Benzo[a]pyrene

Safety Data Sheet

Division of Occupational Health and Safety
National Institutes of Health

WARNING:

This compound is absorbed through the skin and respiratory and intestinal tracts. It is carcinogenic and may irritate tissues and induce sensitivity. Avoid formation and breathing of dusts.

Laboratory operations should be conducted in a fume hood, glove box, or ventilated cabinet.

Avoid skin contact: if exposed, wash with soap and water. Avoid washing with solvents and exposure to UV light.

For eye exposure, irrigate immediately with large amounts of water. For ingestion, induce vomiting. For inhalation, remove victim promptly to clean air. Administer rescue breathing if necessary. Refer to physician.

In case of laboratory spill, wear protective clothing during cleanup. Avoid skin contact or breathing of dust. Use organic solvent (not alcohol) to dissolve compound. Wash down area with soap and water. Check for fluorescence of residues with UV light. Dispose of waste solutions and materials by incineration.

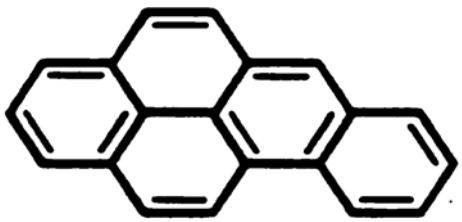
A. Background

Benzo[a]pyrene (BP) is well established as a highly potent carcinogen. BP is a widespread environmental contaminant. It has no known commercial or industrial use and is employed solely in carcinogenesis research. It is destroyed through photooxidation in the atmosphere and is believed to be degraded slowly by bacteria in the soil.

B. Chemical and Physical Data

1. Chemical Abstract No.: 50-32-8
2. Synonyms: B(a)P; Benzpyrene; BP; 1,2-Benzopyrene (obsolete); 3,4-BP; 3,4-Benzpyrene; 3,4-Benzopyrene; 3,4-Benzypyrene
3. Molecular formula, weight and chemical structure:

C_2OH_{12} 252.32



4. Density: 1 .351 g/cm^3.
5. Absorption spectroscopy: UV (Sadtler, 1961; Friedel and Orchin, 1951; Van Duuren, 1958); UV fluorescence (Van Duuren, 1958; Reske and Stauff, 1963); IR (Pouchert, 1971; Grasselli and Ritchey, 1975); MS (Stromberg and Widmark, 1970); NMR (Sadtler, 1961; Bartle *et al.*, 1969; Haigh *et al.*, 1970).
6. Vapor pressure: 5.49 x 10-9 mm Hg at 25°C (Radding *et al.*, 1976). Sublimable.
7. Solubility: Soluble in benzene, chloroform, and tetrahydrofuran; moderately soluble in acetone; sparingly soluble in alcohol. Solubility in water, 0.012 mg/liter.
8. Description, appearance: Pale yellow needles or plates.
9. Boiling point: 475° C.
   Melting point: 179-179-3° C.
10. Stability: Stable in dark at ambient temperature. Solutions undergo photooxidation in air and light.
11. Chemical reactivity: Not spontaneously reactive, but enters into numerous types of reactions with organic reagents.
12. Flash point: Does not apply.
13. Autoignition temperature: No data.
14. Flammable limits: Does not apply.

Fire, Explosion, and Reactivity Hazard Data

1. BP does not require special fire-fighting procedures or equipment. Because of the electrostatic nature of dry BP, fire fighters should wear full-face masks.
2. BP does not present unusual fire and explosion hazards.
3. BP is unstable in presence of light and is more unstable when UV radiation is present.
4. Incompatibilities: No data.
5. BP is not known to produce hazardous decomposition products.
6. BP is nonvolatile and does not require nonspark equipment. When handled in flammable solvents such as benzene, the precautions required for such solvents will apply. In powdered form, BP is electrostatic, and when used in this form, it requires the use of antistatic devices.

D. Operational Procedures

The NIH Guidelines for the Laboratory Use of Chemical Carcinogens describe operational practices to be followed when potentially carcinogenic chemicals are used in NIH laboratories. The Guidelines should be consulted to identify the proper use conditions required and specific controls to be implemented during normal and complex operations or manipulations involving BP.

1. Chemical inactivation: No validated method reported.
2. Decontamination: Turn off equipment that could be affected by BP or the materials used for cleanup. If more than 1 g has been spilled or if there is any uncertainty regarding the procedures to be followed for decontamination, call the NIH Fire Department (dial 911) for assistance. Wash surfaces with copious quantities of soap and water. Glassware should be rinsed (in a hood) with an organic solvent (not alcohol), followed by soap and water. Animal cages should be washed with soap and water.

3. Disposal: No waste streams containing BP shall be disposed of in sinks or general refuse. Surplus BP or chemical waste streams contaminated with BP shall be handled as hazardous chemical waste and disposed of in accordance with the NIH chemical waste disposal system.

   Nonchemical waste (*e.g.*, animal carcasses and bedding) containing BP shall be handled and packaged for incineration in accordance with the NIH medical-pathological waste disposal system. Potentially infectious waste (*e.g.*, tissue cultures) containing BP shall be disinfected by heat using a standard autoclave treatment and packaged for incineration, as above.

   Burnable waste (*e.g.*, absorbent bench top liners) minimally contaminated with BP shall be handled as potentially infectious waste and packaged for incineration, as above. Absorbent materials (*e.g.*, associated with spill cleanup) grossly contaminated shall be handled in accordance with the chemical waste disposal system. Radioactive waste containing BP shall be handled in accordance with the NIH radioactive waste disposal system.

4. Storage: Store solid BP and its solutions in dark-colored, tightly closed containers, preferably under refrigeration.

E. Monitoring and Measurement Procedures Including Direct Field Measurements and Sampling for Subsequent Laboratory Analysis (Jones and Freudenthal, 1978)

1. Sampling: Two methods are recommended: using an adsorption sampler in which sampler in which cooled air is passed through Tenex and using high-volume filtration through fiberglass filter traps.

2. Separation and analysis: Several methods are available and after various degrees of sensitivity. For separation, TLC, HPLC, and GC are useful. TLC is the least efficient of these three methods. HPLC and GC are highly efficient. The most useful and sensitive method for separation and analysis of BP is GC-MS. This method allows for accurate identification in the nanogram to picogram level; it is still desirable to confirm the identification by other analytical methods. UV spectroscopy is useful but is limited because of possible similarity in spectra with a related compound. Fluorescence spectroscopy gives both excitation and emission spectra and its sensitivity level is in the nanogram range. It is more sensitive than UV by a factor of 102 or 103 or greater. Other methods are phosphorescence, NMR, and IR spectroscopy.

F. Biological Effects (Animal and Human)

1. Absorption: BP is readily absorbed through the skin and by intravenous and intraperitoneal injection, ingestion, and inhalation (IARC, 1973).

2. Distribution: Orally or parenterally administered BP accumulates quickly in almost all tissues. Among major organs involved are liver, intestine, skin, respiratory system, kidney, spleen, and bladder. BP is also transmitted across the placenta of pregnant rodents.

3. Metabolism and excretion: BP is metabolized by liver microsomes and liver and lung homogenates, through the action of aryl hydrocarbon hydroxylases (AHH), to a variety of epoxides, diols, phenols, and quinones. Recent evidence indicates that the diastereomeric 7,8-diol-9,10-epoxides of BP are the ultimate carcinogenic metabolites (Koreeda *et al.*, 1978), which bind to tissue DNA, RNA (preferably at the 2-amino group of guanine), and protein. Phenols and diols are conjugated to form glucuronides or sulfates, and epoxides are conjugated with reduced glutathione; these metabolites are excreted in the urine.

4. Toxic effects: The reported acute LD50 of BP is 50 mg/kg (rat, subcutaneous). In general, the toxicity of BP, and of similar polycyclic hydrocarbons, is regarded as low in animals and man (Boyland *et al.*, 1965; Heidelberger, 1975). There is no specific target organ but rather a general toxic and carcinogenic effect on epithelial cells.

5. Carcinogenic effects: BP is carcinogenic in experimental animals. It induces pancreatic ductal adenomas and adenocarcinomas in mice (intraperitoneal), carcinomas of the stomach in hamsters (oral), respiratory tract carcinomas in several species (intratracheal), as well as other carcinomas on topical application.
6. Mutagenic and teratogenic effects: BP is mutagenic in bacteria in the presence of activating systems. Several metabolites are direct mutagens in bacteria and in mammalian and human cells. Teratogenic effects have been reported on parenteral administration to pregnant mice.

G. Emergency Treatment

1. Skin and eye exposure: For skin exposure, remove contaminated clothing and wash skin with soap and water. Skin should not be rinsed with organic solvents or scanned with UV light. For eye exposure, irrigate immediately with copious quantities of running water for at least 15 minutes.
2. Ingestion: Drink plenty of water. Induce vomiting.
3. Inhalation: Remove victim promptly to clean air. Administer rescue breathing if necessary.
4. Refer to physician.

H. References

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