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Case Studies

PCBs/Ballast Burnout in Schools

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Editor's Note: The case studies approach has long been a staple of occupational and environmental hygiene education and practice. Case studies allow us access to approaches that have been attempted by others. As such, they may or may not represent every state-of-the-art, but they do tell us more about the actual state of practice.

Every case study must have an objective, and each invariably includes observations. From these observations, an evaluation may emerge. Most case studies include recommendations. When recommendations are made, it should be remembered that they are made at a single point in time and are likely to apply at that time but may become less applicable as more effective methodologies emerge.

We are very pleased to add this column and believe it will contribute tremendously to the "applied" nature of our journal.

Introduction

While the hazards from exposure to outdated insulating materials in old buildings is a widely recognized problem, the National Institute for Occupational Safety and Health (NIOSH) is learning about yet another health risk posed by these aging structures—exposure to polychlorinated biphenyls (PCBs). In schools, homes, offices, industrial plants, and laboratories, PCB contamination often results from burned-out fluorescent light fixtures manufactured before 1978.[1] Recently, NIOSH has focused on the problems some schools have faced when staff and students are exposed to PCBs following a ballast burnout.

From 1981 to the present, surveys of schools in Cincinnati, Ohio,[2,3] Seattle, Washington,[4] and Cross Lanes, West Virginia,[5] have discovered PCB contamination in rooms where older ballasts burned out. In Stanton, Delaware,[6] and Detroit, Michigan,[7] teachers and students experienced acute eye, nose, and throat irritation from the contaminants that leaked after ballast burnouts. This article is based on observations at these locations.

Background

A ballast is the part of a fluorescent lamp that protects the fixture from variations in electrical voltage. Although the service life of these ballasts is usually 12 years, burnout is reportedly not uncommon after 10 years of operation.[8,9] In ballasts manufactured before 1978, the capacitor contains an insulating fluid made of PCBs. A mixture of asphalt and silica powder surrounds the capacitor. A ballast burnout occurs when electrical malfunction within the ballast dramatically increases the temperature of the asphalt mixture. As a result, the asphalt may soften and vaporize, releasing an acrid smoke with an objectionable odor. The softened asphalt can also leak from the lamp casing, carrying the PCBs with it.

After a burnout, PCBs can be present in the air and on room surfaces at higher concentrations than those which are normally found, known as the background level. Airborne PCB concentrations often remain elevated for several weeks and may take five months under "normal ventilation" conditions to return to near background.[10]

In determining PCB background levels for "normal" occupational settings, NIOSH evaluated office buildings having no record of PCB exposure. Although measurable PCB air and surface concentrations were found in these background samples, all were below guideline levels.[11,12] Because PCBs are considered a potential carcinogen, NIOSH recommends that exposures be controlled to the lowest feasible level (LFL), 1 $\mu g/m^3$ in air, based on the detection limit of the analytical method.[9]

Health Effects

Short-term exposures to contaminants from ballast burnouts do not appear to cause significant health risks. Initially, the asphalt content of the smoke can cause several acute symptoms including headache, eye irritation, sore throat, nasal congestion, and nausea. Since the acute toxicity of PCBs is low, brief contact with surface and airborne PCBs does not cause immediate health effects in adults. However, the acute toxicity of PCBs at the LFL for the large population of young children and adolescents attending schools is unknown. NIOSH occupational guidelines are proposed for a healthy adult workforce.

While acute effects do not seem to be health threatening, chronic exposure to PCBs and asphalt compounds may prove more serious. Limited evidence indicates that PCBs and some constituents of heated asphalt compounds may be carcinogenic. Certain PCBs cause liver cancer in rats and mice after oral administration.[13] A mortality study reported a greater number of deaths than expected from liver cancer among workers chronically exposed to

PCBs in two capacitor manufacturing plants.[14]

In addition, recent findings suggest that PCBs are neurotoxic. Lower infant psychomotor scores were obtained at 6 and 12 months of age, correlating with increased transplacental PCB exposure before birth.[15,16] The potential for elevated blood PCB concentrations in exposed workers was also found by Christiani *et al.*[16]

Asphalt compounds will vary in content of polynuclear aromatic hydrocarbons (including known carcinogens). Skin tumors were found in mice exposed to asphalt "fractions" and asphalt fume condensate.[17–19] Occupational exposures of more than 20 years to asphalt and coal tar pitch fumes have been linked with an increased mortality from cancer and other pulmonary diseases among roofing workers.[20–24]

Although both PCBs and asphalt can leak during ballast burnout and pose a potential carcinogenic risk, this report treats just that of PCB exposure. The NIOSH surveys upon which this article is based did not monitor asphalt emissions.

Methods and Findings

To determine the concentrations of airborne PCBs, NIOSH investigators used a constant flow vacuum pump with Florisil as the sampling medium. Levels of surface contamination were assessed by wiping a measured surface with a gauze pad wetted with hexane. The gauze pads were analyzed using the same method as the air samples.[25]

In one of the schools NIOSH surveyed, PCB air concentrations were as high as 4 $\mu g/m^3$ the week after a ballast burnout. After five weeks, the airborne concentrations had dropped to about 1 $\mu g/m^3$, still significantly higher than the measured background level of 0.33 $\mu g/m^3$.[4] PCB air concentrations in another school with poor ventilation ranged from 0.40–2.09 $\mu g/m^3$ one month after ballast burnout and after improper attempts to clean up the classrooms. Two months later, air concentrations of PCBs were at the same levels, 0.55–2.30 $\mu g/m^3$. After proper cleanup techniques and effective ventilation were employed, the PCB air levels decreased to background, $< 0.25\ \mu g/m^3$.[6]

The experience of NIOSH investigators indicates that typical background concentrations of PCBs on high contact surfaces (e.g., desk tops, counters, tables, and chairs) range between 50 and 100 $\mu g/m^2$. The State of New Mexico recommends PCB concentrations should not exceed 50 $\mu g/m^2$ on these frequently contacted surfaces.[11] In the above investigations, NIOSH took wipe samples of working surfaces in classrooms with ballast burnout and found that concentrations of PCBs ranged from nondetected to 240 $\mu g/m^2$. These amounts may not accurately reflect initial concentrations since samples were often obtained as much as one month after burnout. Normal use of surfaces and daily cleaning probably reduced high-contact surface levels. Greater amounts of PCBs were collected on elevated (> 5 ft high) horizontal surfaces.

Recommendations

Because of the low acute toxicity of PCBs, immediate health effects are unlikely; however, to minimize the long-term respiratory and dermal exposure of faculty and students, the school administration should take the following steps after a ballast fails:

1. Turn off fluorescent light and evacuate people.
2. Ventilate the room by opening windows.
3. While avoiding skin contact by wearing nitrile or neoprene rubber gloves, remove failed ballast.
4. Clear away asphalt residue leaked from the ballast, using a spatula and/or paper towel to dislodge bulk material from hard surfaces. Remove carpeting in a 6-in. radius around the contaminated area. Follow state, regional, and federal Environmental Protection Agency (EPA) regulations in disposing of PCB wastes, including the failed ballast.
5. Wipe down high-contact surfaces with an organic solvent, such as mineral spirits. Next, wash surfaces with a nonionic detergent rinse, containing 5 percent octylphenoxypoly-ethoxyethanol (such as Triton X-100) and trisodium phosphate to remove grease, wax, and furniture polishes that might have absorbed PCBs. Follow with a clear water rinse. Throughout cleaning process, wear rubber gloves to avoid all skin contact. In addition to the nitrile gloves, maintenance and cleanup workers should wear impermeable, disposable coveralls (such as those made of Tyvek®) and use respiratory protection to guard against PCB, asphalt, and cleanup solvent vapors.

While the above steps describe proper cleanup techniques, the best way to reduce PCB contamination in schools is to prevent exposure in the first place. For this reason, NIOSH investigators suggest that schools systematically replace old ballasts with PCB-free ballasts manufactured since 1978. Some local power companies may offer incentives to those who switch to newer energy-saving ballasts having no PCBs. For easy identification, EPA regulations require that PCB-free fluorescent light ballasts manufactured since July 1978 be marked "No PCBs."

Editorial Note: For more information about PCBs in fluorescent light ballasts, contact NIOSH, Hazard Evaluations and Technical Assistance Branch, 4676 Columbia Parkway, Cincinnati, Ohio 45226; 1-800-35NIOSH.

References

1. Jensen, A.A.: Melanoma, Fluorescent Lights, and Polychlorinated Biphenyls. Lancet 23:935 (1982).
2. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: Our Lady of Visitation Elementary School, Cincinnati, OH. NIOSH Report No. HETA 81-237-915. NIOSH, Cincinnati, OH (1981).
3. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: Miamitown Grade School, Cincinnati, OH. NIOSH Report No. HETA 82-068-111. NIOSH, Cincinnati, OH (1982).
4. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: Seattle Public Schools, Seattle, WA. NIOSH Report No. HETA 85-072-1850. NIOSH, Cincinnati, OH (1987).
5. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: Andrew Jackson Junior High School, Cross Lanes, WV. NIOSH Report No. HETA 89-183.

NIOSH, Cincinnati, OH (1989).
6. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: Stanton Middle School, Stanton, DE. NIOSH Report No. HETA 89-025. NIOSH, Cincinnati, OH (1989).
7. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: Henry Ford High School, Detroit, MI. NIOSH Report No. HETA 87-288-1828. NIOSH, Cincinnati, OH (1987).
8. Kaufmann, J.E., Ed.: IES Lighting Handbook, 4th ed. Illuminating Engineering Society, New York, NY (1966).
9. National Institute for Occupational Safety and Health: Current Intelligence Bulletin 45—Polychlorinated Biphenyls (PCBs): Potential Health Hazards from Electrical Equipment Fires or Failures. DHHS/NIOSH Pub. No. 86-111. NIOSH, Cincinnati, OH (1986).
10. Kominsky, J.R.; Paulozzi, L.: Polychlorinated Biphenyl Contamination Resulting from Fluorescent Light Ballast Burnout. Presented at the American Industrial Hygiene Conference, Dallas, TX (May 18–23, 1986).
11. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: New Mexico State Highway Department General Office Building. NIOSH Report No. HETA 85-414-1805. NIOSH, Cincinnati, OH (1987).
12. National Institute for Occupational Safety and Health: Health Hazard Evaluation Report: U.S. Post Office Building, Oklahoma City, Oklahoma. NIOSH Report No. HETA 87-166-1835. NIOSH, Cincinnati, OH (1987).
13. International Agency for Research on Cancer: IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. Chemicals, Industrial Process, and Industries Associated with Cancer in Humans. IARC Monographs: 1–29; supplement 4:218. IARC, Lyon, France (1982).
14. Brown, D.P.; Jones, M.: Mortality and Industrial Hygiene Study of Workers Exposed to Polychlorinated Biphenyls. Arch. Environ. Health 36:120 (1981).
15. Gladen, B.C.; Rogan, W.J.; Hardy, P.; et al.: Development after Exposure to Polychlorinated Biphenyls and Dichlorodiphenyl Dichloroethene Transplacentally and Through Human Milk. J. Pediatr. 113:991–995 (1988).
16. Christiani, D.C.; Kriebel, D.; Fox, N.J.; Baker, E.L.: Persistently Elevated Polychlorinated Biphenyl Levels from Residual Contamination of Workplace Surfaces. Am. J. Ind. Med. 10:143–151 (1986).
17. National Institute for Occupational Safety and Health: Testimony of the National Institute for Occupational Safety and Health on the Occupational Safety and Health Administration's Proposed Rule on Air Contaminants, 29 CFR Part 1910, Docket No. H-020. Presented at the OSHA informal public hearing, August 1, 1988. NIOSH Policy Statements. Cincinnati, OH (1988).
18. Chong, J.P.; Haines, A.T.; Verma, D.K.: A Pragmatic Approach to Standard Setting — The Example of Coal Tar Products and Asphalt. Ann. Occup. Hyg. 33(2):197–208 (1989).
19. McKee, R.H.; Lewis, S.C.; Egan, G.F.: Experience Gained by the Petroleum Industry in the Conduct of Dermal Carcinogenesis Bioassays. In: Skin Carcinogenesis: Mechanisms and Human Relevance, pp. 363–379. Alan R. Liss, Inc., New York (1989).
20. Hansen, E.S.: Cancer Incidence in an Occupational Cohort Exposed to Bitumen Fumes. Scand. J. Work. Environ. Health 15:101–105 (1989).
21. Hansen, E.S.: Cancer Mortality in the Asphalt Industry: A Ten Year Followup of an Occupational Cohort. Brit. J. Ind. Med. 46:582–585 (1989).
22. Knecht, U.; Woitowitz, H.J.: Risk of Cancer from the Use of Tar Bitumen in Road Works. Brit. J. Ind. Med. 46:24–30 (1989).
23. Wolff, M.S.; Herbert, R.; Marcus, M.; et al.: Polycyclic Aromatic Hydrocarbon (PAH) Residues on Skin in Relation to Air Levels Among Roofers. Arch. Environ. Health 44(3):157–163 (1989).
24. Wolff, M.S.; Taffe, B.; Boesch, R.R.; Selikoff, I.J.: Detection of Polycyclic Aromatic Hydrocarbons in Skin Oil Obtained from Roofing Workers. Chemosphere 11(6):595–599 (1982).
25. Eller, P.M.: NIOSH Manual of Analytical Methods, 3rd ed. DHHS/NIOSH Pub. No. 84-100:5503-1 to 5503-5. NIOSH, Cincinnati, OH (1984).