TC NES SUBGROUP ON IDENTIFICATION OF PBT AND VPVB SUBSTANCES

RESULTS OF THE EVALUATION OF THE PBT/VPVB PROPERTIES OF:

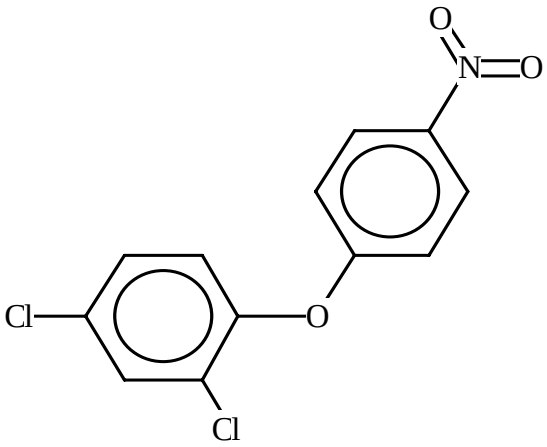
Substance name: Nitrofen

EC number: 217-406-0

CAS number: 1836-75-5

Molecular formula: C12H7Cl2NO3

Structural formula:



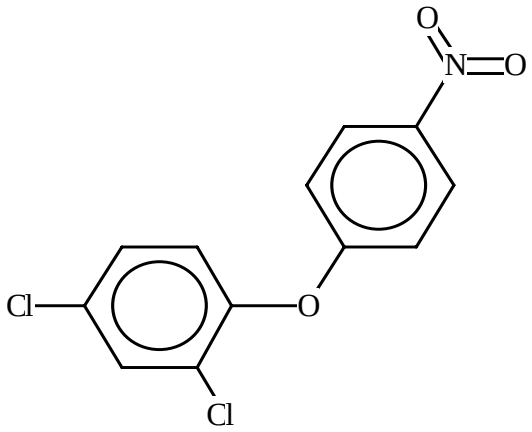
Summary of the evaluation:

Nitrofen is considered to be a PBT substance based on screening data. It may meet the P/vP criteria according to screening data. It fulfils the B criterion. The T criterion is likely to be fulfilled for ecotoxicity based on screening data. The T criterion on human health is met.

JUSTIFICATION

1 IDENTIFICATION OF THE SUBSTANCE AND PHYSICAL AND CHEMICAL PROPERTIES

Name: Nitrofen
EC Number: 217-406-0
CAS Number: 1836-75-5
IUPAC Name:
Molecular Formula: C12H7Cl2NO3
Structural Formula:



Molecular Weight: 284.10
Synonyms: 2',4'-dichloro-4-nitrodiphenly ether; 4-(2,4-dichlorophenoxy)nitrobenzene; niclofen; nitrophen. For a complete list of synonyms and product names, see European Commission (2000)

1.1 Purity/Impurities/Additives

No data available.

1.2 Physico-Chemical properties

Table 1 Summary of physico-chemical properties. For details and references, see European Commission (2000).

REACH ref Annex, §	Property	Value	Comments
V, 5.1	Physical state at 20 C and 101.3 Kpa	solid	
V, 5.2	Melting / freezing point	70-71 ºC	Hoechst AG (1996 and 1994); data not evaluated
V, 5.3	Boiling point	368 ºC (at 1013 hPa)	Hoechst AG (1996 and 1994); data not evaluated
V, 5.5	Vapour pressure	0.00001 hPa (at 40 ºC)	Perkow (1971/1988)
V, 5.7	Water solubility	0.599 mg l^{-1} (at 25 ºC) 0.5 mg l^{-1} (at 20 ºC; pH 7)	WSKOW v1.41 Hoechst AG (1996 and 1994); data not evaluated
V, 5.8	Partition coefficient n-octanol/water (log value)	4.32 4.64 5.18 4.7	KOWWIN v1.67 KOWWIN v1.67 exper. database (Sangster, 1994); data not evaluated) CLOGP Schneider, 2003
VII, 5.19	Dissociation constant		

2 MANUFACTURE AND USES

Two companies have notified the substance under Regulation 93/793/EEC. According to industry, the substance was used in the past as pesticide, but the only present use is the use as intermediate in synthesis of aminofen (CAS 14861-17-7; PBT summary nr. 67) by the producer itself. The marketing of nitrofen has been restricted due to its classification since the year 1988.

3 CLASSIFICATION AND LABELLING

Classification and labelling according to the Annex I of Directive 67/548/EEC:

Classification

Carc. cat 2; R45	May cause cancer
Repr. cat 2; R61	May cause harm to the unborn child
Xn; R22	Harmful if swallowed
N; R50-53	Very toxic to aquatic organisms. May cause long-term adverse effects in the aquatic environment

.

4 ENVIRONMENTAL FATE PROPERTIES

4.1 Degradation (P)

4.1.1 Abiotic degradation

European Commission (2000) lists few test reports on photodegradation tests conducted in laboratory conditions and resulting rapid photodegradation. The test reports were not available to the Rapporteur for evaluation. It must also be noted, that environmentally relevant aquatic exposure occurs in the whole water column and, in the case of nitrofen, especially in sediment and soil. Photodegradation of nitrofen can be expected to be a relevant removal pathway in the environment only in very shallow clear waters and in the first few centimetres layer of the water column. Therefore aquatic photodegradation is not considered to have relevant impact on the overall persistency of nitrofen in the environment.

Indirect photochemical degradation in the atmosphere is considered to be very slow based on the estimated half-life of 14.5 days for the reaction with OH-radicals using AOP v1.91 (24 h day^{-1}; $5*10^5$ OH^- cm^{-3}).

4.1.2 Biotic degradation

A test on ready biodegradability according to Directive 84/449/EEC C.7 (modified MITI I) using domestic sludge resulted in no degradation after 40 days (Hoechst AG, 1984). The study report was not available to the Rapporteur for evaluation.

In another test on biodegradability using non-adapted sludge and a test concentration of 100 mg l^{-1}, a degradation of 40 % was reached in 88 days (Jacobson, et al., 1980). A semi-static aerobic non-standard method was used. In a parallel test of the same author discontinued anaerobic conditions were used and a degradation of 11 % was observed in 88 days.

Hoechst AG (1984) reports of a biodegradation test (HACH-method) with adapted sludge. No degradation was observed in the test during 40 days of duration. The test report was not available to the Rapporteur for evaluation. Birr et al. (1983) in turn report on 33-100 % degradation after 6.5 days in a small scale waste water treatment plant containing adapted sludge.

Kale and Raghu (1989) observed a rapid biodegradation of nitrofen in water and soil using a model ecosystem including black clay soil, rice seedlings, fish, snails and algae at outdoor conditions. Degradation of ^{14}C Nitrofen in an undefined amount of acetone was measured during 120 days using LSC. After 120 days recovery of ^{14}C was only 6%. Loss may have been through volatilization, degradation, mineralization, etc..

Oyamada and Kuwatsuka (1988; described in IUCLID) measured degradation in various soil types at 30 ºC under aerobic, dark conditions. 10-99.8% of the compound had dissipated after 40 days.

Schmidt and Braune (1989; described in IUCLID) measured degradation by soil microorganisms at 21ºC and pH 7.6 in an aqueous medium with addition of acetate. After 28 days, 100% of the compound had dissipated

BIOWIN v4.02 predicts following biodegradation: BIOWIN2 = 0.005, BIOWIN3 = 1.9, BIOWIN6 = 0.001. Hence, the model predicts that the substance is persistent to biotic degradation.

4.1.3 Other information [1]

No data available.

4.1.4 Summary and discussion of persistence

Nitrofen can be considered as a not ready biodegradable substance according to the available standard ready biodegradability (modified MITI) test (Hoechst AG, 1984) and the two biodegradation tests with non-standard methods (Jacobson, et al., 1980). Based on these results, nitrofen is not expected to biodegrade in environmentally relevant conditions. Photodegradation of nitrofen may according to the photodegradation studies occur in very limited parts of the environment, but this pathway is not considered to be relevant for the assessment of persistency of nitrofen. Further testing of biodegradation would be necessary to determine the actual rate of biodegradation in the environmentally relevant conditions.

4.2 Environmental distribution

4.2.1 Adsorption

Data not reviewed for this report.

4.2.2 Volatilisation

Data not reviewed for this report.

4.2.3 Long-range environmental transport

Nitrofen has a significant potential for long-range atmospheric transport due to its very long half-life (> 14 days) in the atmosphere.

4.3 Bioaccumulation (B)

4.3.1 Screening data[2]

Two measured values on logKow are available (4.64 and 4.7; see Table 1).

[1] For example, half life from field studies or monitoring data

[2] For example, log K_{ow} values, predicted BCFs

4.3.2 Measured bioaccumulation data[3]

Lee et al. (1976) studied bioaccumulation of several species in a standardised rice paddy model ecosystem, containing quartz sand, water (pH 4.7), rice seedlings, micoorganisms, plankton, crustaceans, snails, and fish. ^{14}C-nitrofen was added to the system. On the 27th day, musquito larvae were added which were sampled after 96 hours. At day 30, 3 mosquito fish (*Gambusia affinis*) were added to consume the remaining water fleas and mosquitoes, and they were removed after 96 hours at day 33. ^{14}C concentrations in biota and water at day 33 were measured using LSC, bioaccumulation factors were calculated by dividing the total ^{14}C count in biota by the total ^{14}C count in water. For (*Gambusia affinis* (a freshwater fish species) a bioaccumulation factor of 1,546 could be derived. For *Culex pipiens* quinquinfasciatus (a mosquito larvae) a bioaccumulation factor of 3,188 was determined. In a snail species (*Physa* sp.) a bioaccumulation factor of 2,770 was observed. Despite the fact that the exposure concentrations of this study [0.10 mg/L total extractable ^{14}C] were above concentrations, which have caused acute effects in other studies (see chapter 6), the study is considered valid, although phytotoxic effects were observed on the rice seedlings in this study.

Kale and Raghu (1989) used similar rice paddy ecosystem for their bioaccumulation testing (using ^{14}C measurements in water, sediment and fish) but they did observed that only a small part of the applied dose had bioaccumulated in fish algae or plants. However, only a mass balance was reported, showing that 90 % of the applied radioactivity was found in the soil after 10 days and the results are hence not reliable. Total recovery of radioactivity after 120 days was only 6%. Besides that nitrofen in each of the compartments is only expressed as recovery of the applied dose and not as concentration. As a result the study is invalid to assess the bioaccumulation potential of nitrofen.

4.3.3 Other supporting information[4]

No data available.

4.3.4 Summary and discussion of bioaccumulation

No results from standard bioconcentration tests are available. The only reliable study carried out in a rice paddy model ecosystem (Lee et al., 1978) resulted bioaccumulation factors between 1,546 and 2,770 for aquatic animal species. Based on this study, nitrofen is considered to have a high bioaccumulation potential.

5 HUMAN HEALTH HAZARD ASSESSMENT

Nitrofen is included in Annex I to directive 67/548 and classified as Carc. Cat 2, R45 and also as Repro Cat 2, R61, because of developmental toxicity. Whether the developmental toxicity is related to its endocrine disrupting activity is not clear. However, the classification for reproductive toxicity may indicate that the endocrine disruptor status is superfluous. Several studies showing developmental toxicity are listed in European Commission (2000). The studies on laboratory mammals reported do not provide strong indication of endocrine disruption or effects on fertility. However, European Commission (2000) contains test results showing that nitrofen may affect

[3] For example, fish bioconcentration factor

[4] For example, measured concentrations in biota

thyroid hormone homeostasis, possibly secondary to liver enzyme induction. It must be noted, that the study reports were not available to the Rapporteur for evaluation. Based on the classification of nitrofen (R22, R45, R61, R50/53) the T criterion should be regarded as fulfilled.

6 ENVIRONMENTAL HAZARD ASSESSMENT

6.1 Aquatic compartment (including sediment)

6.1.1 Toxicity test results

6.1.1.1 Fish

Acute toxicity

European Commission (2000) lists several short term studies with fish. The LC_{50} in these studies ranges from 0.76 mg l^{-1} to 2.1 mg l^{-1}. The study reports were not available to the Rapporteur for evaluation.

Long-term toxicity

No experimental data are available.

6.1.1.2 Aquatic invertebrates

Acute toxicity

European Commission (2000) lists several short term studies with crustacean, arthropods, molluscs and amphibians. The $L(E)C_{50}$ in these studies ranges from 0.14 mg l^{-1} to 4.9 mg l^{-1}. The study reports were not available to the Rapporteur for evaluation.

Long-term toxicity

No data available.

6.1.1.3 Algae and aquatic plants

European Commission (2000) lists several studies with algae and aquatic plans (*Lemna* sp.). The lowest EC_{50} in these studies is 0.057 mg l^{-1} (biomass) observed for *Chlamydomonas reinhardii* (Fedtke, 1981). The study reports were not available to the Rapporteur for evaluation.

6.1.2 Sediment organisms

No data available.

6.1.3 Other aquatic organisms

Data not reviewed for this report.

6.2 Terrestrial compartment

Data not reviewed for this report.

6.3 Atmospheric compartment

No data available.

7 PBT AND vPvB

7.1 PBT, vPvB assessment

Persistence: nitrofen may meet the P/vP criteria based on screening data. The reliable studies on biodegradation (one standard modified MITI –test and two non-standard tests) indicate that the substance is not readily biodegradable. Further testing would be necessary to determine the actual rate of degradation. Such testing is, however, not required, because the substance has a very limited use as an on-site intermediate at one site in Europe.

Bioaccumulation: the substance meets the B criterion. One reliable study is available for nitrofen, In this study, a standardised rice paddy ecosystem was employed and bioaccumulation factors from 1,546 to 3,188 were derived for aquatic animal species.

Toxicity: T criterion is fulfilled for human health due to the classification as carcinogenic and toxic to reproduction in category 2. The substance may also meet the T criterion based on screening data for ecotoxicity. Short-term tests with fish, invertebrates, algae and aquatic plants are available for nitrofen. The lowest result from these studies was found to be EC_{50} of 0.057 mg l^{-1} for *Chlamydomonas reinhardii* (algae). Long-term testing would be necessary to complete the assessment of ecotoxicity. Such testing is, however, not required, because the substance has a very limited use as an on-site intermediate at one site in Europe and because of the assignment of T based on human-toxicological data.

Other: nitrofen has based on its very slow estimated atmospheric degradation a high potential for atmospheric long-range transport.

Summary: nitrofen may meet the P/vP criteria according to screening data. It fulfils the B criterion. The T criterion may be fulfilled for ecotoxicity based on screening data. The T criterion on human health is met. It is concluded, that nitrofen is considered to be a PBT substance based on screening data.

INFORMATION ON USE AND EXPOSURE

Further information not reviewed for this report.

OTHER INFORMATION

The information and references used in this report were taken from the following source:

European Commission, 2000. IUCLID Dataset, nitrofen, CAS 1836-75-5, 18.2.2000.

Schneider, S. 2003. Determination of the partition coefficient [1-Octanol/Water] of nitrofen in accordance with EEC guideline A.8. Report No. B 011/2003. AllessaChemie GmbH, Gemany.