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on Existing Chemicals of
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1,4-Dichloro-2-nitrobenzene

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on Existing Chemicals of Environmental Relevance (BUA)

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Foreword

The German Chemicals Act (Chemikaliengesetz - ChemG) of 1980 stipulates that certain existing chemicals must be reported to the competent authority, if they exhibit properties which indicate that they may be hazardous, either alone or in combination with other substances.

In the summer of 1982, an Advisory Committee on Existing Chemicals of Environmental Relevance (BUA) was set up by the German Chemical Society (Gesellschaft Deutscher Chemiker - GDCh). It brings together representatives from the scientific community, the chemical industry and the governmental authorities. This Advisory Committee is responsible for elaborating appropriate solutions for substances of relevance for health and the environment on the basis of voluntary measures. It selects and examines existing chemicals from the aforementioned angles. The testing and evaluation are based on scientific criteria alone.

It was, therefore, necessary to develop priority setting procedures. In a first phase reports were only prepared for priority chemicals. Within the framework of a first priority setting procedure, chemicals were compiled from several priority lists and 135 chemicals were selected for detailed substance reports.

In a second priority setting procedure the survey of the German Chemical Industry Association (VCI) on all substances with a production volume of more than 10 tons per year was used as a starting list. Since this survey covered 4,600 chemicals, BUA decided to process the corresponding list in several stages. The first stage included approx. 1,050 substances with a production volume of more than 1,000 tons per year.

Detailed reports are drawn up on chemicals suspected of having a hazard potential and abridged reports on those presenting only a minor hazard potential, according to the current state of knowledge.

The detailed BUA reports take in both the published literature and data from industry. If data for the evaluation of the chemicals are not available, additional studies are recommended and the results are published as updates to the reports. The reports serve as a basis for the instigation of administrative measures, when there are indications of risks to health or the environment.

Tübingen, May 1993

Ernst Bayer
Chairman of the Advisory Committee
on Existing Chemicals
of Environmental Relevance

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BUA Report on 1,4-Dichloro-2-nitrobenzene

Summary and conclusions

Ecological aspects

Occurrence and distribution in the compartments

1,4-Dichloro-2-nitrobenzene is an intermediate in the manufacture of dyes and pigments, of an antimicrobial agent and UV absorbers used for the stabilization of polyolefins. The volume produced in the Federal Republic of Germany in 1990 amounted to about 2400 tonnes; 100 tonnes were exported. There is no information available on importation.

Discharge into the environment from industrial production and use takes place both via waste water (> 90 %) and exhaust air (< 10 %). In 1990 about 560 kg entered the hydrosphere arid less than 40 kg were emitted into the atmosphere. A discharge, which cannot be quantified exactly but can be estimated at less than 350 kg, takes place via waste water during processing of the first generation derivatives, which contain residues of 1,4-dichloro-2-nitrobenzene.

Due to its physico-chemical properties, slow transfer of 1,4-dichloro-2-nitrobenzene from water to the atmosphere is possible.

No information is available on its occurrence in the atmosphere or in soil. Maximum concentrations of dichloronitrobenzene (non-specific isomeric mixture) in the Rhine River in the Netherlands amounted to 3 µg/l in 1978 and 0.2 µg/l in 1983. 1,4-Dichloro-2-nitrobenzene was detected (concentration not stated) in Main River fish in 1982.

Degradability

Tests for ready biodegradability using various inocula at a wide range o concentrations of the compound gave no evidence of such degradation in the aquatic environment. Degradation by hydrolysis under environmental conditions is unlikely to occur. Nonadapted soil fungi are able to biotransform 1,4-dichloro-2-nitrobenzene to 2,5-dichloroaniline.

In the atmosphere, slow photodegradation takes place by reaction with photochemically produced OH radicals. The half-life is calculated to be 315 days.

In view of the n-octanol/water partition coefficient (log P_{OW} = 2.90 to 3.08) bioaccumulation is likely to occur. In fish (on a wet-weight basis) bioconcentration factors of 113 ± 23 (log BCF = 2.05 ± 0.1), and in another study, of 67 ± 6 (log BCF = 1.83 ± 0.04) have been found experimentally. Following oral intake the biological half-life in fish is less than 3 days.

There are indications that 1,4-dichloro-2-nitrobenzene is moderately adsorbed on soils.

Ecotoxic effects

The toxicity thresholds for inhibition of the oxygen consumption of aerobic bacteria and the gas production of anaerobic bacteria are 500 mg/l and > 80 mg/l respectively. For soil fungi, the EC_{50} values (fungistatic activity) amount to 9.6 mg/l.

Following the exposure of algae for 96 hours to 2.1 mg/l, 50 percent inhibition of growth has been observed.

1,4-Dichloro-2-nitrobenzene at concentrations 42.2 mg/l is phytotoxic (6-d EC_{50}; reduction in fresh weight) to higher plants (seedlings of cucumber and bean).

For water fleas (*Daphnia magna*), 48-hr EC_{50} value (immobilization) amounts to 11 mg/l and the 21-d EC_{50} value to 3.8 mg/l. In a semi-static 21-day reproduction test the lowest concentrations at which the population growth rate and mean length of the animals significantly ($p < 0.01$) decreased were 1.8 mg/l and 3.2 mg/l respectively.

For fish, the value of acute toxicity (96-hr LC_{50}) in an open system under semi-static conditions is 6.3 mg and the corresponding value (48-hr LC_{50}) in a closed system under static conditions is 4.5 mg/l. The lowest 96-hr LC_0 was 3.15 mg/l. In the prolonged fish toxicity test under semi-static conditions a 14- d LC_{50} value of 4.9 mg/l has been found.

Toxicological Aspects

1,4-Dichloro-2-nitrobenzene is readily absorbed after oral administration or dermal application. The substance is metabolized to a number of products. Following oral application chiefly 2,5-dichloroaniline, the mercapturic acid derivative N-acetyl-S-(4-chloro-2-nitrophenyl)-L-cysteine as well as glucuronic and sulfuric acid conjugates of 4-amino-2,5-dichlorophenol were identified in urine. No information is available on toxicokinetics.

Following oral administration to rats the value for the acute toxicity (LD_{50}) was 2503 mg/kg body weight; another study yielded a LD_{50} value of 1210 mg/kg body weight. Disturbance of equilibrium and palmospasms have been observed as symptoms of acute intoxication. 1,4-Dichloro-2--nitrobenzene given orally to cats causes methemoglobin formation (a maximum of 9.1 % was observed after 24 hours at 250 mg/kg body weight). No effect has been observed following 7-hour inhalation exposure of rats to air saturated with 1,4-dichloro-2-nitrobenzene (47.6 mg/m³ (nominal concentration) and 2 to 39 mg/m³ (measured concentration)).

The repeated oral administration of subacute doses (10, 50 and 250 mg/kg body weight and day) to rats by gavage for 28 days causes increased liver weights and bilirubin values. In male animals at 250 mg/kg body weight and day decrease in the weight of testes, lack of mature sperma and signs of germimal epithel lesions, and in female animals from 50 mg/kg body weight and day onward ulcera of the forestomach have been observed. The no-observed-effect level (NOEL) was 10 mg/kg body weight and day.

The repeated dermal application at doses of 100 to 400 mg/kg body weight on rabbits causes dose-dependent changes in the blood picture (diminution of erythrocytes and hemoglobin value) and lethal intoxication. Histological investigations revealed increased erythropoiesis, hyperaemia and deposits of iron in the Spleen.

1,4-Dichloro-2-nitrobenzene is mildly irritating to eyes and non-irritating to skin. When tested in animals the product has been proved to be a non-sensitizer; however, there are indications of skin sensitization in man.

No information is available on chronic toxicity and cancerogenicity.

No studies on reproductive toxicology are available, apart from azoospermia and the germinal epithel lesions observed in the 28-day oral toxicity study.

Investigation of genotoxic effect indicated a mutagenic effect in the Ames test. No mutagenic effects have been observed in mammalian cell cultures (V 79 cells) in the HGPRT test with and without metabolic activation and in the chromosome aberration test without metabolic activation. In the presence of a metabolic activation System no clear-cut dose relation of clastogenic effects has been observed.

Recommendations

Ecology

A test for inherent biodegradability and studies on biodegradation under anaerobic conditions are recommended to enable final evaluation of the environmental relevance.

Toxicology

Although no studies on chronic toxicity and cancerogenicity are available, the performance of the corresponding studies is not regarded as having priority in view of the exposure situation. As to reproductive toxicology, a study on teratogenicity is planned as part of the OECD programme on existing chemicals.