99 | HPLC-UV | S | am | 6.2 | | 18.0-18.4 | 0.8 - 1.1 h | 34.9 | 7.9 | LBB | Cbiota/Cw | 3 | 5 | 9 | Van Wezel et al., 1995 |
| *Pimephales promelas* | 9-11 mo; 0.68±0.31 g; 4.4±2.5% lipid | >99 | HPLC-UV | S | am | 8.4 | | 18.0-18.4 | 1.3 - 2.5 h | 22.5 | 13 | LBB | Cbiota/Cw | 3 | 5 | 9 | Van Wezel et al., 1995 |
| *Salmo trutta* | 4.5 g | 97 | GC-ECD | S | | | | 5 | 24 h | 1.7 | 10 | LBB | Cbiota/Cw | 3 | | 10 | Hattula et al., 1981 |
| *Trachurus novaezelandiae* | caught in Sidney Harbour | ag | GC-MS | R | nw (sea) | | | 21 | 7 d | 0.1 | 107.7 | muscles ww | (equilibrium) Cbiota/Cw or kinetic | 2 | 6 | 4 | Jennings et al, 1996 |
| fish | | | | | | | | | | | 32 | whole body | Cbiota/Cw | 4 | 7 | | Lu et al., 2000 |

Notes:
1 Analyses indicated that there was no significant volatilization or photodegradation of the chlorophenols after a 24h exposure period
2 BCF calculated using reported concentration in biota (290 pmol/g) and water (50 nmol/L)
3 Original source: Rhone-Poulenc Chimie Courbevoie Cedex, 1979
4 DMSO used as dispersant at concentrations below 0.01%
5 Measured concentrations during exposure remained within 5% of initial water concentrations
6 no bioconcentration detected in the liver
7 Review article; specific references per compound not specified

Explanation Ri:
1 3 leaches per timepoint; steady state was reached within 5 days
2 3 leaches per timepoint; steady state wasnot reached during the experiment
3 only 1 leech used per experiment. May have been pre-exposed but probably not
4 steady state was reached after 40 hours
5 steady state was not reached at all
6 Exposure duration is short, equilbrium might not be fully reached; aquaeous concentration presumably not measured
7 Probably the same as Kobayashi, 1979; very little information on test procedures
8 According to OECD 305C
9 Lethal body burdens
10 Lethal body burdens; static system; maximum of 100 ml ethanol/l

# Appendix 2. Detailed aquatic toxicity data

**Table A2.1 Acute toxicity of 2,4-dichlorophenol to freshwater organisms.**

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bacteria** | | | | | | | | | | | | | | | |
| Pure culture | | N | S | | am | 7.2 | ca. 20 | | | EC50 | growth on phenol | 98.2 | 3 | 1 | Banerjee, 1987 |
| *Arthrobacter globiformis* | | | | | am | | 27 | | 48 h | EC50 | growth | 4 | 3 | 2 | Baarschers et al., 1988 |
| *Bacillus* sp. | isolated from activated sludge, cell age 18 - 20 h | | | | | | 21 | | 30 min | EC50 | dehydrogenase activity | 75 | 2 | 3 | Liu et al., 1982 |
| *Bacillus subtilis* | | | | | | 7.2 | | | | EC50 | spore germination | 39.4 | 4 | 4 | Yasuda et al., 1982 |
| *Burkholderia RASC c2* | *lux*-marked, Gram-negative | N | S | ≥ 98 | am | 7.1 | 25 | | 20 min | EC50 | bioluminescence | 11.1 | 2 | 5 | Boyd et al., 2001 |
| *Escherichia coli* | HB101 pUCD607 | N | S | > 99.5 | dw | 5.5 | | | 20 min | EC50 | bioluminescence | 19.6 | 2 | | Tiensing et al,. 2002 |
| *Escherichia coli* | HB101 pUCD607 | | | | | | | | 15 min | EC50 | bioluminescence | 12.6 | 2 | | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | | | | 15 min | EC25 | bioluminescence | 11.6 | 2 | | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | 4 | | | 15 min | EC50 | bioluminescence | 5.2 | 3 | 6 | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | 4.5 | | | 15 min | EC50 | bioluminescence | 9.0 | 3 | 6 | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | 5 | | | 15 min | EC50 | bioluminescence | 12.1 | 2 | | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | 5.5 | | | 15 min | EC50 | bioluminescence | 15.9 | 2 | | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | 6 | | | 15 min | EC50 | bioluminescence | 22.8 | 2 | | Sinclair et al., 1999 |
| *Escherichia coli* | HB101 pUCD607 | | | | | 6.5 | | | 15 min | EC50 | bioluminescence | 22.1 | 2 | | Sinclair et al., 1999 |
| *Escherichia coli* | 10E4 cells/mL | N | S | | am | | 37 | | | EC50 | growth rate | 53.8 | 4 | 7 | Nendza and Seydel, 1988a; Nendza and Seydel, 1988b; Nendza and Seydel, 1990 |
| *Pseudomonas fluorescens* | 10586r pUCD607 | N | S | > 99.5 | dw | 5.5 | | | 20 min | EC50 | bioluminescence | 27.7 | 2 | | Tiensing et al., 2002 |
| *Pseudomonas fluorescens* | pUCD607 | | | | | | | | 15 min | EC50 | bioluminescence | 38.3 | 2 | | Sinclair et al., 1999 |
| *Pseudomonas fluorescens* | pUCD607 | | | | | | | | 15 min | EC25 | bioluminescence | 34.2 | 2 | | Sinclair et al., 1999 |
| *Pseudomonas fluorescens* | soil bacteria, *lux*-marked, Gram-negative | N | S | ≥ 98 | am | 7.1 | 25 | | 20 min | EC50 | bioluminescence | 14.7 | 2 | 5 | Boyd et al., 2001 |
| *Psuedomonas fluorescens* | isolated from soil | N | S | ag | am | | 20 | | 5 h | EC50 | dehydrogenase activity (stimulation) | 123 | 3 | 8 | Tørsløv, 1993 |
| *Psuedomonas fluorescens* | isolated from soil | N | S | ag | am | | 20 | | 5 h | EC50 | esterase activity (inhibition) | > 400 | 3 | 9 | Tørsløv, 1993 |
| *Pseudomonas pictorum* | | | | | am | | 27 | | 48 h | EC50 | growth | <0.63 | 2 | 10 | Baarschers et al., 1988 |
| *Salmonella typhimurium* | TA98 | | | | am | 6.6 | 37 | | 30 min | EC50 | specific growth rate | 78.2 | 3 | 11 | Pill et al., 1991 |
| *Spirochaeta aurantia* | ATCC 25082 | | | | am | 7 | 30 | | 30 min | EC50 | specific growth rate | 19.6 | 2 | | Pill et al., 1991 |
| | | | | | | | | | | | | | | | |
| **Cyanobacteria** | | | | | | | | | | | | | | | |
| *Microcystis aeruginosa* | | | | | dw | 7 | 27 | | 8 d | NOEC | growth | 2 | 2 | 12 | Bringmann and Kuhn, 1976; Bringmann and Kühn, 1978. |
| **Algae** | | | | | | | | | | | | | | | |
| *Chlorella pyrenoidosa* | inoculum 10E4 cells/mL | | | | am | | | 63 | 10 - 14 d | EC50 | growth | 4 | 3 | 13 | Baarschers et al., 1988 |
| *Chlorella pyrenoidosa* | 1e+5 cells/ml | N | S | | am | | 18 | | 12d | EC100 | number of cells | 10 | 3 | 14 + 13 | Rowe et al., 1982 |
| *Chlorella pyrenoidosa* | | | S | | | 7 | | | 72h | EC50 | chlorophyll reduction | 21 | 4 | | Krijgsheld and Van der Gen, 1986 |
| *Chlorella vulgaris* | | N | | rg | am | | | | 7 d | EC50 | cell density | 2.10 | 3 | 15 | Yen et al., 2002 |
| *Chlorella vulgaris* | 5E+04 cells/mL | N | S | | am | | 21 ± 1 | | 96 h | EC50 | growth rate | 9.2 | 2 | | Shigeoka et al., 1988 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Chlorella vulgaris* | inoculum 10E4 cells/mL | | | | am | | | 63 | 10 - 14 d | EC50 | growth | 9 | 3 | 13 | Baarschers et al., 1988 |
| *Pseudokirchneriella subcapitata* | 5E+04 cells/mL | N | S | | am | | 21 ± 1 | | 96 h | EC50 | growth rate | 14 | 2 | | Shigeoka et al., 1988 |
| *Pseudokirchneriella subcapitata* | | | | | | | | | 72 h | EC50 | growth rate | 4.8 | 2 | 15a | CITI data |
| *Pseudokirchneriella subcapitata* | 1E+06 cells/mL (exposure) and 2E+04 cells/mL (recovery) | N | | | am | 7 (initial pH) | 24 ± 2 | | 96 h | EC50 | cell recovery (cell density) | 112 | 2 | 16 | Hickey et al., 1991 |
| *Pseudokirchneriella subcapitata* | | N | | | am | | | | 96 h | EC50 | cell density | 34.3 / 101.6 | 4 | 17 | Hickey et al., 1991 |
| *Scenedesmus quadricauda* | | N | S | | dw | 7 | 27 | 55 | 8 d | NOEC | growth | 3.6 | 2 | 18 | Bringmann and Kühn, 1978 |
| *Scenedesmus subspicatus* | | N | S | | am | 8.0 - 9.3 | 24 ± 1 | | 48 h | EC50 | biomass (AUC) | 11.5 | 2 | | Kühn and Pattard, 1990 |
| *Scenedesmus subspicatus* | | N | S | | am | 8.0 - 9.3 | 24 ± 1 | | 48 h | EC50 | growth rate | 57 | 3 | 19 | Kühn and Pattard, 1990 |
| **Protozoa** | | | | | | | | | | | | | | | |
| *Tetrahymena pyriformis* | strain GL-C | N | S | > 95 | am | 7.35 | 27 ± 1 | 75 | 40 h | EC50 | population growth (cell density) | 14.9 | 2 | 20 + 21 | Schultz, 1997<br>Schultz, 1999 |
| *Tetrahymena pyriformis* | | | | | | | | | 48 h | EC50 | population growth (density) | 15 | 4* | 20 | Schultz, 1987 |
| *Tetrahymena pyriformis* | | | S | | | | | | 60 h | EC50 | population growth (density) | 15 | 4* | 20 | Schultz and Riggin, 1985<br>Schultz et al., 1986 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 10.3 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 5.1 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 14.1 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 4.28 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 6.64 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 9.23 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 6.7 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 4.47 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 11.2 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 2500 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 4.93 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 8.4 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 10.8 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 8.05 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 17.1 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 5.9 | 2 | | Larsen, 1996 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 7.67 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 11.7 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 7.19 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 9.69 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 16.8 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | generation time | 21.4 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 6.41 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 9.37 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 14.4 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 6.13 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 6.06 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 14.3 | 2 | | Larsen, 1996 |
| *Tetrahymena pyriformis* | strain GL, 1000 cells/mL from exponentially growing culture | N | S | | am | 7.35 | 28 | | 46 h | EC50 | population density | 9.21 | 2 | | Larsen, 1996 |
| **Macrophyta** | | | | | | | | | | | | | | | |
| *Lemna minor* | | N | S | | | 5.1 | 25 ± 1 | | 48 h | LC50 | mortality (chlorosis) | 56 | 3 | 22 | Blackman et al., 1955 |
| *Lemna gibba* | | Y | S | | | | 27.8 | | 10 d | EC50 | vegetative frond reproduction | 1.50 | 3 | 23 | Ensley et al., 1994 |
| **Fungi** | | | | | | | | | | | | | | | |
| *Pichia* | fermentative strain from dinitrification stage of STP | N | S | | am | 7 | 22 ± 2 | | 12 h | EC50 | growth (turbidity) | 42.5 | 2 | 24 | Kwasniewska and Kaiser, 1983 |
| *Rhodotorula rubra* | oxidative strain from shore of Lake Ontario | N | S | | am | 7 | 22 ± 2 | | 12 h | EC50 | growth (turbidity) | 16.5 | 2 | 24 | Kwasniewska and Kaiser, 1983 |
| *Saccharomyces cerevisiae* | | N | | ag | am | 3.2 | 28 | | 16 - 18 h | EC20 | fermentation | 12.1 | 3 | 25 | Weber et al., 2000 |
| | | | | | | | | | | | | | | | |
| **Cnidaria** | | | | | | | | | | | | | | | |
| *Hydra vulgaris* | adult | N | R | | am | 7 | | | 92 h | LOEC | tulip stage | 10.00 | 2 | 26 | Mayura et al., 1991 |
| **Mollusca** | | | | | | | | | | | | | | | |
| *Fossaria cubensis* | | | | | | | | | 24 h | EC100 | | 10 | 4 | | European Commission (European Chemical Bureau), 2000 |
| *Pseudosuccinea columella* | | | | | | | | | 24 h | EC100 | | 10 | 4 | | European Commission (European Chemical Bureau), 2000 |
| **Crustacea** | | | | | | | | | | | | | | | |
| *Ceriodaphnia dubia* | < 24 h old | Y | S | | | | 23 ± 1 | | 48 h | EC50 | immobility | 3.56 | 2 | | Mulhall, 1997 In: Warne and Westbury, 1999 |
| *Daphnia carinata* | < 24 h old | Y | S | | | | 20 ± 1 | | 48 h | EC50 | immobility | 1.57 | 2 | | Azim, 1998. In: Warne and Westbury, 1999 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Daphnia* | | | | | | | | | 24 h | EC50 | | 7 | 4 | | IRCHA. 1981.<br>In: Bazin et al., 1987 |
| *Daphnia magna* | < 24 h old | | S | | am | | | | 24 h | LC50 | mortality | 9.91 | 2 | 27 + 28 | LeBlanc et al., 1988 |
| *Daphnia magna* | < 24 h old | N | S | ≥ 80 | rw | 7.4 - 9.4 | 22 ± 1 | 173 ± 13 | 48 h | LC50 | mortality | 2.6 | 2 | 27 | LeBlanc, 1980 |
| *Daphnia magna* | < 24 h old | N | S | ≥ 80 | rw | 7.4 - 9.4 | 22 ± 1 | 173 ± 13 | 48 h | NOEC | mortality | 0.46 | 2 | 27 | LeBlanc, 1980 |
| *Daphnia magna* | | | | | | 8.25 - 8.35 | | | 24 h | EC50 | immobility | 6.67 | 2 | 29 | Trapido et al., 1997 |
| *Daphnia magna* | | N | Sc | ag | nw | | | | 24 h | EC50 | immobility | 6 | 2 | | Bazin et al., 1987 |
| *Daphnia magna* | 6 - 24 h old | N | S | | am | 8.0 ± 0.2 | 20 | 240 | 48 h | EC50 | immobility | 1.4 | 2 | 30 | Kühn et al., 1989 |
| *Daphnia magna* | 12 ± 12 h old | | S | | nw | | 18 ± 1 | | 48 h | LC50 | mortality | 2.61 | 2 | | Kopperman et al., 1974 |
| *Daphnia magna* | | | | | | | | | 48 h | LC50 | mortality | 5.1 | 2 | | Kuiper and Hanstveit, 1984 |
| *Daphnia magna* | ≤ 24 h old | | S | | am | 8.0 ± 0.2 | 20 or 25 ± 1 | 250 | 24 h | EC50 | immobility | 3.9 | 2 | | Bringmann and Kühn, 1982;<br>Kühn et al., 1989a |
| *Daphnia magna* | | Y | | 99.4 | rw | 4.7 | 20 ± 2 | 250 ± 25 | 24 h | EC50 | immobility | 4.1 | 3 | 31 | Tissot et al., 1985 |
| *Daphnia magna* | < 24 h old | N | S | > 98 | | | 20 ± 1 | | 48 h | EC50 | immobility | 2.85 | **2** | 32 | Steinberg et al., 1992 |
| *Daphnia magna* | < 24 h old | N | S | > 98 | | | 20 ± 1 | | 48 h | EC50 | immobility | 3.12 | 3 | 33 | Steinberg et al., 1992 |
| *Daphnia magna* | < 24 h old | N | S | > 98 | | | 20 ± 1 | | 48 h | EC50 | immobility | 2.84 | **2** | 32 | Steinberg et al., 1992 |
| *Daphnia magna* | < 24 h old | N | S | > 98 | | | 20 ± 1 | | 48 h | EC50 | immobility | 2 | 3 | 34 | Steinberg et al., 1992 |
| *Daphnia magna* | 6 - 24 h old | N | S | > 95 | am | | 22 ± 1 | | 24 h | EC50 | immobility | 3.25 | 2 | | Zhao et al., 1995 |
| *Daphnia magna* | < 72 h old | N | S | > 95 | rw | 7.8 - 8.2 | 20 ± 1 | 200 | 24 h | EC50 | immobility | 2.68 | 2 | 35 | Devillers and Chambon, 1986a;<br>Devillers and Chambon, 1986b<br>Devillers et al., 1987 |
| *Daphnia magna* | | | | | | | | | 48 h | EC50 | immobility | 2.6 | **4** | 36 | BASF AG. 1986.<br>In: Gesellschaft Deutscher Chemiker, 1989 |
| *Daphnia magna* | ≤ 24 h old, wild strain | | | | dtw | 7.6 - 7.7 | 20 - 22 | 285 | 24 h | EC50 | immobility | 11 | 2 | | Bringmann and Kühn, 1977 |
| *Daphnia magna* | 20-24h old | | | | | | | | 24h | EC100 | mortality | 3 | 4 | 37 | Klein, 2000 |
| *Daphnia magna* | 2-6h old | | | | | | | | 24h | EC10 | mortality | <3 | 4 | 37 | Klein, 2000 |
| *Daphnia magna* | <24h | N | S | | rw | 8 | 25 | 150 | 48 h | LC50 | mortality | 3.68 | 2 | | Kim et al., 2006 |
| *Daphnia magna* | | | | | | | | | 48 h | EC50 | immobility | 2.2 | 2 | OECD 202 | CITI data |
| *Orconectes propinquus* | | | S | | | | | | 7 d | LC100 | mortality | 5 | 4 | 38 | Telford, 1974<br>In: Krijgsheld and van der Gen, 1986 |
| *Orconectes immunis* | | | S | | | | | | 7 d | LC100 | mortality | 5 | 4 | 38 | Telford, 1974<br>In: Krijgsheld and van der Gen, 1986 |
| *Cambarus robustus* | | | S | | | | | | 7 d | LC100 | mortality | 5 | 4 | 38 | Telford, 1974<br>In: Krijgsheld and van der Gen, 1986 |
| **Pisces** | | | | | | | | | | | | | | | |
| *Carassius auratus* | 1.0 ± 0.1 g | | S | ± 100 | tw | 7.0 ± 0.1 | 27 - 28 | | 5 h | LC50 | mortality | 7.8 | 3 | 39 + 40 | Kishino and Kobayashi, 1996 |
| *Carassius auratus* | 1.0 ± 0.1 g | N | S | ± 100 | tw | 7.0 ± 0.1 | 27 - 28 | | 2.5 h | LC50 | mortality | 8.00 | 3 | 39 | Kishino and Kobayashi, 1996 |
| *Carassius auratus* | 2.2 ± 0.2 g | | | ± 100 | tw | 6 | 20 - 21 | | 5 h | LC50 | mortality | *5 - 7* | 3 | 39 | Kishino and Kobayashi, 1995 |
| *Carassius auratus* | 2.2 ± 0.2 g | | | ± 100 | tw | 8 | 20 - 21 | | 5 h | LC50 | mortality | *7 - 10* | 3 | 39 + 40 | Kishino and Kobayashi, 1995 |
| *Carassius auratus* | 2.2 ± 0.2 g | | | ± 100 | tw | 10 | 20 - 21 | | 5 h | LC50 | mortality | *> 100* | 3 | 39 + 40 | Kishino and Kobayashi, 1995 |
| *Carassius auratus* | 2 g | | R | | | | 20 | | 24 h | LC50 | mortality | 7.8 | 2 | | Kobayashi et al., 1979 |
| *Carassius auratus* | fingerlings < 10.2 cm | | | | | 7 | 12.8 | 300 | 24 h | NOEC | mortality | ≥ 5 | 3 | 41 | Wood, 1953 |
| *Carassius auratus* | fingerlings < 10.2 cm | | | | | 7 | 12.8 | 300 | 24 h | NOEC | mortality | 5 | 3 | 41 | Hollis and Lennon, 1954 |
| *Danio rerio* | | | S | | | 7.5 ± 0.3 | | | 96 h | LC50 | mortality | 3.9 | 2 | | Wellens, 1982 |
| *Danio rerio* | 160 - 185 mg | N | | > 95 | am | | 22 ± 1 | | 24 h | LC50 | mortality | 4.75 | 2 | | Devillers and Chambon, 1986 |
| *Lepomis macrochirus* | 0.32 - 1.2 g ww | N | Sc | ≥ 8 | am | 6.5 - 7.9 | 21 - 23 | 32 - 48 | 96 h | LC50 | mortality | 2 | 2 | 42 | Buccafusco et al., 1981 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lepomis macrochirus* | fingerlings < 10.2 cm | | | | | 7 | 12.8 | 300 | 24 h | NOEC | mortality | ≥ 5 | 3 | 41 | Wood, 1953 |
| *Lepomis macrochirus* | fingerlings < 10.2 cm | | | | | 7 | 12.8 | 300 | 22 h | LOEC | mortality | 5 | 3 | 41 | Hollis and Lennon, 1954 |
| *Lepomis macrochirus* | fingerlings, ca. 10 cm | N | S | | nw | 7.5 - 8.2 | 13 | | 12 h | LOEC | mortality/obvious distress | 5 | 3 | 41 + 43 | Applegate et al., 1957 |
| *Lepomis macrochirus* | fingerlings, ca. 10 cm | N | S | | nw | 7.5 - 8.2 | 13 | | 24 h | NOEC | mortality/obvious distress | ≥ 5 | 3 | 41 + 43 | Applegate et al., 1957 |
| *Leuciscus idus melanotus* | 1.5 ± 0.3 g, 5 - 7 cm | | S | | | 7 - 8 | 20 ± 1 | 267 ± 53 | 48 h | LC50 | mortality | 5 | 2 | | Juhnke and Lüdemann, 1978 |
| *Leuciscus idus melanotus* | | | S | | | 7-8 | 20 | 267 | 48 h | LC50 | mortality | 4.5 | 2 | 43a | Rübelt et al., 1982 |
| *Notropis cornutus* | larvae, 0.75 - 3.5 mg dw; fertilisation occurred in the field | Y | R | 99 | dtw | | 20 | 133 | 7 d | EC50 | growth (dw) | 1.820 | 2 | 44 | Borgmann and Ralph, 1986 |
| *Oncorhynchus ishawytscha* | | | | | | 7.2 - 7.6 | | | 0 - 1 h | LOEC | mortality | 5 | 4 | 45 | MacPhee and Ruelle, 1969 in: Lipnick et al. 1985. |
| *Oncorhynchus kisutch* | | | | | | 7.2 - 7.6 | | | 0 - 1 h | LOEC | mortality | 10 | 4 | 45 | MacPhee and Ruelle, 1969 in: Lipnick et al. 1985. |
| *Oncorhynchus mykiss* | 4.6 - 6.4 cm, 1.2 - 3.8 g | Y | CF | rg | tw | 7.60 - 8.19 | 14.1 - 16.5 | | 96 h | LC50 | mortality | 2.61 | 2 | 46 | Hodson et al., 1984 |
| *Oncorhynchus mykiss* | fingerlings, ca. 10 cm | N | S | | nw | 7.5 - 8.2 | 13 | | 3 h | LOEC | mortality/obvious distress | 5 | 3 | 41 + 43 | Applegate et al., 1957 |
| *Oncorhynchus mykiss* | fingerlings, ca. 10 cm | N | S | | nw | 7.5 - 8.2 | 13 | | 6 h | LOEC | mortality/obvious distress | 5 | 3 | 41 + 43 | Applegate et al., 1957 |
| *Oryzias latipes* | | | S | | | | 25 ± 2 | | 48 h | LC50 | mortality | 8.4 | 2 | | CITI data |
| *Oryzias latipes* | | | | | | | | | 96 h | LC50 | mortality | 3.4 | 2 | OECD 203 | CITI data |
| *Petromyzon marinus* | larvae, 7.6 - 13 cm, collected from the field | N | S | | nw | 7.5 - 8.2 | 13 | | 12 h | LOEC | mortality/obvious distress | 5 | 3 | 41 + 43 | Applegate et al., 1957 |
| *Petromyzon marinus* | larvae, 7.6 - 13 cm, collected from the field | N | S | | nw | 7.5 - 8.2 | 13 | | 24 h | NOEC | mortality/obvious distress | ≥ 5 | 3 | 41 + 43 | Applegate et al., 1957 |
| *Pimephales promelas* | 30 - 35 d old | Y | F | | nw | ca. 7.5 | 25 ± 2 | 43.3 - 48.5 | 96 h | LC50 | mortality | 8.3 | 2 | 47 | Phipps et al., 1981 |
| *Pimephales promelas* | 30 - 35 d old | Y | F | | nw | ca. 7.5 | 25 ± 2 | 43.3 - 48.5 | 96 h | LC50 | mortality | 8.2 | 2 | 48 | Phipps et al., 1981 |
| *Pimephales promelas* | 30 - 35 d old | Y | F | | nw | ca. 7.5 | 25 ± 2 | 43.3 - 48.5 | 192 h | LC50 | mortality | 6.5 | 2 | 47 | Phipps et al., 1981 |
| *Pimephales promelas* | 30 - 35 d old | Y | F | | nw | ca. 7.5 | 25 ± 2 | 43.3 - 48.5 | 192 h | LC50 | mortality | 6.5 | 2 | 48 | Phipps et al., 1981 |
| *Pimephales promelas* | 30 - 35 d old | Y | S | | nw | ca. 7.5 | 21.6 - 25.4 | 43.3 - 48.5 | 48 h | LC50 | mortality | 8.4 | 2 | 49 | Phipps et al., 1981 |
| *Pimephales promelas* | larvae | Y | R | 99.9 | nw | 7.0 - 8.1 | 24.0 - 26.0 | 73 - 79 | 7 d | MATC | mortality | 3.48 | 1 | 50 | Mayes et al., 1988 |
| *Pimephales promelas* | larvae | Y | R | 99.9 | nw | 7.0 - 8.1 | 24.0 - 26.0 | 73 - 79 | 7 d | LC50 | mortality | 3.82 | 1 | 51 | Mayes et al., 1988 |
| *Pimephales promelas* | larvae | Y | R | 99.9 | nw | 7.0 - 8.1 | 24.0 - 26.0 | 73 - 79 | 7 d | EC50 | weight | > 4.85 | 1 | 50 | Mayes et al., 1988 |
| *Pimephales promelas* | larvae | Y | R | 99.9 | nw | 7.0 - 8.1 | 24.0 - 26.0 | 73 - 79 | 7 d | NOEC | weight | ≥ 4.85 | 1 | 50 | Mayes et al., 1988 |
| *Pimephales promelas* | 30 - 35 d | | F | | nw | | 25 ± 2 | 43.3 - 48.5 | 192 h | LC50 | mortality | 8.17 | 4* | 52 | Hall et al., 1984 |
| *Pimephales promelas* | 31 d old, 0.11 g | Y | F | | nw | 7.57 - 9.08 | 25 ± 1 | 46.2 | 96 h | LC50 | mortality | > 4.6 | 3 | 53 | Holcombe et al., 1980 |
| *Pimephales promelas* | 31 d old, 0.11 g | Y | F | | nw | 7.57 - 9.08 | 25 ± 1 | 46.2 | 192 h | LC50 | mortality | 7.8 | 3 | 53 | Holcombe et al., 1980 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Pimephales promelas* | 31 d old, 0.11 g | Y | F | | nw | 7.57 - 9.08 | 25 ± 1 | 46.2 | 24 h | LC50 | mortality | 1.1 | 3 | 53 | Holcombe et al., 1980 |
| *Pimephales promelas* | 26 - 34 d old (juveniles), laboratory-cultured | Y | CF | > 95 | nw | 7.8 | 25 | 45 | 96 h | LC50 | mortality | 7.75 | 4* | 54 | Veith and Broderius, 1987; Broderius et al., 1995 |
| *Pimephales promelas* | 26 - 34 d old (juveniles), laboratory-cultured | Y | CF | > 95 | nw | 7.8 | 25 | 45 | 96 h | LC50 | mortality | 11.6 | 2 | 54 | Broderius et al., 1995 |
| *Pimephales promelas* | 30 d, 0.029 g | Y | F | | nw/dtw | 7.38 | 25.4 | 45.2 | 96 h | LC50 | mortality | 7.75 | 1 | | Geiger et al., 1985 |
| *Poecilia reticulata* | 2 - 3 mo | | R | | am or rw | 6.1 | 22 ± 1 | 25 | 7 or 14 d | LC50 | mortality | 3.25 | 2 | 55 | Könemann and Musch, 1981 |
| *Poecilia reticulata* | 2 - 3 mo | | R | | am or rw | 7.3 | 22 ± 1 | 25 | 7 or 14 d | LC50 | mortality | 4.19 | 2 | 55 | Könemann and Musch, 1981 |
| *Poecilia reticulata* | 2 - 3 mo | | R | | am or rw | 7.7 - 7.9 | 22 ± 1 | 25 | 7 or 14 d | LC50 | mortality | 5.92 | 2 | 55 | Könemann and Musch, 1981 |
| *Poecilia reticulata* | 40 - 60 mg | Y | R | | dtw | 7 | 25-27 | | 96 h | LC50 | mortality | 5.5 | 2 | 56 | Salkinoja-Salonen et al., 1981 |
| *Poecilia reticulata* | 40 - 60 mg | | R | | | 6 | 26 ± 1 | | 96 h | LC50 | mortality | 3.48 | 2 | | Saarikoski and Viluksela, 1982 |
| *Poecilia reticulata* | 40 - 60 mg | | R | | | 7 | 26 ± 1 | | 96 h | LC50 | mortality | 5.52 | 4* | | Saarikoski and Viluksela, 1982 |
| *Poecilia reticulata* | 40 - 60 mg | | R | | | 8 | 26 ± 1 | | 96 h | LC50 | mortality | 7.62 | 2 | | Saarikoski and Viluksela, 1982 |
| *Poecilia reticulata* | 2 - 3 mo old males | | | rg | tw | 7.7 ± 0.1 | | | 24 h | LC50 | mortality | 2.93 | 4 | 57 | Benoit-Guyod et al., 1984 |
| *Ptychochelilus oregonensis* | | | | | | 7.2 - 7.6 | | | 0 - 1 h | LOEC | "sublethal effects" | 10 | 4 | 45 | MacPhee and Ruelle, 1969 in: Lipnick et al., 1985. |
| *Ptychochelilus oregonensis* | | | | | | 7.2 - 7.6 | | | 1 - 3 h | LOEC | mortality | 10 | 4 | 45 | MacPhee and Ruelle, 1969 in: Lipnicket al., 1985. |
| *Salmo trutta* | average 4.5 g | | | ≥ 97 | | | ca. 5 | | 24 h | LC50 | mortality | 1.7 | 2 | | Hattula et al., 1981. |
| *Tilapia zilli* | 2 - 6 cm | N | R | rg | | 6.6 | 25 ± 1 | 215 | | LC50 | mortality | 2.30 | 2 | 58 | Yen et al., 2002 |
| *Salmo trutta* | fingerlings < 10.2 cm | | | | | 7 | 12.8 | 300 | 5 h | LOEC | mortality | 5 | 3 | 41 | Wood, 1953 |
| *Salvelinus fontinalis* | fingerlings < 10.2 cm | | | | | 7 | 12.8 | 300 | 7 h | LOEC | mortality | 5 | 3 | 41 | Hollis and Lennon, 1954 |
| **Amphibia** | | | | | | | | | | | | | | | |
| *Rana japonica* | tadpoles from eggs collected in the field, 2.5 ± 0.1 cm, 0.09 ± 0.01 g | | R | ag | nw | | 22-25 | | 24 h | LC50 | mortality | 16.5 | 2 | 59 | Wang et al., 2000 |

Notes:
1 Species unknown; exposure during exponential growth phase; endpoint not relevant; grown in medium with phenol as pure carbon source; growth is not supported by chlorophenols
2 Soil bacteria
3 Species is relevant to the aquatic compartment
4 Mean of three determinations; test duration not clear
5 Test result is average of three replicates; soil bacteria which also occurs in water
6 irrelevant pH
7 original reference unclear; test duration not reported
8 No clear dose-response curve. Significance of stimulation for population is unclear.
9 Stimulation at concentrations where growth was depressed or stopped; inhibition only at high concentrations. No clear dose-response relationship
10 EC50 is below the concentration range used.
11 Mutant, which is more sensitive to toxicants than natural strain.
12 Significant effect defined as ≥ 3% effect. Testing conditions described in other Bringmann and Kuhn articles
13 Test duration too long.
14 In accordance with US EPA method.
15 Test duration > 96 h and unclear if cells are still in exponential growth phase.
15a OECD 201

16 4 h expsosure, 96 h recovery
17 EC50 value unclear, as both values are mentioned (in text and in table, respectively).
18 Significant effect defined as ≥ 3% effect.
19 Extrapolated value.
20 ≤ 0.7% DMSO. Unclear if the EC50 is based on nominal or mean measured concentrations. Recovery of the test substance was > 80% of nominal in an abiotic control, Final DMSO concentration of 0.35 mL DMSO / 50 mL not toxic to Tetrahymena,
21 8 - 9 life cycles
22 Fronds were considered to be dead when they were colorless over more than half the surface of the bath; study deemed unreliable because of possible metabolic transformation
23 Test result based on nominal concentrations, which were ≥ 80% of nominal in abiotic control but < 80% in presence of plants due to uptake/metabolism.
24 Turbidity test.
25 Minimal medium and temparature and pH were chosen to induce stress in order to increase the sensitivity of the yeast cells. EC20 is no relevant endpoint.
26 Criterion (tulip stage) considered relevant because it preceeds desintegration (mortality).
27 In accordance with U.S. EPA (1975).
28 Ethanol as solvent (< 0.05%). LC50 calculated from graph using GraphPad Prism 4.
29 In accordance with Finnish standard SFS 5062.
30 In accordance with DIN 38412, Part II 1982.
31 pH too low for Daphnia, OECD range is pH 6 – 9.
32 No dissolved humic material (DHM)
33 5 ppm DHM; 2 h pretest contact time of DHM and test substance.
34 5 ppm DHM; 60 h pretest contact time of DHM and test substance.
35 Test performed in closed system; test was considered valid when dissolved oxygen concentration ≥ 2.27 mg/L which is slightly lower than the oxygen level given in OECD 202 (≥ 3 mg/L).
36 In accordance with EC Directive 79/831/EC Annex 5 Part C.
37 Result mentioned in results paragraph, test not mentioned in methods
38 Not clear if tested as one group with the Orconectes immunis and Cambarus robustus
39 No control group included.
40 A 5-h exposure period was chosen, because within this period, no detoxification of the test substance occurred.
41 Reported as time to effect. Only two fish tested.
42 Dissolved oxygen concentrations too low (range: 9.7 at start - 0.3 mg/L after 96 h) for a number of the compounds tested). Not clear if this was also the case for this compound. In accordance with U.S. EPA 1975.
43 Up to three fish species were tested simultanuously.
43a According to german standard methods (1974).
44 Test result based on nominal concentrations, which were ≥ 80% of nominal. 3 - 7 fish per treatment. EC50 calculated from raw data using Graphpad Prism 4.00.
45 Endpoint unclear. Reported as time to effect.
46 Test result is mean of 3 bioassays. Oxygen concentration may have been low (range of all experiments: 5.6 - 9.4 mg/L $O_2$ at 14.1 - 16.5 °C). Temperature increased from 15 to 17 °C over 18 h due to failure in temperature control system. Problems with measurement of test substance because of turbidity due to fish waste particles in control.
47 Replicate 1; According to US EPA methods; Compound was measured but recoveries not reported, also unclear if results are based on measured or nominal concentrations
48 Replicate 2; According to US EPA methods; Compound was measured but recoveries not reported, also unclear if results are based on measured or nominal concentrations
49 Compound was measured but recoveries not reported, also unclear if results are based on measured or nominal concentrations
50 Unclear if test result is based on nominal or actual concentrations, but actual concentrations were ≥ 80% of nominal.
51 Calculated from raw data. Unclear if test result is based on nominal or actual concentrations, but actual concentrations were ≥ 80% of nominal.
52 Unit of endpoint not reported. Assumed that unit is mol/L. In accordance with EPA-660/3-75-009.
53 Test concentration was kept constant, but undissociated concentration (calculated) varied because different pHs were tested (7.57, 7.87, 7.97, 8.25, 8.68, 9.08). Results expressed in mg/L undissociated fraction. No control included (test vessel with test substance, but with unaltered pH was used as control); fish were not fed (previous studies have shown no effect when fish were starved for 216 h).
54 In accordance with ASTM 1980. Unclear if the LC50 is based on nominal or mean measured concentrations, but recovery of the test substance was > 90% of nominal. Not clear if tested together with phenol or separately
55 Exposure duration (7 or 14 days) not clear; influence of pH on toxicity tested.
56 Unclear if results are based on measured or nominal concentrations; measured concentrations close to nominal concentrations
57 Unit of LC50 not reported, assumed it is given in mol/L
58 Test duration not reported, probably 96 hours.
59 Renewed every 6 hours.

**Table A2.2 Acute toxicity of 2,4-dichlorophenol to marine organisms.**

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Salinity [‰] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bacteria** | | | | | | | | | | | | | | | |
| *Vibrio fischeri* | *lux*CDABE genes | | | | | | | 21.9 | 15 min | EC50 | bioluminescence | 4.06 | 2 | 1 | Sinclair et al., 1999 |
| *Vibrio fischeri* | *lux*CDABE genes | | | | | | | 21.9 | 15 min | EC25 | bioluminescence | 1.47 | 2 | 1 | Sinclair et al., 1999 |
| *Vibrio fischeri* | | N | S | | am | | 15 | 21.9 | 30 min | EC50 | bioluminescence | 5.52 | 2 | 1,2 | Ribo and Kaiser, 1983 |
| *Vibrio fischeri* | | | | | | | | | 3 min | EC50 | bioluminescence | 35.62 | 2 | 1,3 | Lee et al., 1999 |
| *Vibrio fischeri* | | | | | | | | | 10 min | EC50 | bioluminescence | 15.03 | 2 | 1,3 | Lee et al., 1999 |
| *Vibrio fischeri* | | | | | | | | | 20 min | EC50 | bioluminescence | 12.72 | 2 | 1,3 | Lee et al., 1999 |
| *Vibrio fischeri* | | N | Sc | | am | 6.5 - 7.5 | 15 | | 5 min | EC50 | bioluminescence | 2.00 | 2 | 1 | Blum and Speece, 1991a<br>Blum and Speece, 1991b |
| *Vibrio fischeri* | | N | S | 97 | am | 7 | 15 | 21.9 | 15 min | EC50 | bioluminescence | 1.55 | 2 | 1 | Svenson and Zhang, 1995 |
| *Vibrio fischeri* | | N | S | 97 | am | 7.3 | 15 | 21.9 | 15 min | EC50 | bioluminescence | 1.78 | 2 | 1 | Svenson and Zhang, 1995 |
| *Vibrio fischeri* | | N | S | ag | | | | | 30 min | EC50 | bioluminescence | 3.00 | 2 | 4 | Strotmann and Eglsäer, 1995. |
| *Vibrio fischeri* | | | | | | | | 21.9 | 30 min | EC50 | bioluminescence | 5.92 | 2 | 5 | Schüürmann et al., 1997 |
| *Vibrio fischeri* | strain NRRL B-11177 (1.0E+06 cells/mL) | | | | am | | 20 | 21.9 | 30 min | EC50 | bioluminescence | 21.02 | 2 | 6 | Wagner et al., 1989 |
| *Vibrio fischeri* | ahs98 (1.0E+06 cells/mL) | | | | am | | 20 | 21.9 | 30 min | EC50 | bioluminescence | 22.05 | 3 | 6,7 | Wagner et al., 1989 |
| *Vibrio fischeri* | ahs98 (1.0E+06 cells/mL) | | | | am | | 20 | 21.9 | 30 min | EC50 | bioluminescence | 23.55 | 3 | 6,7,8 | Wagner et al., 1989 |
| *Vibrio fischeri* | | N | S | ag | | | 15 | | 10 min | EC50 | bioluminescence | 6.00 | 2 | 1 | Bazin et al., 1987 |
| *Vibrio fischeri* | | N | S | | | | 15 | 21.9 | 15 min | EC50 | bioluminescence | 3.55 | 2 | | Kafka et al., 1999 |
| *Vibrio fischeri* | | N | S | | | | 15 | 21.9 | 15 min | EC20 | bioluminescence | 1.27 | 2 | | Kafka et al., 1999 |
| *Vibrio fischeri* | | | | | | | | | 30 min | EC50 | bioluminescence | 5.52 | 4 | 1 | Computox database. In: Kaiser et al., 1995 |
| *Vibrio fischeri* | | N | S | | | | 15 | | 5 min | EC50 | bioluminescence | 2.25 | 4 | 1 | Mulhall, 1997.<br>In: Warne and Westbury, 1999 |
| *Vibrio fischeri* | | N | S | | | | 15 | | 15 min | EC50 | bioluminescence | 3.59 | 4 | 1 | Stauber et al., 1994a.<br>In: Warne and Westbury, 1999 |
| *Vibrio fischeri* | | | | | | | | | 30 min | EC50 | bioluminescence | 5.52 | 4 | 1 | Computox database.<br>In: Sixt and Altschuh, 1997 |
| *Vibrio fischeri* | | N | S | > 95 | am | | 20 | 32.9 | 15 min | EC50 | bioluminescence | 5.78 | 2 | 1 | Zhao et al., 1993<br>Zhao et al., 1995 |
| *Vibrio fischeri* | | N | S | | am | | 15 ± 0.1 | 21.9 | 5 min | EC50 | bioluminescence | 5.00 | 2 | 1 | Somasundaram et al., 1990 |
| *Vibrio fischeri* | | | | | | | 20 | | 15 min | EC50 | bioluminescence | 6.70 | 4 | | BASF AG. 1986.<br>In: Gesellschaft Deutscher Chemiker (German Chemical Society), 1989 |
| *Vibrio fischeri* | | | | | | | | | | EC50 | bioluminescence | 3.36 | 4 | | Indorato et al., 1984<br>In: WHO. 1989 |
| **Algae** | | | | | | | | | | | | | | | |
| *Dunaliella bioculata* | | N | S | | rw | | 15 ± 1 | 28 | 6 h | EC50 | photosynthesis | 12.17 | 2 | 9 | Kusk and Nyholm, 1992 |
| *Dunaliella bioculata* | 3 - 5E3 cells/mL | Y | S | | rw | | 15 ± 1 | 28 | 72 h | EC50 | growth (density). | 20.00 | 2 | 10 | Kusk and Nyholm, 1992 |
| *Dunaliella bioculata* | 3 - 5E3 cells/mL | Y | S | | rw | | 15 ± 1 | 28 | 72 h | EC50 | growth (density). | 16.81 | 2 | 10 | Kusk and Nyholm, 1992 |
| *Nitzschia closterium* | log growth phase | Y | S | | | | 21 | | 72 h | EC50 | cell division | 8.8 | 2 | | Stauber et al., 1994a.<br>In: Warne and Westbury, 1999 |
| *Phaeodactylum tricornutum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC50 | photosynthesis | 9.4 | 2 | 9 | Kusk and Nyholm, 1992 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Salinity [‰] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Phaeodactylum tricornutum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC50 | photosynthesis | 7.2 | 2 | 9 | Kusk and Nyholm, 1992 |
| *Phaeodactylum tricornutum* | 3 - 5E3 cells/mL | Y | S | | rw | | 15 ± 1 | 20 | 72 h | EC50 | growth (density). | 0.7 | 2 | 10 | Kusk and Nyholm, 1992 |
| *Skeletonema costatum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC50 | photosynthesis | 1.7 | 2 | 9 | Kusk and Nyholm, 1992 |
| *Skeletonema costatum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC50 | photosynthesis | 1.4 | 2 | 9 | Kusk and Nyholm, 1992 |
| *Skeletonema costatum* | 3 - 5E3 cells/mL | Y | S | | rw | | 15 ± 1 | 20 | 72 h | EC50 | growth (density). | 3.8 | 2 | 10 | Kusk and Nyholm, 1992 |
| *Thalassiosira pseudonana* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC50 | photosynthesis | 5.2 | 2 | 9 | Kusk and Nyholm, 1992 |
| **Crustacea** | | | | | | | | | | | | | | | |
| *Allorchestes compressa* | 7 ± 1 mm | N | S | 99 | nw | 8 ± 1 | 20 ± 1 | 34 ± 2 | 96 h | LC50 | mortality | 10.6 | 2 | 11 | Burridge et al., 1995 |
| *Allorchestes compressa* | 10 ± 1 mm | N | S | 99 | nw | 8 ± 1 | 20 ± 1 | 34 ± 2 | 96 h | LC50 | mortality | 10.2 | 2 | 11 | Burridge et al., 1995 |
| *Allorchestes compressa* | 12 ± 1 mm | N | S | 99 | nw | 8 ± 1 | 20 ± 1 | 34 ± 2 | 96 h | LC50 | mortality | 0.7 | 2 | 11 | Burridge et al., 1995 |
| *Allorchestes compressa* | 7 ± 1 mm | N | S | 99 | nw | 8 ± 1 | 20 ± 1 | 34 ± 2 | 96 h | EC10 | mortality | 3.8 | 2 | 6 | Burridge et al., 1995 |
| *Allorchestes compressa* | 10 ± 1 mm | N | S | 99 | nw | 8 ± 1 | 20 ± 1 | 34 ± 2 | 96 h | EC10 | mortality | 0.1 | 2 | 6 | Burridge et al., 1995 |
| *Allorchestes compressa* | 12 ± 1 mm | N | S | 99 | nw | 8 ± 1 | 20 ± 1 | 34 ± 2 | 96 h | EC10 | mortality | 0.2 | 2 | 6 | Burridge et al., 1995 |
| *Tisbe battagliai* | 6 d old copepodid stages | | S | ≥ 98 | nw | 8.0 ± 0.1 | 20 | 30 | 24 h | LC50 | mortality | 15.97 | 2 | | Smith et al., 1994 |
| *Palaemonetes pugio* | Intermolting adults, field collected; 25 mm | N | R | 99 | nw | | 20 | 10 | 96 h | LC50 | mortality | 2.55 | 2 | 12 | Rao et al., 1981 |
| *Palaemonetes pugio* | Molting adults, field collected; 25 mm | N | R | 99 | nw | | 20 | 10 | 96 h | LC50 | mortality | 2.16 | 2 | 13 | Rao et al., 1981 |
| **Pisces** | | | | | | | | | | | | | | | |
| *Platichthys flesus* | collected in the field, 56 ± 2.5 g | Y | R | ≥ 98 | | 8 ± 0.1 | 6 | 5 | 96 h | LC50 | mortality | 5.99 | 3 | 14 | Smith et al., 1994 |
| *Platichthys flesus* | collected in the field, 56 ± 2.5 g | Y | R | ≥ 98 | | 8 ± 0.1 | 6 | 5 | 96 h | LC50 | mortality | 6.83 | 3 | 14 | Smith et al., 1994 |
| *Solea solea* | collected in the field, 45 ± 2.5 | Y | R | ≥ 98 | | 8 ± 0.1 | 6 | 22 | 96 h | LC50 | mortality | 5.13 | 3 | 15 | Smith et al., 1994 |

Notes:
1 Microtox test.
2 Data from 15 and 30 min-exposures are most accurate.
3 Article in chinese language
4 In accordance with DIN 38412, Part 341 (1993).
5 In accordance with DIN 38412 L34.
6 EC50 determined from figure using TechDig.
7 Mutagenesis induced by chemical to obtain more sensitive mutant.
8 Unit of EC50 is not reported.
9 Endpoint read from figure. Exposure for 6 h (4 h pre-incubation, followed by 2 h incubation with 14C)
10 Endpoint read from figure. Results based on measured concentrations
11 EC50 determined by fitting logistic dose-response relationship through data from digitised graph, using nonlinear regression.
12 Intermolt
13 Molting
14 In accordance with OECD 203 (1981). Fish loading exceeds recommended value (34 g/L instead of 1 g/L).
15 In accordance with OECD 203 (1981). Fish loading exceeds recommended value (27 g/L instead of 1 g/L).

**Table A2.3 Chronic toxicity of 2,4-dichlorophenol to freshwater organisms.**

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bacteria** | | | | | | | | | | | | | | | |
| *Escherichia coli* | strain K12 W3110 *thy*- F- | N | S | | am | | 37 | | 4 - 5 h | LOEC | growth rate | 48 | 2 | 1 | Espigares et al., 1990 |
| *Escherichia coli* | strain K12 W3110 *thy*- F- | N | S | | am | | 37 | | 4 - 5 h | LOEC | doubling time | 48 | 2 | 1 | Espigares et al., 1990 |
| *Escherichia coli* | strain K-12 J5-3 | N | S | | am | | 37 | | 5 h | NOEC | growth rate | 12 | 2 | | Espigares and Mariscal, 1989 |
| *Escherichia coli* | strain K-12 J5-3 | N | S | | am | | 37 | | 5 h | NOEC | growth rate | 12 | 2 | | Espigares and Mariscal, 1989 |
| *Escherichia coli* | strain K-12 J5-3 | N | S | | am | | 37 | | 5 h | NOEC | growth rate | 12 | 2 | | Espigares and Mariscal, 1989 |
| *Escherichia coli* | strain K-12 JA 221 | | | | am | | 37 | | 5 h | NOEC | growth rate | < 12 | 2 | | Espigares and Mariscal, 1989 |
| *Escherichia coli* | strain K-12 JA 221 | | | | am | | 37 | | 5 h | NOEC | doubling time | < 12 | 2 | | Espigares and Mariscal, 1989 |
| *Escherichia coli* | strain K-12 JA 221 | | | | am | | 37 | | 5 h | NOEC | number of generations | < 12 | 2 | | Espigares and Mariscal, 1989 |
| *Escherichia coli* | 10E4 cells/mL, in logarithmic phase | N | S | ag | am | | 37 | | | LOEC | cell density | 58.7 | 4 | 2 | Nendza and Seydel, 1990 |
| *Mycobacterium smegmatis* | 10E4 cells/mL, in logarithmic phase | N | S | ag | am | | 37 | | | LOEC | cell density | 58.7 | 4 | 2 | Nendza and Seydel, 1990 |
| *Pseudomonas fluorescens* | | N | S | ag | | | 20 | | 16 h | EC10 | growth | 82.4 | 3 | 3 | Tørsløv and Lindgaard-Jørgensen, 1994 |
| *Pseudomonas fluorescens* | isolated from soil | N | S | ag | am | | 20 | | 16 h | EC50 | growth | 59 | 2 | | Tørsløv, 1993 |
| *Pseudomonas fluorescens* | isolated from soil | N | S | ag | am | | 20 | | 16 h | NOEC | growth | 22 | 2 | 4 | Tørsløv, 1993 |
| *Pseudomonas fluorescens* | isolated from soil | N | S | ag | am | | 20 | | 5 h | EC20 | dehydrogenase activity (inhibition) | 2.5 | 3 | 5,4 | Tørsløv, 1993 |
| *Pseudomonas fluorescens* | isolated from soil | N | S | ag | am | | 20 | | 5 h | EC20 | esterase activity (stimulation) | 12.5-25 | 3 | 6,4 | Tørsløv, 1993 |
| *Pseudomonas putida* | bact | N | S | | am | 7 | 25 | | 16 h | NOEC | growth (cell density) | 6 | 2 | 7 | Bringmann and Kühn, 1980 |
| **Algae** | | | | | | | | | | | | | | | |
| *Chlorella pyrenoidosa* | | N | S | | am | 7 | 22 | | 72h | NOEC | chlorophyll/ oxygen production | 1 | 3 | 8 | Huang and Gloyna, 1968 |
| *Pseudokirchneriella subcapitata* | | | | | | | | | 72 h | NOEC | growth rate | 0.67 | 2 | 22 | CITI data |
| *Scenedesmus quadricauda* | | N | S | | am | 7 | 27 | 55 | 8 d | NOEC | growth inhibition | 3.6 | 2 | 7 | Bringmann and Kühn, 1980 |
| *Scenedesmus subspicatus* | | N | S | | am | 8.0 - 9.3 | 24 ± 1 | | 48 h | EC10 | biomass | 2.4 | 2 | | Kühn and Pattard, 1990 |
| *Scenedesmus subspicatus* | | N | S | | am | 8.0 - 9.3 | 24 ± 1 | | 48 h | EC10 | growth inhibition | 6.3 | 2 | | Kühn and Pattard, 1990 |
| *Scenedesmus subspicatus* | | N | S | | am | 7 | 27 | 550 | 8 d | LOEC | growth | 4.3 | 2 | 9 | Schmidt and Schnabl, 1988 |
| *Scenedesmus subspicatus* | | N | S | | am | 7 | 27 | 550 | 8 d | LOEC | fluorescence | 0.0012 | 2 | 10 | Schmidt and Schnabl, 1988 |
| **Protozoa** | | | | | | | | | | | | | | | |
| *Entosiphon sulcatum* | | N | S | | am | 6.9 | 25 | 75.1 | 72 h | NOEC | growth inhibition | 0.5 | 2 | 7 | Bringmann and Kühn, 1980 |
| *Chilomonas paramaecium* | | N | S | | am | 6.9 | 20 | 74.5 | 48 h | NOEC | growth inhibition | 5.8 | 2 | 7 | Bringmann and Kühn, 1981 |
| *Uronema parduczi* | | N | S | | am | 6.9 | 25 | 75.1 | 20 h | NOEC | growth inhibition | 1.5 | 2 | 7 | Bringmann and Kühn, 1981 |
| *Uronema parduczi* | | N | S | | am | 6.9 | 25 | 75.1 | 20 h | NOEC | growth inhibition | 1.6 | 2 | | Bringmann and Kuhn, 1980 |
| **Macrophyta** | | | | | | | | | | | | | | | |
| *Lemna gibba* | | Y | | | | | | | 7 d | EC10 | vegetative frond reproduction | 0.407 | 4* | 11,13 | Sharma et al., 1997 |
| *Lemna gibba* | | Y | S | am | | | 27.8 | | 10 d | EC10 | vegetative frond reproduction | 0.407 | 3 | 12 | Ensley et al., 1994 |
| *Lemna perpusilla* | single three-frond colony | N | S | | am | | 27 | | 10-14d | LOEC | growth: number of fronds | >5 | 3 | | Rowe et al., 1982 |
| **Fungi** | | | | | | | | | | | | | | | |
| *Saccharomyces cerevisiae* | 10^7 cells from early stationary culture | | | | am | | 30 | | 24 h | NOEC | growth | 0.019 | 4 | 14 | Ahlers et al., 1988 |
| **Crustacea** | | | | | | | | | | | | | | | |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Daphnia magna* | ≤ 24 h old | Y | R | | am | 8.0 ± 0.2 | 25 ± 1 | 250 | 21 d | NOEC | survival, reproduction rate, time to 1st reproduction | 0.32 | 3 | 11 | Kühn et al., 1989b |
| *Daphnia magna* | | | | | | | | | 21 d | LC50 | mortality | 2.3 | 4 | | Kuiper and Hanstveit, 1984 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99 | nw | 7.7 - 7.9 | 22.2 - 24.3 | 170 | 14 d | NOEC | mortality | 1.57 | 2 | 15 | Gersich and Milazzo, 1990 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99 | nw | 7.7 - 7.9 | 22.2 - 24.3 | 170 | 14 d | NOEC | reproduction | 0.79 | 2 | 15 | Gersich and Milazzo, 1990 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99 | nw | 7.7 - 7.9 | 22.2 - 24.3 | 170 | 14 d | NOEC | growth (dw/adult) | 1.57 | 2 | 15 | Gersich and Milazzo, 1990 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99 | nw | 7.7 - 7.9 | 22.2 - 24.3 | 170 | 14 d | NOEC | mortality | 1.55 | 2 | 15 | Gersich and Milazzo, 1990 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99 | nw | 7.7 - 7.9 | 22.2 - 24.3 | 170 | 14 d | NOEC | reproduction | 0.78 | 2 | 15 | Gersich and Milazzo, 1990 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99 | nw | 7.7 - 7.9 | 22.2 - 24.3 | 170 | 14 d | NOEC | growth (dw/adult) | 1.55 | 2 | 15 | Gersich and Milazzo, 1990 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99.9 | nw | 7.4 - 8.3 | 19.0 - 21.0 | 170 | 21 d | NOEC | mortality | 0.74 | 1 | | Gersich and Milazzo, 1988 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99.9 | nw | 7.4 - 8.3 | 19.0 - 21.0 | 170 | 21 d | NOEC | reproduction | 0.74 | 1 | | Gersich and Milazzo, 1988 |
| *Daphnia magna* | ≤ 24 h old | Y | R | 99.9 | nw | 7.4 - 8.3 | 19.0 - 21.0 | 170 | 21 d | NOEC | growth (dw/adult) | 1.48 | 1 | | Gersich and Milazzo, 1988 |
| *Daphnia magna* | | | | | | | | | 21 d | NOEC | reproduction | 0.052 | 2 | 22 | CITI data |
| **Pisces** | | | | | | | | | | | | | | | |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 4 d | LC50 | larval mortality | 4.85 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 8 d | LC50 | larval mortality | 0.37 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 4 d | LC50 | larval mortality | 2.87 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 8 d | LC50 | larval mortality | 0.27 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 4 d | LC10 | larval mortality | 2.88 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 8 d | LC10 | larval mortality | 0.14 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 4 d | EC10 | hatching success | 3.03 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 4 d | LC10 | larval mortality | 0.78 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 8 d | LC10 | larval mortality | 0.1 | 2 | 16 | Birge et al., 1979 |
| *Carassius auratus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 4 d | EC10 | hatching success | 2.33 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 25.9 - 29.6 | 50 | 4.5 d | LC50 | larval mortality | 4.85 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 25.9 - 29.6 | 50 | 8.5 d | LC50 | larval mortality | 4.33 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 25.9 - 29.6 | 200 | 4.5 d | LC50 | larval mortality | 3.83 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 25.9 - 29.6 | 200 | 8.5 d | LC50 | larval mortality | 3.51 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 4.5 d | LC10 | larval mortality | 2.4 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 8.5 d | LC10 | larval mortality | 1.57 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 50 | 4.5 d | EC10 | hatching success | 2.53 | 2 | 16 | Birge et al., 1979 |

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Hardness $CaCO_3$ [mg/L] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 4.5 d | LC10 | larval mortality | 2.22 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 8.5 d | LC10 | larval mortality | 1.48 | 2 | 16 | Birge et al., 1979 |
| *Ictalurus punctatus* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 18.2 - 25.8 | 200 | 4.5 d | EC10 | hatching success | 2.23 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fry | | | | | | | | | NOEC | | 0.055 | 4 | | McCarty et al., 1985 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | NOEC | larval wwt at hatch | 0.18 | 3 | 17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 (fry growth) | 135 | 85 d | NOEC | larval % moisture at hatch | 0.56 | 3 | 17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | NOEC | post-hatch mortality | 0.18 | 3 | 17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | NOEC | larval wwt at 10 d post-hatch | 0.18 | 3 | 17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | NOEC | larval dwt at 10 d post-hatch | 0.18 | 3 | 17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | NOEC | fry mortality | 0.099 | 3 | 17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | NOEC | fry wwt at 4 wk post swim-up | <0.099 | 3 | 18,17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs | Y | CF | ag | nw | 10.0 - 10.9 | 10 -15 | 135 | 85 d | EC10 | fry wwt at 4 wk post swim-up | 0.019 | 3 | 19,17 | Hodson et al., 1991 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 50 | 23 d | LC50 | larval mortality | 0.16 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 50 | 27 d | LC50 | larval mortality | 0.12 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 200 | 23 d | LC50 | larval mortality | 0.12 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 200 | 27 d | LC50 | larval mortality | 0.096 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 50 | 23 d | LC10 | larval mortality | 0.031 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 50 | 27 d | LC10 | larval mortality | 0.02 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 50 | 23 d | EC10 | hatching success | 0.032 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 200 | 23 d | LC10 | larval mortality | 0.017 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 200 | 27 d | LC10 | larval mortality | 0.013 | 2 | 16 | Birge et al., 1979 |
| *Oncorhynchus mykiss* | fertilised eggs (1 - 2 h postspawning) | Y | CF | | rw | 7.8 ± 0.1 | 12.5 - 14.5 | 200 | 23 d | EC10 | hatching success | 0.017 | 2 | 16 | Birge et al., 1979 |
| *Oryzias latipes* | larvae | | CF | >98 | tw | 7.5 | 24 | | 96 h | NOEC | mortality | 3.3 | 2 | | Kondo et al., 2005 |
| *Pimephales promelas* | eggs (< 24 h after spawning) | Y | F | rg | nw | 7.2 - 7.9 | 25 ± 2 | 46 | 32 d | NOEC | hatching success | > 1.24 | 1 | 20 | Holcombe et al., 1982 |
| *Pimephales promelas* | eggs (< 24 h after spawning) | Y | F | rg | nw | 7.2 - 7.9 | 25 ± 2 | 46 | 32 d | NOEC | survival | 0.29 | 1 | 20 | Holcombe et al., 1982 |
| *Pimephales promelas* | eggs (< 24 h after spawning) | Y | F | rg | nw | 7.2 - 7.9 | 25 ± 2 | 46 | 32 d | NOEC | weight | 0.77 | 1 | 20 | Holcombe et al., 1982 |
| *Pimephales promelas* | eggs (< 24 h after spawning) | Y | F | rg | nw | 7.2 - 7.9 | 25 ± 2 | 46 | 32 d | LOEC | hatching success | 3.8 | 1 | 21 | Holcombe et al., 1982 |

Notes:

1 Reported as Minimum Effective Concentration
2 Reported as Minimal Inhibition Concentration (MIC); test duration not celar
3 EC10 much higher than EC20 in studies from same author
4 EC10 calculated from EC50 and EC20 (32 mg/L) values
5 No clear dose-response curve. Significance of stimulation for population is unclear.
6 Stimulation at concentrations where growth was depressed or stopped; inhibition only at high concentrations. No clear dose-response relationship.
7 Test result given as Toxic Threshold (≥ 3% inhibition).
8 Cell densitiy too high
9 Reported as an IC10, which was defined as the lowest concentration that differs statistically from the control.
10 Reported as an IC10, which was defined as the lowest concentration that differs statistically from the control and thus an unknown % effect. Relevant endpoint since chlorophenols uncouple electron transport
11 Test result based on measured concentrations in abiotic control, which were < 80% of nominal.
12 Test result based on measured, which were ≥ 80% of nominal in abiotic control but < 80% in presence of plants due to uptake/metabolism.
13 Test substances remained unchanged in abiotic control, but duckweed was able to metabolise test substance (at least 50% within the first 4 d of growth). Same as Ensley
14 Calculated using EC20: NOEC = 0.0384 / 2. Unit test result unclear.
15 Temperature too high (range in OECD 211 is 18 - 22 °C), which may have increased sensitivity of test. A 14-d test is considered acceptable because 3 broods were produced.
16 Closed system devoid of air space. Results recalculated by fitting logistic dose-response relationship through data provided by author, using nonlinear regression.
17 Test result based on nominal concentrations. Unclear if these were were ≥ 80% of nominal. Irrelevant pH
18 LOEC = 0.61 mg/L.
19 EC10 calculated by fitting a logistic dose response model through data presented by author.
20 Embryo larval test. Recovery of test substance was 103 ± 9%.
21 Preliminary embry larval test. Recovery of test substance was 103 ± 9%.
22 OECD 201

**Table A2.4 Chronic toxicity of 2,4-dichlorophenol to marine organisms.**

| Species | Species properties | A | Test type | Purity [%] | Test water | pH | T [°C] | Salinity [‰] | Exp. time | Criterion | Test endpoint | Value [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Algae** | | | | | | | | | | | | | | | |
| *Dunaliella bioculata* | | N | S | | rw | | 15 ± 1 | 28 | 6 h | EC10 | photosynthesis (14C assimilation) | 4.70 | 2 | 1 | Kusk and Nyholm, 1992 |
| *Dunaliella bioculata* | 3 - 5E3 cells/mL | Y | S | am | rw | | 15 ± 1 | 28 | 72 h | EC10 | growth (density). | 7.17 | 2 | 1 | Kusk and Nyholm, 1992 |
| *Dunaliella bioculata* | 3 - 5E3 cells/mL | Y | S | am | rw | | 15 ± 1 | 28 | 72 h | EC10 | growth (density). | 5.25 | 2 | 1 | Kusk and Nyholm, 1992 |
| *Nitzschia closterium* | log growth phase | Y | S | | | | 21 | | 72 h | NOEC | cell division | >0.82 | 2 | 2 | Stauber et al., 1995 |
| *Phaeodactylum tricornutum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC10 | photosynthesis (14C assimilation) | 1.04 | 2 | 3 | Kusk and Nyholm, 1992 |
| *Phaeodactylum tricornutum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC10 | photosynthesis (14C assimilation) | 1.79 | 2 | 3 | Kusk and Nyholm, 1992 |
| *Phaeodactylum tricornutum* | 3 - 5E3 cells/mL | Y | S | am | rw | | 15 ± 1 | 20 | 72 h | EC10 | growth (density). | 0.18 | 2 | 1 | Kusk and Nyholm, 1992 |
| *Phyllospora comosa* | | N | S | 99 | nw | 7 ± 1 | 15 | | 96 h | NOEC | mortality | < 0.0001 | 4 | 4 | Burridge et al., 1995 |
| *Phyllospora comosa* | | N | S | 99 | nw | 7 ± 1 | 15 | | 96 h | LOEC | mortality | 0.0001 | 4 | 4 | Burridge et al., 1995 |
| *Skeletonema costatum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC10 | photosynthesis (14C assimilation) | 0.93 | 2 | 3 | Kusk and Nyholm, 1992 |
| *Skeletonema costatum* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC10 | photosynthesis (14C assimilation) | 0.19 | 2 | 3 | Kusk and Nyholm, 1992 |
| *Skeletonema costatum* | 3 - 5E3 cells/mL | Y | S | am | rw | | 15 ± 1 | 20 | 72 h | EC10 | growth (density). | 0.54 | 2 | 1 | Kusk and Nyholm, 1992 |
| *Skeletonema costatum* | 1.00E+05 | N | S | 99 | am | 8-9 | 20 | | 96 h | NOEC | growth | <6 | 2 | | Yang et al., 2002 |
| *Thalassiosira pseudonana* | | N | S | | rw | | 15 ± 1 | 20 | 6 h | EC10 | photosynthesis (14C assimilation) | 1.60 | 2 | 3 | Kusk and Nyholm, 1992 |

Notes:

1 Endpoint read from figure. Results based on measured concentrations
2 No effect at lowest test concentration.
3 Endpoint read from figure. Exposure for 6 h (4 h pre-incubation, followed by 2 h incubation with 14C)
4 Too many inconsistencies regarding exact result in text, table and figure

# Appendix 3. Bird and mammal toxicity data

**Table A3.1 Bird and mammal toxicity data for 2,4-dichlorophenol.**

| Species | Species properties | purity | Application route[a] | Exposure time | Criterion | Test endpoint[b] | Effect concentration [mg/kg$_{bw}$/day] | Effect concentration [mg/kg$_{diet}$] | Effect concentration [mg/L] | Ri | Notes | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| rat | male/female | | diet | 90 d | NOAEL | decreased body weight gain | 1500 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| mouse | ICR-strain, male | | diet | 6 mo | NOAEL | body weight gain, food consumption | | >230 | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| mouse | | | diet | 90 d | NOAEL | mortality | | 12000 | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| mouse | CD1-strain; female | 99 | drinking water | 90 d | NOAEL | body weight | >491 | | >2000 | 2 | 1 | EC, 2000: Rhone Poulenc Chimie |
| mouse | CD1-strain; male | 99 | drinking water | 90 d | NOAEL | body weight | >383 | | >2000 | 2 | 1 | EC, 2000: Rhone Poulenc Chimie |
| rat | Sprague-Dawley | | drinking water | 24 mo | NOAEL | carcinogenicity | | | > 300 | 2 | | EC, 2000: Rhone Poulenc Chimie |
| rat | Sprague-Dawley | | drinking water | 24 mo | NOAEL | carcinogenicity | | | > 300 | 3 | 2 | EC, 2000: Rhone Poulenc Chimie |
| rat | Fisher 344; males | >99 | diet | 2 y | NOAEL | body weight | 210 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| rat | Fisher 344; males | >99 | diet | 2 y | NOAEL | food consumption | <210 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| rat | Fisher 344; females | >99 | diet | 2 y | NOAEL | body weight | 120 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| rat | Fisher 344; females | >99 | diet | 2 y | NOAEL | body weight | <120 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| mouse | B6C3F1 strain | >99 | diet | 2 y | NOAEL | body weight, food consumption | | | | 4 | 3 | EC, 2000: Rhone Poulenc Chimie |
| mouse | | | drinking water | 90 d + pregnancy period | NOAEL | fertility and fetal mortality | >500 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| mouse | B6C3F1 females and CD1 males | | drinking water | 90 d | NOAEL | fertility | >500 | | | 2 | | EC, 2000: Rhone Poulenc Chimie |
| rat | Sprague-Dawley | 99 | drinking water | 1 generation | NOAEL | reduced litter size | 2-15 | | 30 | 2 | 4 | EC, 2000: Rhone Poulenc Chimie |

a: Studies with irrelevant application routes (single oral gavage, dermal, intreperitoneal, etc.) not included
b: Studies with irrelevant endpoints (for instance, ChE activity) not included

Notes:
1 similar to OECD Guideline 408; administered in water containing 21% Emulphor; vehicle control performed
2 tested together with ethylnitrosourea
3 NOAEL not dose-related; dose related NOAELs not further specified
4 According to mean water consumptions, dosed ranged from 2 to 15 mg/kg bw/day, for the treatments 3, 30, and 300 mg/L

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National Institute
for Public Health
and the Environment

P.O. Box 1
3720 BA Bilthoven
The Netherlands
www.rivm.com