COMMENTARY

Averting Another Toxics Disaster in China

By Arlene Blum

Rarely does a week go by in China without a report of a serious chemical pollution problem—melamine in baby formula, workers with lead poisoning, or fish die-offs from industrial effluents. Chinese authorities closed several metal smelters in 2009 over community outrage when thousands of children were diagnosed with excessive lead levels in their blood. The Chinese government is increasingly concerned how to mitigate the environmental and health costs of toxic chemicals and the growing citizen unrest linked to toxic pollution. However, lowering toxic chemical pollution is a major challenge for China, which has become the factory of the world.

TUG-OF-WAR OVER HALOGENATED FLAME RETARDANTS

Nearly one thousand scientists from around the globe gathered in Beijing from 23-28 August 2009 at the Dioxin 2009 meeting on persistent organic pollutants (POPs) to present their research findings and discuss toxics problems in China and worldwide. POPs are chemicals that are persistent (they do not break down into safer chemicals in the environment for many years); bioaccumulative (they accumulate in plants and animals, becoming more concentrated as they move up the food chain); and toxic. All of the 21 chemicals currently designated as POPs by the Stockholm Convention belong to the family of halogenated chemicals, where carbon is bonded to a halogen such as fluorine, chlorine, bromine or iodine. The Dioxin 2009 meeting included numerous research reports about halogenated flame retardants, a class of chemicals that are being found at increasing levels in humans and animals throughout the world. When certain toxic flame retardants are banned, companies often switch to using other chemicals of similar structure and toxicity, the health impacts of which have not yet been identified.

Dioxin 2009 affirmed China's commitment to reducing such toxics and working towards a POPs-free world. During an opening ceremony worthy of the Olympics, a dozen welcoming speeches were heralded with trumpets and drum-rolls. Talented young singers and dancers clothed in vibrant red and gold silk performed environmental songs and skits. A dynamic rock group, singing about protecting the environment, was flanked by two large screens with images of environmental devastation, flaming oil wells, and deforestation.

Yet only a month later in Shanghai, at a much larger event, a scenario for further worsening toxics problems from flame retardants began to unfold. A multitude of flame retardant chemical producers and buyers thronged the Shanghai Expo Centre for the Fourth International New Flame-Retarding Technology and Flame-Retarding Material Industry Exhibition from 23-25 September 2009. The expos are one of many strategies to promote the use of flame retardant chemicals in China. (See http://www.flameexpo.com/en/). When it comes to the

production and use of flame retardants, China is in a tug-of-war with the protection of the citizen health and environment pulling in one direction and profit-seeking foreign companies pulling in the other.

GLOBAL HEALTH AND ECOLOGICAL THREATS

The increasing production and use of halogenated flame retardants in China poses a threat to the health of China and the world. These compounds are ubiquitous and have been detected in human tissues, marine mammals, house dust, soil, air, water, and most biological or environmental media collected from all over the planet. In lab animals, they can cause neurological and reproductive impairments; cancer; attention-deficit/hyperactivity disorder; infertility; reduced sperm count and endocrine disruption; cryptorchidism (undescended testicles); and hypospadias (a penile deformity), among other health disorders. In humans they have been associated with reduced IQ; increased time to pregnancy; changes in thyroid hormones; undescended testicles in infants (a condition associated with a higher cancer risk later in life); decreases in sperm quality; and function and alterations in the levels of male hormones.

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In addition to being hazardous during production and use, halogenated flame retardant chemicals often return to China and pose a threat at the end of their life as e-waste. For example, plastic cases of electronics and other consumer products laced with flame retardants are sent to China from around the world for disposal. When burned, they convert to highly toxic dioxins and furans, which can remain in the human body and the atmosphere for decades. It has been estimated that the primitive recycling of thousands of tons of pentaBDEs contained in e-waste releases tons of brominated and brominated-chlorinated dioxin/furans into the environment. In open burning e-waste areas in China, the measured levels of dioxins in soil exceeded allowable soil standards. Worldwide, pentaBDE flame retardants have been shown to be the major precursor chemicals for this severe environmental contamination from dioxins.

In China's e-waste disposal regions, the air, soil, and water as well humans and animals contain some of the highest levels of halogenated flame retardants and their combustion products in the world. Researchers have reported that flame retardants blood levels in workers in the electronics dismantling center of Guiyu—China's biggest e-waste city in Guangdong Province—are, on average, nearly 600 parts per billion, some of the highest amounts reported in humans. Remarkably, in the flame retardant production area of Laizhou Bay, residents have recently been found to have levels comparable to those found in Guiyu. The Guiyu and Laizhou Bay levels are 10 times higher than average levels in the United States and more than 100 times higher than levels in Europe and parts of China not impacted by the chemical or e-waste industries directly.

Not only are halogenated flame retardants associated with health risks to production and recycling workers, and consumers, the overall benefit of flame retardants in increasing fire safety has not been proven for use in furniture and other consumer products. While halogenated flame retardants may somewhat reduce the time for a material to ignite and the heat released, at the same time they considerably increase the carbon monoxide, toxic gases, and soot emitted once the fire has begun. Most fire deaths and fire injuries result from inhalation

of these gases and soot. More effective and less dangerous ways to increase fire safety include reducing smoking; using smoke detectors and/or sprinkler systems; and better enforcement of fire safety standards.

Since smoldering cigarettes are the major cause of fire deaths, the United States and the European Union now require "fire-safe" cigarettes. Bands of thick paper in these self extinguishing cigarettes reduce the flow of oxygen. If left unattended or if the smoker falls asleep, the cigarette will extinguish itself when it burns to one of these "speed bumps," rather than smoldering long enough to start a fire. China, with the largest number of smokers in the world, could reduce fire hazard by requiring fire-safe cigarettes rather than by adding chemicals to all the potentially flammable items in homes and public places.

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SHIFTING MARKET FOR HALOGENATED FLAME RETARDANTS

Given the health and environmental hazards and lack of proven fire safety benefit, many scientists, environmentalists and even the International Association of Fire Fighters oppose the use of chemical flame retardants unless there is a proven need and alternative methods are not effective. Nonetheless, their use is being actively promoted in China by the three major flame retardant producers: Albemarle, Chemtura, and Israel Chemicals Ltd. As the European Union and the United States are reducing their use of halogenated flame retardant chemicals—the most toxic variety—these three companies are turning to China for both manufacturing and sales The market share for halogenated flame retardants is estimated to be 20 percent and declining in the European Union and the United States, while it is 55 percent and growing in China. The production capacity of flame retardants in China has gone from 50 kilotons in 1993 to 350 in 2006 and continues to grow rapidly.

The production of brominated flame retardants—the most toxic and persistent of the halogens—has a 30-year history in China. About 70 different varieties of brominated flame retardants are produced, primarily in Shandong and Jiangsu provinces. In 2010, the demand for brominated flame retardants in China should reach approximately 200,000 tons. In addition, in China the manufacturing of chlorinated paraffins as flame retardants and for other uses is growing exponentially. About 60,000 tons of chlorinated paraffins, currently under review to be listed as a POP under the Stockholm Convention, were produced in China in 2007. The growth in production of brominated and chlorinated flame retardants is expected to further accelerate as the major producers of these chemicals work to expand their manufacturing and markets in China.

Chemtura recently moved its Asia-Pacific headquarters from Singapore to Shanghai and has opened a new Application Development Center in Nanjing. Albemarle entered into a joint venture in December of 2008 with Sinobrom, extracting bromine directly from the Shandong brine fields. One motivation for this investment is the high profitability of these chemicals. Albermarle's profits rose 377 percent in 2009 compared to 2008, powered by an increase in the sales of brominated flame retardants. These three bromine producing companies have a history of proposing and supporting flammability requirements that would increase their sales, independent of whether a fire safety benfit has been established

When a regulation for a flammability standard for public places in China was promulgated by the Ministry of Public Security in July 2008,

prior to the Olympics, the advertising literature for the Annual Flame Retarding Expo in Shanghai proclaimed, "The enforcement of such a requirement will definitely bring a bright prospect to China's flame-retarding industry." Not surprisingly, the potential adverse health and environmental impacts are not discussed in the promotional literature.

Seeking Less-Toxic Alternatives

One potentially positive trend is that China could take the lead in the production of safer alternative non-halogenated flame retardants based on phosphorus. China has the largest supply of the basic phosphorus raw material in the world, located in Yunnan and Sichuan provinces. Chinese scientists are working to develop new phosphate flame retardants as safer alternatives to those currently on the market. It would be beneficial for the Chinese ministries of environment and commerce to discuss opportunities to work together to speed the development and use of phosphate flame retardants, while discouraging the production and use of the more hazardous halogenated flame retardants. This shift to safer flame retardants would benefit China and the world.

A TOXICS DÉJÀ VOUS

Decision-makers in China need to be informed about the history of adverse impacts of such chemicals to prevent a repeat and amplification of problems in the past. This unfortunate history began with poisoning in the state of Michigan, where in 1973, one ton of a brominated flame retardant called polybrominated biphenylether (PBB) was inadvertently mixed with animal food being produced in the state. The toxic chemical moved from farm animals to milk, eggs and meat, ending up in humans. Millions of farm animals that had consumed the toxic mixture had to be killed and humans with high levels of exposure had increased risks for some cancers. This situation evokes parallels to the recent food safety scandal in China caused when melamine, a flame retardant, was added to dog food and infant formula.

The addition of the fire retardant pentabromodiphenyl ether (pentaBDE) to polyurethane foam in furniture and baby products in the United States is another example of a case where the potential harm far exceeded the fire safety benefit. After pentaBDE was found to be highly toxic and persistent, the United States ceased production in 2004. Production in China continued until May 2009, when pentaBDE was listed as a POP under the Stockholm Convention. The primary replacements are from similar chemical families that share similar properties and likely adverse impacts.

Although the flame retardants are only required for California furniture, all Chinese furniture being exported to North America contains flame retardant chemicals. In addition, leftover foam treated with chemicals is exported to North America for use in bonded carpet cushion insulation. To meet the demand, thousands of small foam and furniture factories throughout southern China produce flame retardant foam and furniture for export to North America. Workers wearing little protective gear add chemicals to the foam before cutting and producing the furniture. The chemicals are also a threat to the health of villagers who live adjacent to these small factories and to farmers who grow rice and vegetables nearby.

Clearly driving the use of these chemicals in products made in China is the lack of regulation of them by importers, like the United States. For example, why have toxic pentaBDEs been replaced with other toxic flame retardants (such as chlorinated tris and Firemaster 550) without government oversight? One problem is that the U. S. Environmental Protection Agency does not currently have the authority to regulate such potentially toxic chemicals. The Safe Chemicals Act of 2010, recently introduced into the U.S. Congress, proposes

to solve this problem by amending the Toxic Substances Control Act of 1976 (TSCA), to require industry to test industrial chemicals before they are used in consumer products. If passed, this new legislation should help protect American consumers well as Chinese workers and citizens who live in the manufacturing and waste disposal regions of China from toxic and untested chemical flame retardants.

Primarily used in North America, pentaBDE and its replacement flame retardants are now found in high levels throughout the world in creatures at the top of the food chain such as marine mammals, birds of prey and humans. These chemicals can persist for a very long time. Retardants, such as PBBs, banned more than three decades ago, are still present and problematic in sediments and wildlife.

The Beijing Dioxin 2009 meeting included research showing brominated flame retardants in both giant and red pandas, in fish on the Tibetan Plateau, in dolphins and porpoises in the Pearl River Delta of South China, as well as in frogs, birds of prey, and human breast milk throughout China.

CHOICE FOR POPS-FREE WORLD

Given the potential dangers an important question is whether the production and use of toxic halogenated flame retardants should continue to increase in China. As the flame retardant industry works to expand its scope, government decision-makers are pulled in

On the bridge at the Western Academy of Beijing, a pre-K-12 international school in Beijing China where the Green Science Policy Institute Fire Retardant Dilemma meeting was held in August 2009.

From L-R: Mike Bilan (IB Biology instructor), Erika Helms (Executive Director, Jane Goodall Institute, China), Michael Crook (Founder, Western Academy of Beijing), Arlene Blum (Executive Director, Green Science Policy Institute), Seungmin Cho (Student), SooJin Yim (Student), Trish Smith (Director of Development, Western Academy of Beijing)
Photo Credit: Arlene Blum

conflicting directions. Will they listen to their scientists' research as presented at the Dioxin 2009 meeting in Beijing and strive for a POPs-free world or will they listen to the chemical industry as at the Flame-Retarding Industry Exhibition in Shanghai and build more plants to produce halogenated flame retardants with the potential to pollute China's land and people? Their decision could have a major impact on the health of China and the world.

To share information about health and environmental impacts of halogenated flame retardant chemicals, the Green Science Policy Institute hosted a workshop on 22 August 2009 at the Western Academy of Beijing. Distinguished U.S. and Chinese scientists presented information about the dangers of increasing production and use of halogenated flame retardants in China. Their lectures, some of which informed this article, are posted in both Chinese and English at: http://greensciencepolicy.org/flame-retardant-dilemma-beijing-22-august-2009

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