TOXICOLOGICAL PROFILE FOR 1,3,5-TRINITROBENZENE

Criteria and Standards Division
Office of Drinking Water
U.S. Environmental Protection Agency
Washington, DC 20460

June, 1989

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A. GENERAL

1. CAS Number: 99-35-4

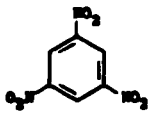
2. RTECS Number: DC 3850000

3. General Name/Synonyms: Benzite
   S-Trinitrobenzene
   TNB
   Trinitrobenzene

4. Molecular Formula: $C_6H_3N_3O_6$

5. Molecular Weight: 213.11

6. Structure:



B. PHYSICAL AND CHEMICAL PROPERTIES

1. State:	Yellow crystals; highly sensitive to heat and shock	Windholz et al. (1983) Sax and Lewis (1987)
2. Vapor Pressure:	No information was found.	
3. Melting Point:	122.5°C	Windholz et al. (1986)
4. Boiling Point:	315°C at 760 mmHg	Weast (1986)
5. Specific Gravity:	1.76 at 20°C/4°C	Windholz et al. (1983)

6. Solubility (g/100 g solvent): water 0.035; benzene 6.2; methanol 4.9; alchohol 1.9; ether 1.5 — Windholz et al. (1983)

7. Log K_{ow}: 1.36 — Liu et al. (1983)

8. UV Absorption: No information was found.

C. PHYSICAL/CHEMICAL EQUILIBRIUM FACTORS

1. Bioconcentration Factors (BCF): The steady-state BCF for 1,3,5-trinitrobenzene (TNB) was calculated as 6.36 (Log P = 1.36) by Liu et al. (1983). The authors also reported that in static tests, the 96-hour LC_{50} value for immature fathead minnows was 1.1 mg/L (95% confidence limits 1.0-1.2 mg/L).

2. K_{wa}: No information was found.

3. K_{oc}: No information was found.

D. ENVIRONMENTAL FATE

1. Photolysis: Photoirradiation of synthetic condensate wastewater containing 0.45 mg TNB/L resulted in almost a twofold increase in TNB concentration (Liu et al., 1983). This increase was thought to be due to the formation of TNB as a phototransformation product from other compounds or as a reaction product.

2. Leaching: No information was found.

3. Route of Water Contamination: No information was found.

4. Hydrolysis: No information was found.

5. Plant Uptake: No information was found.

6. Microbial Degradation: Mitchell et al. (1982) observed incomplete (i.e., 6 to 24%) and unsustained microbial degradation of 10 or 20 μg TNB/mL in Tennessee River water over a 19-day period. In contrast, the presence of 100 ppm yeast extract plus 500 ppm glucose caused nearly complete degradation of 16 to 53 μg TNB/mL within 6 days. On the basis of these data, Mitchell et al. (1982) calculated a pseudo first-order rate constant of 8×10^{-4} hr^{-1} and a second-order rate constant (for TNB disappearance) of 1.7×10^{-10} mL $cell^{-1}$ $hour^{-1}$. Reduction of the nitro groups was evident following incubation of river water and microorganisms in nutrient-rich culture media. Approximately 11 to 43% of pure TNB added to the yeast-enriched culture was converted to 3,5-dinitrobenzene (DNB) within 40 hours; percent conversion was, in general, inversely related to initial TNB concentration. Addition of TNB-spiked river water to the media resulted in a 16 to 48% conversion of TNB to DNB.

7. Persistence in Soil/Water: No information was found.

8. Byproducts: No information was found.

9. Vaporization: No information was found.

E. ACUTE TOXICITY IN MAMMALS

Animal/strain/sex	Route	LD_{50} (mg/kg)	Reference
Mouse/-[a]/-	Oral	572	RTECS (1987)
Rat/-/-	Oral	450	Korolev et al. (1977)
Guinea pig/-/-	Oral	730	Korolev et al. (1977)

[a]Data not provided.

F. SKIN AND EYE IRRITATION AND SENSITIZATION IN MAMMALS

No information was found.

G. SUBCHRONIC TOXICITY IN MAMMALS

No information was found.

H. REPRODUCTIVE EFFECTS AND TERATOGENICITY IN MAMMALS

No information was found.

I. MUTAGENICITY/GENOTOXICITY

Data are presented in tabular form on page 7.

J. CHRONIC/CARCINOGENICITY STUDIES IN MAMMALS

In a study designed to examine the biological role of charge transfer complexes of aromatic hydrocarbons in carcinogenesis, a single subcutaneous dose of TNB (in 0.4 mL paraffin oil at a level equivalent to 1 mg 3-methylcholanthrene/animal) produced no tumors in a group of 20 male BALB/c mice after a 4-month observation period (Gorski, 1969). In contrast, 100% of the 30 mice that received a single subcutaneous administration of 1 mg 3-methylcholanthrene (MCH) developed tumors during the same time interval (carcinogenic index rating, 85). Of 32 mice given a complex of MCH and TNB, 25 (80%) developed tumors (carcinogenic index, 56). TNB appeared to promote tumor development when complexed with the primary oxidation product of MCH (index rating of 104 compared with an index of 43 for mice given only the primary oxidation product of MCH). Papillomas and subcutaneous sarcomas were found at the site of compound administration in all but the TNB-only treated animals.

K. PHARMACOKINETICS IN MAMMALS

Male Wistar rats injected intraperitoneally with 100 μmol TNB (in propylene glycol)/kg body weight (21.3 mg/kg bw) excreted approximately 3.24 to 3.42 mg p-aminophenol equivalents/kg bw in the urine 5 hours after dosing. Since these levels were only twice the baseline levels excreted by vehicle-only treated animals, it was concluded that absorption and metabolism of TNB is slow. Additional details on TNB disposition were not included in the study (Watanabe et al., 1976).

L. HUMAN HEALTH EFFECTS

Gosselin et al. (1984) rated TNB as an extremely toxic compound with a probable oral lethal dose of 5 to 50 mg/kg in humans. No specific toxicity data were located, but the toxic actions are similar to those of dinitrobenzene.

M. EXISTING STANDARDS/CRITERIA

No information was found.

I. MUTAGENICITY/GENOTOXICITY

Test	Strain	Activation	Dose/concentration	Effects	Reference
Ames (reverse mutation)	Salmonella typhimurium TA 1537, TA 1538 TA 98, TA 100, TA 1535	±	0.1, 0.3, 1.0, 3.3, 10.0, 33.3, or 100.0 µg/plate	Positive mutagenic activity; S9 reduced the magnitude of the response. Lowest effective exposure level in the most sensitive strain, TA 98, was 1.0 µg/plate in the absence of S9 mix.	McGregor et al. (1980)
Mitotic recombinogenic tests	Saccharomyces cerevisiae D5	±	2.0 to 60 mg/mL (2 mL solution/plate)	No toxicity at any level up to 60 mg/mL in the absence of S9; toxicity was observed with S9, but no evidence for recombinogenic activity or any other gene toxicity was observed.	McGregor et al. (1980)
Escherichia coli/ DNA repair	W3110/polA+ p3478/polA-	±	100 µg, 500 µg, 1 mg, 5 mg, or 10 mg/plate	Toxic in both the presence and absence of S9 at all exposure levels; precipitates formed at 1 mg and higher. No differential toxicity existed between polA+ and polA-.	McGregor et al. (1980)

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