Health Concerns About PCBs and PBDEs

What are PBDEs?

PBDEs (or Polybrominated Diphenyl Ethers) are a family of flame-retarding chemicals used in computer plastics, furniture foams, textiles, and other products. There are 209 different kinds of PBDEs, but only a few are present in commercial mixtures. Last November, the most toxic forms of PBDEs were withdrawn from use in the United States, but consumer products containing high levels of the chemical are still found in homes and workplaces; and deca-PBDE.

What are PCBs?

PCBs (or Polychlorinated Biphenyls) are a family of chemicals once used in a variety of industrial applications but banned in North America in the late 1970s because they were found to pose health risks. These chemicals were widely used in such applications as electrical equipment, hydraulic fluid, and plastics, and they may still be present in equipment today.

Why be concerned about these chemicals?

PCBs are known to be interfere with the body's hormone systems, and can cause a range of adverse effects on health. PBDEs are chemically similar to PCBs, and, not surprisingly, show similar toxic effects in laboratory studies.

Both PCBs and PBDEs degrade slowly in the environment, and build up in living things, magnifying in concentration as they move up the food chain. Even though production of PCBs in the US has been prohibited for decades, they remain present in the environment and in human bodies. In recent years, PBDE levels in wildlife, soil samples, and human tissues have been doubling every two to five years, and have reached particularly high concentrations in North America, where the manufacture and use of products with PBDEs has been the most prevalent.

How can PCBs and PBDEs affect health?

- **Memory and learning.** Multiple studies in human populations have linked exposure to PCBs prior to birth and lower scores on tests of neurological function into infancy and childhood. Studies on a group of children in the Netherlands found correlations between pre-birth exposures to PCBs and reduced neurological function [Schantz 2003]. In a Michigan study that tested children at 11 years, those in the group most highly exposed to PCBs prior to birth averaged six IQ points lower than those in the lowest exposed group [Jacobson 2002].

  PBDE exposure impairs learning in mice. Laboratory mice exposed to a single dose of PBDE-99 (a main ingredient of the PBDE mixture used in polyurethane foams) during a critical stage of rapid brain development (10 days of age) showed impaired performance in a maze test [Eriksson 2001].

- **Sexual development.** Research in the Netherlands has also identified a connection between pre-birth exposure to PCBs and similar compounds, and changes in gender-specific play behavior among boys and girls [Vreugdenhil 2002]. This finding is consistent

with experiments with laboratory animals indicating that exposures to hormone-disrupting chemicals such as PCBs can alter sexual development.

- **Behavior.** A single dose of PBDE-47 administered at 10 days of age, or of PBDE-99 at 3 or 10 days of age, changed the behavior of mice as they habituated to new surroundings. (PBDE-47 and -99 are each major constituents of commercial PBDE mixtures used widely in North America.) These effects were persistent and became more pronounced as the mice aged [Eriksson 2001 and 2002]. More prolonged PBDE exposure during rat development also caused mild reductions in overall activity when exposed rats reach adulthood [Branchi 2002].
- **Immune system.** Children in the Netherlands who were exposed pre-birth to PCBs also exhibited reduced function of the immune system [Patandin 1999]. PCBs in the bodies of Puget Sound harbor seals have been detected at levels high enough to suppress the seals' immune systems [PSAT 2003].
- **Cancer.** PCBs cause cancer in laboratory animals, and EPA considers PCBs "probable" human carcinogens [USEPA 2002].
- **Thyroid hormones.** Tests on laboratory animals have found that commercial PBDE products disrupt thyroid hormones, which play essential roles in brain development. For example, a single oral dose of penta-PBDE, which is commonly found in foam products can decrease thyroid hormone levels in mice. PBDEs and PCBs, may work together to depress thyroid hormone levels. As the liver metabolizes PBDEs, it may turn them into compounds that interfere with the thyroid system [McDonald 2002].
- **Multiple effects.** PCBs can damage hormone functions, and in the process cause a range of effects on the immune system, reproductive system, and nervous system [USEPA 2002].

Can low levels of PCBs or PBDEs cause harm?

Studies of human populations have found harmful effects of PCBs from dietary exposures, not just from industrial accidents. For example, in the Michigan study identifying a connection between PCB exposures and reduced neurological function, the children studied were exposed at the higher end of "background levels" because their mothers ate large amounts of fish, but exposures were generally representative of the US population as a whole [Jacobson 2002].

While no studies have been done on the effects of PBDEs on humans, laboratory studies suggest that the risks are similar to those of PCBs. In one laboratory study, a single oral dose of PBDE-99 at 0.8 parts per million parts body weight in a developing mouse caused permanent behavioral aberrations that worsened as the mice aged. On day 10, the most sensitive time for PBDE exposure, the PBDE-99 concentration in mouse brain tissue was calculated at roughly 12 parts per billion (expressed as mass of PBDE per mass of brain lipid) [Eriksson 2002; Lunder 2003]. In comparison, 14 of the 40 women tested in the Pacific Northwest had more than 12 parts per billion of PBDE-99 in their breast milk fat.

While extrapolations from effects in laboratory animals to humans entail a range of uncertainties, these data suggest that PBDE levels currently found in people may be of toxicological concern.

How do PCBs and PBDEs interact with one another?

Research indicates that PCBs may work together with PBDEs to affect thyroid and other hormone functions, and the two in combination may be more potent than the individual effects of the chemicals [Eriksson 2003].

Is breastmilk a reliable indicator of community body burdens?

After adjusting for differing fat content, levels of toxic chemicals such as PCBs and PBDEs are comparable in breastmilk, mother's blood serum, and umbilical cord blood serum [Mazdai 2003, Guvenius 2003, Solomon 2002]. Breastmilk contamination, especially if samples are collected soon after birth, is therefore a useful indicator of exposure levels for developing infants *in utero,* and may be a useful indicator of body burdens for males of a similar age [Hooper, 2003].

Are there health concerns about breastfeeding and breastmilk contamination?

Research is very clear: Despite the presence of environmental chemicals, breastfeeding is healthiest for both mothers and babies. As noted by the US Surgeon General, breastmilk is one of the most important contributors to infant health. Breastfeeding decreases the risk of childhood infections of the bloodstream, ears, lungs, urinary system, and gut, as well as chronic diseases such as diabetes and food sensitivities [HHS 2000]. Breastfeeding also reduces postpartum bleeding and certain gynecological cancers in mothers [GBPSR 1999].

Many researchers believe that the most significant health effects from chemical contamination stem from *in utero* exposure rather than exposure through breastfeeding. Chemical exposure before birth have been shown to have adverse health effects, but common exposures through breastfeeding have not been shown to cause harm. This may be because infants are less vulnerable to the effects of these chemicals than are fetuses, or because breastmilk's beneficial effects on the immune system and brain development protect the infant from harm. [GBPSR 1999]

Moreover, the studies demonstrating the benefits of breastmilk have all been performed on mothers whose milk contained at least some contaminants; for decades, all mothers in the industrialized world who have been tested have contained detectable levels of synthetic chemicals in their bodies. After toxics such as PCBs and DDT were banned, chemical levels in human bodies have fallen, in some cases substantially, lessening some concerns over contaminant levels. [Solomon 2002]

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