September 26, 2014

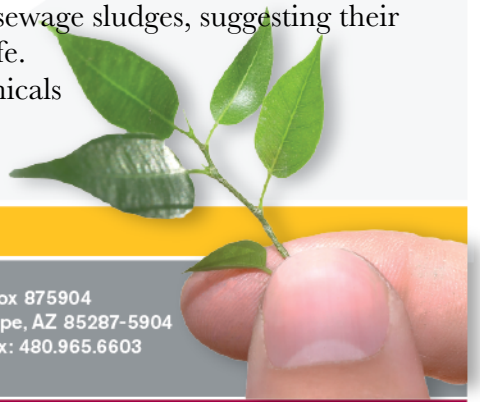
I, Rolf Halden, am writing this statement in support of the Petition to the CPSC to regulate four categories of household products containing non-polymeric additive organohalogen flame retardants.

1. I, Rolf Halden, am Director of the Center for Environmental Security at the Biodesign Institute and Professor in the Ira A. Fulton School for Sustainable Engineering and the Built Environment, Arizona State University. I am also a Senior Sustainability Scientist in the Global Institute of Sustainability at Arizona State University and hold an adjunct faculty appointment at the John Hopkins Bloomberg School of Public Health. I am an environmental scientist and engineer by training, and my research focuses on the movement of chemicals through the environment and their potential health impacts. I received my M.S. (1994) and Ph.D. (1997) in Civil (Environmental) Engineering from the University of Minnesota-Minneapolis. I have authored over 110 peer-reviewed articles, 11 book chapters, 15 patent applications and 160 conference papers. I have also presented over 110 invited lectures and keynote addresses at national and international scientific symposia. I have attached a copy of my *curriculum vitae* and a list of my publications for your reference.

2. I strongly believe that there is a need to regulate hazardous chemicals, such as organohalogen flame retardants, as classes or compound families. Many organohalogen flame retardants have been shown to be persistent, bioaccumulative and/or toxic, and have been detected in the environment, wildlife, and human populations across the globe. Due to these concerns, two major commercial flame retardant formulations, penta- and octa-brominated diphenyl ethers (BDE), were banned by the European Union (EU) in 2004 and voluntarily phased-out in the U.S. in 2005. The fully brominated deca-BDE was banned in electrical and electronic applications within the EU in 2008, while negotiations between the EPA and deca-BDE producers in the U.S. led to an agreement to cease all uses of this product in the U.S. by the end of 2013. Many of the replacement chemicals now finding their way into commerce as substitutes for PBDEs are structurally similar to the original, now banned/phased-out compounds; as a result, they show similar persistence and bioaccumulative characteristics in the environment.[i,ii]

3. In general, the replacement of hydrogen with halogen atoms positively correlates with problematic characteristics such as hydrophobicity (which facilitates bioaccumulation), environmental persistence and toxicity.[iii] It is therefore a not surprising, but underappreciated fact, that 74% of harmful organic compounds regulated by the U.S. EPA (U.S. Environmental Protection Agency) under the Safe Drinking Water Act contain at least one halogen atom[iv].

4. A recent study by our group featured the use of municipal sewage sludge (a solid byproduct of wastewater treatment) for identifying and prioritizing persistent and bioaccumulative chemicals. We identified eight top priority chemicals with high abundance and bioaccumulative potential, including five organohalogens, three of which were brominated flame retardants.[v] The brominated flame retardants were the third most abundant group of chemicals detected in nationally representative U.S. sewage sludges, suggesting their widespread use and ongoing exposures of human populations and wildlife.
The study also revealed that, out of 55 potentially bioaccumulative chemicals detectable in sewage sludge, 93% were halogenated.



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5. The mass manufacture of toxic chemicals that lack effective routes of degradation creates unnecessary problems for current and future generations. The substitution of known harmful organohalogen flame retardants with chemicals sharing structural and functional similarity is not an effective solution to this problem[6]. Substitutes are often chemicals that have minor modifications to the carbon backbone (i.e., the length or shape of the carbon chain) or halogen substitution pattern (i.e., the arrangement of halogens in the molecule) of known hazardous chemicals. These minor changes do not result in major changes in the risk profile of the substitutes relative to the compounds targeted for replacement.

6. In particular, because of their bioavailability and potential for bioaccumulation, organohalogen flame retardants of low molecular weight that are not covalently bonded to the consumer product will very likely pose significant environmental and human health risks, irrespective of any minor modifications to their structure.

7. The solution to this problem ultimately depends on curtailing the use and production of chemicals sharing structural and functional similarity to known hazardous compounds, rather than making minor modifications to the carbon backbone or halogen substitution pattern, and then hoping for a different, better outcome. Pragmatic steps for reducing environmental pollution and adverse human health impacts include[6]: (i) avoiding the use of flame retardants in consumer products that do not pose a significant fire risk in the first place, (ii) avoiding the use of flame retardants that resemble their hazardous predecessors in molecular size and structure, and (iii) developing next-generation flame retardants that are covalently bound to the consumer products to minimize release, and have large molecular sizes (e.g., large polymers) to limit uptake by biota.

8. My professional opinion is that organohalogen flame retardants should be regulated as a class, especially the ones used in additive form (i.e., not covalently bound) in consumer products. Instead of regulating individual formulations such as penta- or octa-BDE and replacing them with similar formulations, a more proactive and adequate strategy is required for chemical safety management. Learning from past failures is necessary for an effective regulatory framework, and organohalogen flame retardants should be the starting point for the redesign of safer and greener consumer products. I therefore support the accompanying petition and urge the CPSC to regulate consumer products containing non-polymeric additive organohalogen flame retardants.

Yours sincerely,

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[iii] Halden RU 2014. On the Need and Speed of Regulating Triclosan and Triclocarban in the United States. *Environ Sci Technol* 48:3603−3611. DOI: 10.1021/es500495p. (Cover & Feature Article, April 1, 2014).

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[v] Venkatesan AK, Halden RU. 2014. Wastewater Treatment Plants as Chemical Observatories to Forecast Ecological and Human Health Risks of Manmade Chemicals. *Sci Rep* 4:3731. DOI: 10.1038/srep03731. www.nature.com/srep/2014/140116/srep03731/full/srep03731.html

[6] Venkatesan AK and Halden RU. New Strategies for Monitoring and Regulating Chemical Mixtures and Contaminants Sharing Pathways of Toxicity (Internal White Paper, Arizona State University).

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