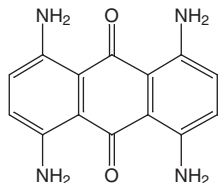


Disperse Blue 1

CAS No. 2475-45-8

Reasonably anticipated to be a human carcinogen
First Listed in the *Eighth Report on Carcinogens* (1998)



Carcinogenicity

Disperse Blue 1 is *reasonably anticipated to be a human carcinogen* based on evidence of malignant tumor formation in experimental animals to an unusual degree with regard to incidence, site, and type of tumor (NTP 1986), and because it is an anthraquinone and therefore, structurally related to other substances listed in a previous Annual Report on Carcinogens as either *known to be human carcinogens* or *reasonably anticipated to be human carcinogens* (NTP 1994).

Disperse Blue 1 was a carcinogen in both sexes of F344/N rats; the findings in B6C3F₁ mice were equivocal. Clear evidence of carcinogenicity in the urinary bladder of F344/N rats was evidenced by increased incidences of transitional cell neoplasms, leiomyomas or leiomyosarcomas, and squamous cell neoplasms (NTP 1986). Transitional cell and squamous cell tumors of the urinary bladder of male F344 rats receiving Disperse Blue 1 were also noted in a study reported by Burnett and Squire (1986).

Additional Information Relevant to Carcinogenicity

The neoplasms in the urinary bladder of rats exposed to Disperse Blue 1 were associated with dose-dependent incidences of calculi that were thought to induce chronic inflammation and cell proliferation. Calculi and resulting inflammatory and proliferative lesions also occurred in the urinary bladders of both sexes of B6C3F₁ mice in the absence of significantly increased incidences of neoplastic lesions (NTP 1986).

Data on the genotoxicity of Disperse Blue 1 indicate that it induced a weak positive response in *Salmonella typhimurium* (Brown and Brown 1976, cited by IARC 1990), DNA damage (sister chromatid exchanges) and chromosomal aberrations in Chinese hamster ovary cells (Anderson *et al.* 1990), *tk* gene mutations in mouse lymphoma L5178Y cells (Myhr *et al.* 1990; cited by CIRB 1995), and morphological transformation in Balb/c 3T3 mouse cells (Matthews *et al.* 1993). NTP studies of structurally related compounds, nitro- and amino-anthraquinones, have demonstrated that each compound tested has some activity as a mutagen. Most compounds of this class that have been the subjects of two-year studies have also been found to be carcinogenic in one or more species. Sites of tumor development include the urinary bladder in rats and the liver of both rats and mice.

Data are available to suggest that transitional cell and squamous cell tumors induced by Disperse Blue 1 in the urinary bladder would not occur in humans exposed to amounts of Disperse Blue 1 insufficient to also cause bladder calculi. However, compelling data that demonstrate a causal relationship between urinary bladder calculi and leiomyomas and leiomyosarcomas have not been sufficiently developed to contradict other evidence that Disperse Blue 1 is *reasonably anticipated to be a human carcinogen*.

Properties

Disperse Blue 1, an anthraquinone dye, is a blue-black microcrystalline powder containing approximately 50% 1,4,5,8-tetraaminoanthraquinone, 30% other compounds structurally related

to 1,4,5,8-tetraaminoanthraquinone, and 20% water. It is soluble in acetone, ethanol, and Cellosolve; slightly soluble in benzene and linseed oil; and slightly soluble in water (IARC 1990).

Use

Disperse Blue 1, an anthraquinone dye, is not known to occur as a natural product, but it is produced and used as a mixture of chemicals. It is an aminoanthraquinone-based dyestuff used in hair color formulations and in coloring fabrics and plastics. Commercial preparations of Disperse Blue 1 contain approximately equal amounts of dyestuff and lignosulfonate dispersants. Over 3 million people in the United States use hair color preparations containing Disperse Blue 1 in semipermanent hair color formulations at concentrations of less than 1%. Disperse Blue 1 has been used as a fabric dye for nylon, cellulose acetate and triacetate, polyester, and acrylate fibers. It has also been used for surface dyeing of thermoplastics and as a solvent dye in cellulose acetate plastics. Disperse Blue 1 is also used to dye fur, sheepskins, acetate, nylon, and other synthetic fibers (NTP 1986, IARC 1990, HSDB 2001).

Production

One manufacturer of Disperse Blue 1 was identified in 2001 (HSDB 2001). The U.S. International Trade Commission (USITC) listed one manufacturer of the chemical for 1993 and 1994 (USITC 1994, 1995). For all previous years, the total production volume of all Disperse Blue dyes was unreported (USITC 1984-1991, 1993). The last reported value was over 350,500 lb in 1972. After 1972, separate figures were no longer disclosed (IARC 1990). The United States imported approximately 7,700 lb of Disperse Blue 1 in 1980, 8,800 lb in 1981, 8,085 lb in 1982, and 13,756 lb in 1983 (USITC 1980-1983).

Exposure

The primary routes of potential human exposure to Disperse Blue 1 are inhalation and dermal contact. Since Disperse Blue 1 is used in hair dyes, potential exposure by these routes exists for personnel producing and applying such products (IARC 1990), as well as for those subjected to their administration. In the mid 1980s, it was reported that over 3 million people in the United States used semipermanent hair color preparations containing Disperse Blue 1 at concentrations of less than 1% (NTP 1986). The National Occupational Hazard Survey, conducted by NIOSH from 1972 to 1974, estimated that 482 workers were potentially exposed to Disperse Blue 1 in the workplace (NIOSH 1976). The National Occupational Exposure Survey (1981-1983) indicated that 43,522 workers, including 32,059 women, were potentially exposed to Disperse Blue 1 (NIOSH 1990).

Regulations and Guidelines

No specific regulations or guidelines relevant to reduction of exposure to Disperse Blue 1 were identified.

REFERENCES

- Anderson, B. E., E. Zeiger, M. D. Shelby, M. A. Resnick, D. K. Gulati, J. L. Ivett and K. S. Loveday. 1990. Chromosome aberration and sister chromatid exchange test results with 42 chemicals. *Environ Mol Mutagen* 16 Suppl 18: 55-137.
- Brown, J. P. and R. J. Brown. 1976. Mutagenesis by 9,10-anthraquinone derivatives and related compounds in *Salmonella typhimurium*. *Mutat Res* 40(3): 203-24.
- Burnett, C. M. and R. A. Squire. 1986. The effect of dietary administration of Disperse Blue 1 on the urinary system of the Fischer 344 rat. *Food Chem Toxicol* 24(4): 269-76.
- CIRB. 1995. Final report on the safety assessment of Disperse Blue 1. *J Am Coll Toxicol* 14(6): 431-451.
- HSDB. 2001. Hazardous Substances Data Base. National Library of Medicine. <http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>.
- IARC. 1990. Some Flame Retardants and Textile Chemicals and Exposures in the Textile Manufacturing Industry. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans, vol. 48. Lyon, France: International Agency for Research on Cancer. 345 pp.
- Matthews, E. J., J. W. Spalding and R. W. Tennant. 1993. Transformation of BALB/c-3T3 cells: V. Transformation responses of 168 chemicals compared with mutagenicity in *Salmonella* and carcinogenicity in rodent bioassays. *Environ Health Perspect* 101 Suppl 2: 347-482.
- Myhr, B., D. McGregor, L. Bowers, C. Riach, A. G. Brown, I. Edwards, D. McBride, R. Martin and W. J. Caspary. 1990. L5178Y mouse lymphoma cell mutation assay results with 41 compounds. *Environ Mol Mutagen* 16 Suppl 18: 138-67.

- NIOSH. 1976. National Occupational Hazard Survey (1972-74). Cincinnati, OH: Department of Health, Education and Welfare.
- NIOSH. 1990. National Occupational Exposure Survey (1981-83). Unpublished provisional data as of 7/1/90. Cincinnati, OH: U. S. Department of Health and Human Services.
- NTP. 1986. Toxicology and Carcinogenesis Studies of C.I. Disperse Blue 1 (CAS no. 2475-45-8) in F344/N Rats and B6C31F Mice (Feed Studies). Technical Report Series No 299. NIH Publication No. 86-2555. Research Triangle Park, NC and Bethesda, MD: National Toxicology Program. 241 pp.
- NTP. 1994. Report on Carcinogens, 7th ed. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program.
- USITC. 1980. Imports of Benzenoid Chemicals and Products, 1979. USITC Publication No 1053. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1981. Imports of Benzenoid Chemicals and Products, 1980. USITC Publication No 1163. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1982. Imports of Benzenoid Chemicals and Products, 1981. USITC Publication No 1272. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1983. Imports of Benzenoid Chemicals and Products, 1982. USITC Publication No 1401. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1984. Synthetic Organic Chemicals, United States Production and Sales, 1983. USITC Publication No 1588. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1985. Synthetic Organic Chemicals, United States Production and Sales, 1984. USITC Publication No 1745. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1986. Synthetic Organic Chemicals, United States Production and Sales, 1985. USITC Publication No 1892. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1987. Synthetic Organic Chemicals, United States Production and Sales, 1986. USITC Publication No 2009. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1988. Synthetic Organic Chemicals, United States Production and Sales, 1987. USITC Publication No 2118. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1989. Synthetic Organic Chemicals, United States Production and Sales, 1988. USITC Publication No 2219. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1990. Synthetic Organic Chemicals, United States Production and Sales, 1989. USITC Publication No 2338. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1991. Synthetic Organic Chemicals, United States Production and Sales, 1990. USITC Publication No 2470. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1993. Synthetic Organic Chemicals, United States Production and Sales, 1991. USITC Publication No 2607. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1994. Synthetic Organic Chemicals, United States Production and Sales, 1992. USITC Publication No 2720. Washington, D.C.: U.S. Government Printing Office.
- USITC. 1995. Synthetic Organic Chemicals, United States Production and Sales, 1994. USITC Publication No 2933. Washington, D.C.: U.S. Government Printing Office.
-