OCCURRENCE OF PERSISTENT, BIOACCUMULATIVE TOXIC (PBTs) IN GROUND WATER

What Are PBTs and Why Are They Important?

PBTs are chemicals that are toxic to humans and other organisms and are persistent in the environment. These chemicals move through or are stored in air, water, and soil, and many accumulate in the food chain. The United States Environmental Protection Agency (EPA) has listed 53 chemicals as priority PBTs (http://www.epa.gov/rgytgrnj/specinit/p2/wmpbt119.htm; http://www.pprc.org/pprc/pubs/topics/pbt.html).

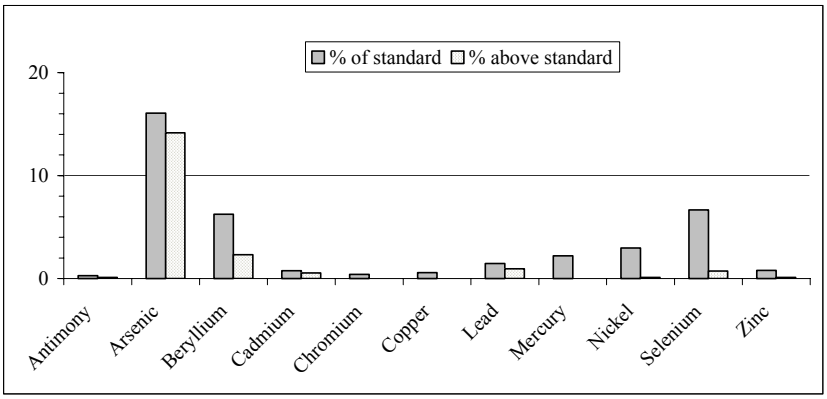
How Are PBTs Introduced to the Environment?

An important historical source of PBTs was disposal of toxic wastes. Programs such as Superfund and RCRA have diminished the importance of this source. Nonpoint sources are important for some PBTs, particularly pesticides. Air emissions are probably the most important source today. Specific sources for air emissions include industry, open burning, mining, landfills, and vehicles (http://recetox.chemi.muni.cz/PBTs/content.htm).

What is the Occurrence of PBTs in Ground Water?

Most ground water sampling and monitoring has focused on chemicals that are not PBTs. Some work has been done in other parts of the nation. In Minnesota, we can look at data from regulated sites, the United States Geological Survey National Water Quality Assessment studies in the Red and Upper Mississippi River basins (http://wwwmn.cr.usgs.gov/umis/; http://wwwmn.cr.usgs.gov/redn/), and from MPCA Ground Water Monitoring and Assessment (GWMAP) studies. This fact sheet focuses on GWMAP data.

GWMAP conducted two studies between 1992 and 2001 that provide information on occurrence of some PBTs in ground water. During the statewide baseline assessment (1992-1996), we sampled 954 private wells statewide. Priority PBTs we sampled included antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, naphthalene, chloroform, 1,1-Dichloroethane, 1,1,1-Trichloroethane, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,2,4-Trichlorobenzene, and Hexachlorobutadiene. Figure 1 shows that concentrations of inorganic chemicals were low relative to the drinking water standards, except for arsenic. Arsenic (14.2% of samples), beryllium (2.3%), lead (0.9%), and selenium (0.7%) most frequently exceeded their drinking standard. Chloroform was detected in 4.9 percent of samples, with a median concentration that was 0.5 percent of the drinking standard. Naphthalene was detected on two occasions at a median concentration that was 1 percent of the drinking standard. There were no detections of other PBTs and there were no exceedances of drinking standards for organic chemicals.



During our land use study in St. Cloud, Minnesota (1996-2001), we sampled the chemicals mentioned above, plus polynuclear aromatic hydrocarbons (10 chemicals). These samples were collected from shallow ground water under six different land uses. We did not observe significant differences between concentrations of inorganic chemicals in shallow ground water and those observed in deeper samples from the baseline study. We observed higher concentrations of antimony, arsenic, lead, and zinc in urban areas compared to forested areas. Although concentrations were below drinking standards, the results indicate some anthropogenic effect for these chemicals. We observed chloroform in 7 of 23 wells, with a median concentration that was 0.5 percent of the drinking standard. The wells occurred in a variety of land use settings, although there were no detections in forested areas. 1,1-Dichloroethane was consistently detected in one well from an industrial area, at a concentration that was 0.5 percent of the drinking standard. PAHs were detected in one well at concentrations below drinking standards.

What Further Information is Needed?

The PBTs we sampled do not appear to represent an exposure concern, with the exception of naturally-occurring chemicals such as arsenic and beryllium. Many of the PBTs that we did not sample are relatively immobile in soil and are unlikely to reach ground water, although chlorinated pesticides are occasionally found in shallow ground water under depositional areas, such as along rivers. Of the remaining PBTs, the phthalate esters (3 chemicals), phenols (3 chemicals), and nitrobenzene could potentially leach to ground water. They should be considered in future sampling. We observed a high occurrence, in industrial areas, of chlorinated hydrocarbons that are not currently listed as PBTs. Tetrachloroethylene and trichloroethylene were most commonly detected. Continued monitoring for these chemicals is warranted.

What is Being Done About PBTs?

On November 16, 1998, the EPA released a Multimedia Strategy for Priority PBT Pollutants (PBT Strategy). The goal of the PBT Strategy is to identify and reduce risks to human health and the environment from current and future exposure to priority PBT pollutants (http://www.epa.gov/pbt/background.htm.) The Minnesota Toxic Pollution Prevention Act of 1990 states "… it is the policy of the state to encourage toxic pollution prevention. The preferred means of preventing toxic pollution are techniques and processes that are implemented at the source and that minimize the transfer of toxic pollutants from one environmental medium to another". The Coordinated Toxics Reduction Strategy refers to a collaborative effort by staff in the Office of Environmental Assistance and MPCA to gain meaningful cross-media reduction in toxic substances emphasizing preventative approaches. Staff from a wide range of programs has met to discuss developing an Inter-agency Coordinated Toxic Reduction Strategy.