Homes To Waters:

How Toxic Flame Retardants Pollute Our Waterways

Toxic flame retardants have been turning up in our waterways since at least 1981, when scientists discovered the persistent toxic compounds known as PBDEs polluting a Swedish river. Since then, flame retardants have been found in fresh and salt water, sediment, fish, and marine mammals. And it's not just PBDEs—a whole alphabet soup of flame retardants that cause cancer, hormone disruption, and other toxic effects are now known to contaminate waters and wildlife around the world.

But how are they getting there? Flame retardants are used **indoors**, in products like couches. It's not obvious how a toxic chemical could be making its way from our couches to our rivers. So scientists have been hot on the trail of these compounds to trace their path from products we use in our homes to pollution in rivers, lakes, and salt water.

The Washington Toxics Coalition designed a study to investigate a hidden but possibly important pathway: through the home laundry. We know that flame retardants collect in household dust and indoor air. Could it be that they then settle on our clothes, wash out in the washing machine, and leave the home to travel directly to the wastewater treatment plant, which discharges to waterways?

The Study

To find out, we recruited 20 households in the Longview and Vancouver, WA communities to participate in a study. In each of those households, we took a sample of household dust. We also asked participants to collect a load of laundry, of clothing worn primarily around the home. Then we did the wash—and took a sample of the

laundry water. We sent the samples to a chemist, at the Virginia Institute of Marine Science, who specializes in analysis of flame retardants. He was able to test the samples for 22 flame retardants.

We also collected samples at two wastewater treatment plants, so we could compare the levels in wastewater leaving the house with the influent entering the plants, and the effluent leaving the plants after treatment. We took samples of influent and effluent at the Marine Park plant in Vancouver and the Three Rivers plant in Longview.

What We Found: Dust and Laundry Water

Flame retardants are significant contaminants of household dust: we detected a total of 21 flame retardants in house dust, with 16 of those in 95% or more of the homes.

The results of our laundry water tests made clear that flame retardants are making their way to wastewater treatment plants via laundry: we found 18 flame retardants in laundry wastewater. One class of flame retardants dominated in both dust and laundry water: the chlorinated organophosphates, or Tris compounds. Some of these chemicals (TCEP and TDCPP) have been designated as carcinogens, but they are still found in the foam portion of couches and children's products, and TCPP is used in home insulation. We also found PBDEs, phased out for most uses but still present in our homes: TBB and TBPH, components of Firemaster 550, used in furniture and children's products; HBCD, a persistent toxic chemical used in home insulation; TBBPA, used in electronics; and alternative brominated flame retardants DBDPE and BDBPE, possibly increasing in use.

What we Found: Wastewater Treatment Plants

We sampled two treatment plants, and the levels we found in the influent coming into the plants matched fairly closely with our detections in laundry water. We generated estimates of levels of flame retardants that would be expected in influent if laundry water were the only source, and for most of the compounds the estimates were very similar to the levels actually detected.

Perhaps most alarmingly, some of the flame retardant compounds appear to pass right through the treatment plant, and the levels we detected in effluent were just as high as those in influent. Specifically, the chlorinated organophosphates, the chemicals found at the highest levels in house dust and laundry water, are highly soluble in water and resistant to degradation. Total chlorinated organophosphate levels in effluent were up to 11,800 ng/L (parts per trillion).

Loading up the Columbia River

We estimated the amount of flame retardants discharged from these treatment plants to the Columbia River using the levels detected in effluent: the highest estimated loadings were again for the chlorinated organophosphates, with a total load for these compounds of 174 kg (384 pounds) per year from the Marine Park plant.

Impacts on the Columbia

Flame retardants have been detected in water and sediment of the Columbia River, including PBDEs as well as chlorinated organophosphates. PBDEs have been found in animals relying on the Columbia: levels rose quickly in the early 2000s, to the point that levels in ospreys inhibited reproduction. in samples taken in 2009, nearly all fish (largescale suckers) tested positive for PBDEs. In addition, PBDEs have been detected in the bodies and stomach contents of juvenile salmon of the Columbia. Laboratory and field studies have linked exposure of fish to PBDEs to hormone disruption, inhibited spawning, and weakened immune response. A US Geological Survey study detected two chlorinated organophosphates (TCEP and TDCPP) in effluent from each of nine wastewater treatment plants discharging into the Columbia.

What Should Be Done

Toxic flame retardants are escaping from products in our homes and hitchhiking on our clothes to pollute the Columbia River. How can we stop this? By replacing the toxic flame retardants at the source with safer substitutes. Washington State has been a leader in addressing flame retardants, and must pass legislation to ensure the most toxic flame retardants are no longer used. More broadly, we need legislation at the state and federal level to end the use of the most toxic chemicals and ensure that chemicals used to replace them are less toxic.