Additive Flame Retardants in Electronics: Use and Potential Health Concerns

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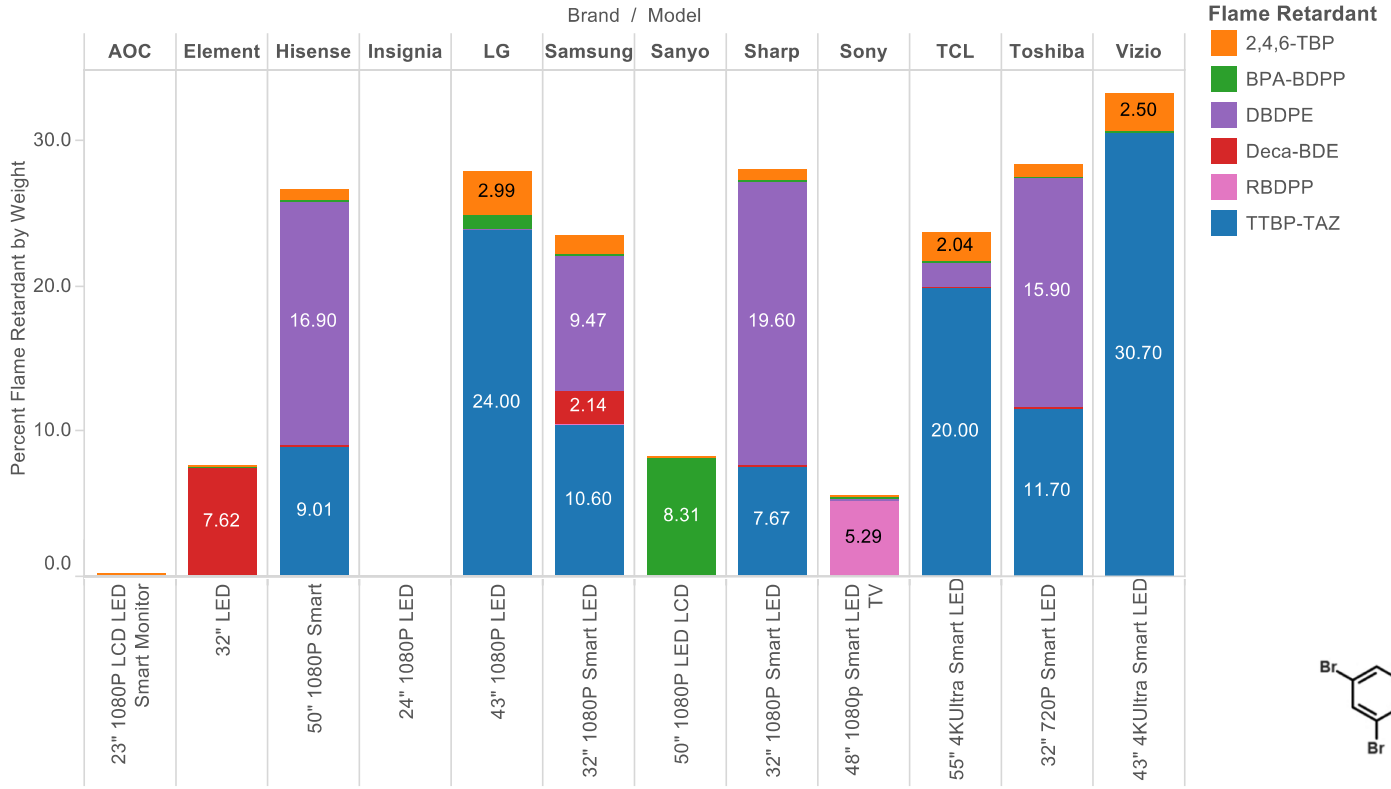
Flame Retardants in Electronics

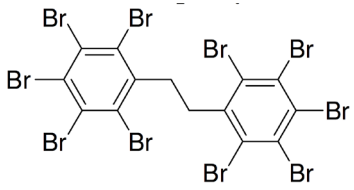
Flame retardant chemicals are used in a variety of electronic items to meet specific flammability tests:

Product	Test Method
Televisions	UL94V
Computers	UL94
Cell Phones	UL 94
Printers/Monitors	UL 94
Appliances	UL 94
Wiring/Cables	UL 1685; UL 1666

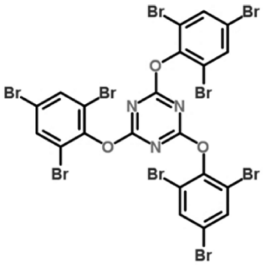
FR Chemicals Detected in TV Casings

Results: Flame Retardants in Television Enclosures





DBDPE



TTBP-TAZ

https://toxicfreefuture.org/science/research/flame-retardants-tvs/

FR Levels in Electronics

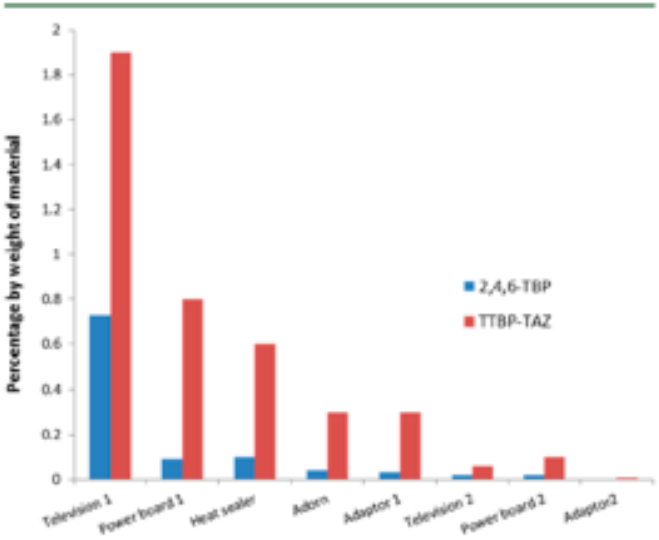
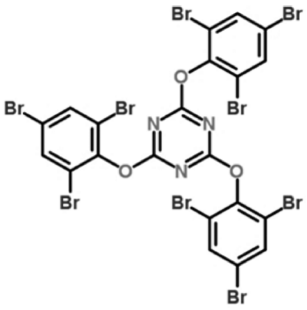


Figure 3. Concentrations (percentage by weight of material) of 2,4,6-TBP in the plastic samples containing TTBP-TAZ. The concentration values of 2,4,6-TBP are estimated or semiquantitative since the method was not validated for this compound.



TTBP-TAZ

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A Novel Brominated Triazine-based Flame Retardant (TTBP-TAZ) in Plastic Consumer Products and Indoor Dust

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FR Levels in Electronics

Flame retardant chemicals are detected in recycled and waste electrical and electronic items. Researchers use various types of equipment to detect FRs, including XRF and mass spectrometry.

Table 1
Statistical summary of total XRF-Br and MS-BFR concentrations categorized by Waste Type.

Waste type	Sample group	Total no. of samples (N)	XRF-Br range (mg kg^{-1})	XRF-Br median (mg kg^{-1})	MS-ΣBFRs range (mg kg^{-1})	MS-ΣBFRs median (mg kg^{-1})
Waste electrical and electronic equipment (WEEE)	IT & Telecoms[a]	78	0–110,000	18	0–110,000	0.5
	Small domestic appliances[a]	26	0–1,900	1	0–10,000	0.1
	Display[a]	43	0–150,000	320	0–270,000	58
	Large household appliances	57	0–2,100	0	0–2,000	0.04
	Fridge/freezer	30	0–14	0	0–3.6	0
Expanded polyurethane foams	Furniture foam[a]	20	0–12,000	110	0–8,500	100
	Mattress foam	17	0–880	59	0–870	8.4
	ELV foam[a]	38	0–780	14	0–740	1.6
Fabrics & upholstery	Furniture upholstery[a]	22	0–87,000	320	0–73,000	112
	Mattress upholstery	17	0–240	10	0–58	8.7
	ELV upholstery[a]	50	0–35,000	72	0–31,000	17
Construction & demolition	C&D EPS[a]	40	9,200	45	0–10,000	83
	C&D XPS[a]	20	160	23	0–94	20
Packaging	Pack EPS[a]	7	0–5,600	18	0–5,900	1.1
	Pack XPS[a]	14	0–1,300	2	0–370	0.2
Other textiles & plastics	ELV (other)[b]	30	0–28,000	12	0–23,000	3.8
	Curtain	15	0–88	3	0–58	0
	Carpet	31	0–9,600	8	0–7,000	0.1

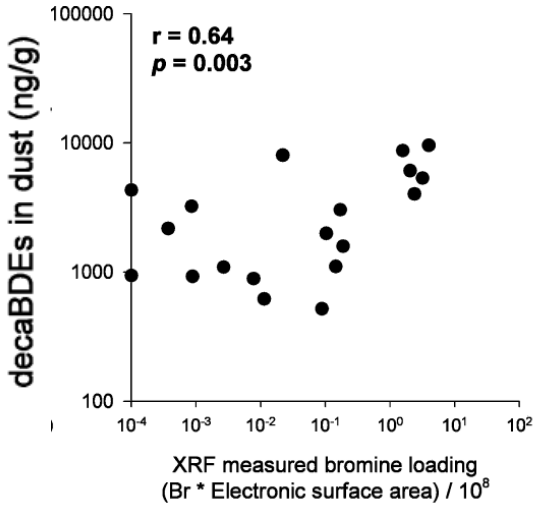
[a] Sample-groups included for regression analysis (see Section 3.2).
[b] Sample-group consists of plastics from roof trim, floor mats, under seat EPS padding, etc. thus making it unsuitable for regression of similar materials.

Sharkey et al. 2018 (Science of the Total Environment)

Links Between FR Use and Exposure

- Are electronic items sources of FRs to the home environment? Answer: Yes
- Several research studies have investigated the relationships between FR use in TVs, and levels of the same FRs in indoor dust. Higher use of FRs in TVs has been found to be significantly associated with higher levels of FRs in house dust (Allen et al. 2008). Two studies found that FR levels decreased in house dust with distance from the TV (Brandsma et al. 2013; Ballesteros-Gomez et al. 2014).

House Dust



Allen et al., 2008

Levels of FRs in Dust Predict Exposure

- Why do we care about FR levels in dust? Because it's an exposure pathway, particularly for young children

- Higher levels of FRs (PBDEs) in hand wipes and house dust, are significantly associated with levels of FRs in blood.

Hand Wipes

House Dust

Body Burden

Allen et al. 2008; Brandsma et al. 2013

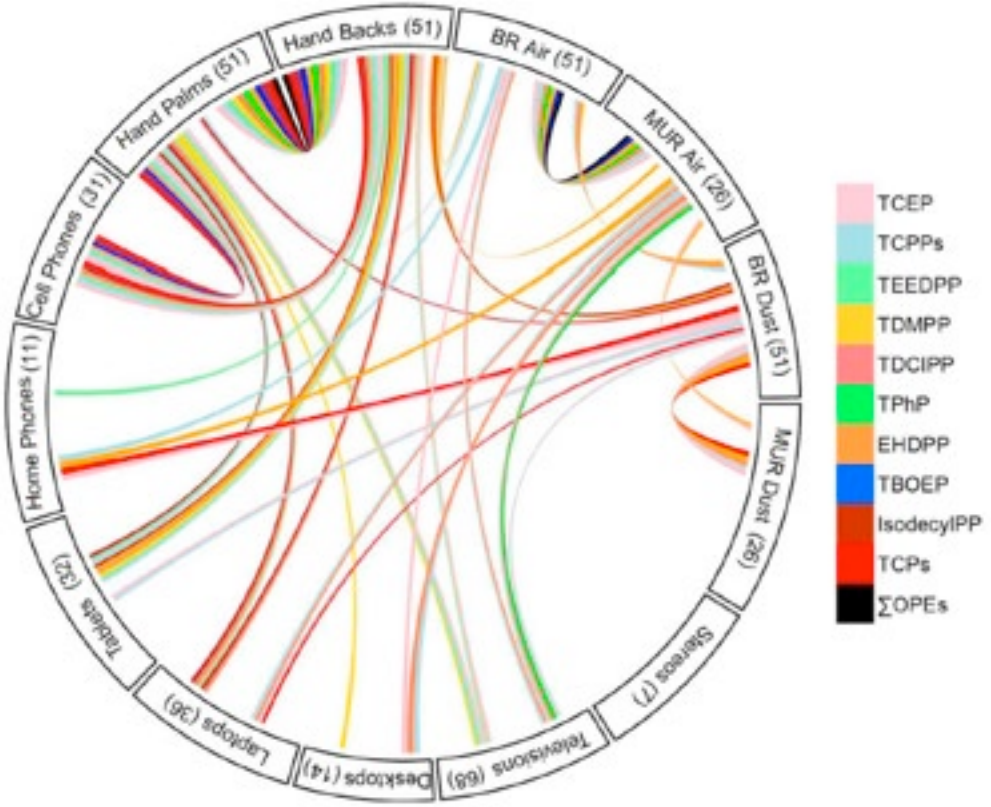
Johnson et al. 2011 Stapleton et al. 2012

Yang et al. 2019 Stapleton et al. 2018

Levels of FRs in Cell Phone Wipes Predict Exposure

- Researchers analyzed indoor air, dust, hand wipes and surface wipes of cell phones and electronic devices

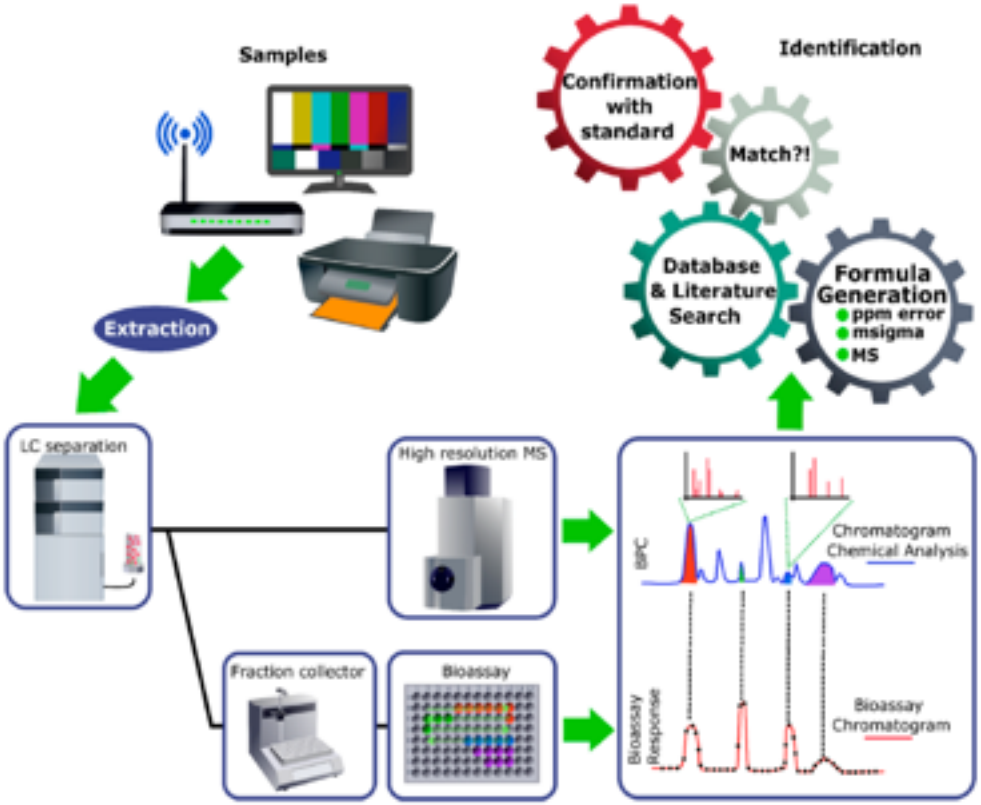
- Levels of OPEs on cell phone wipes were significantly correlated with levels on hand wipes, and urinary metabolites



Yang et al. 2019 (Environment International)

Are Chemicals in Electronics Endocrine Disruptors?

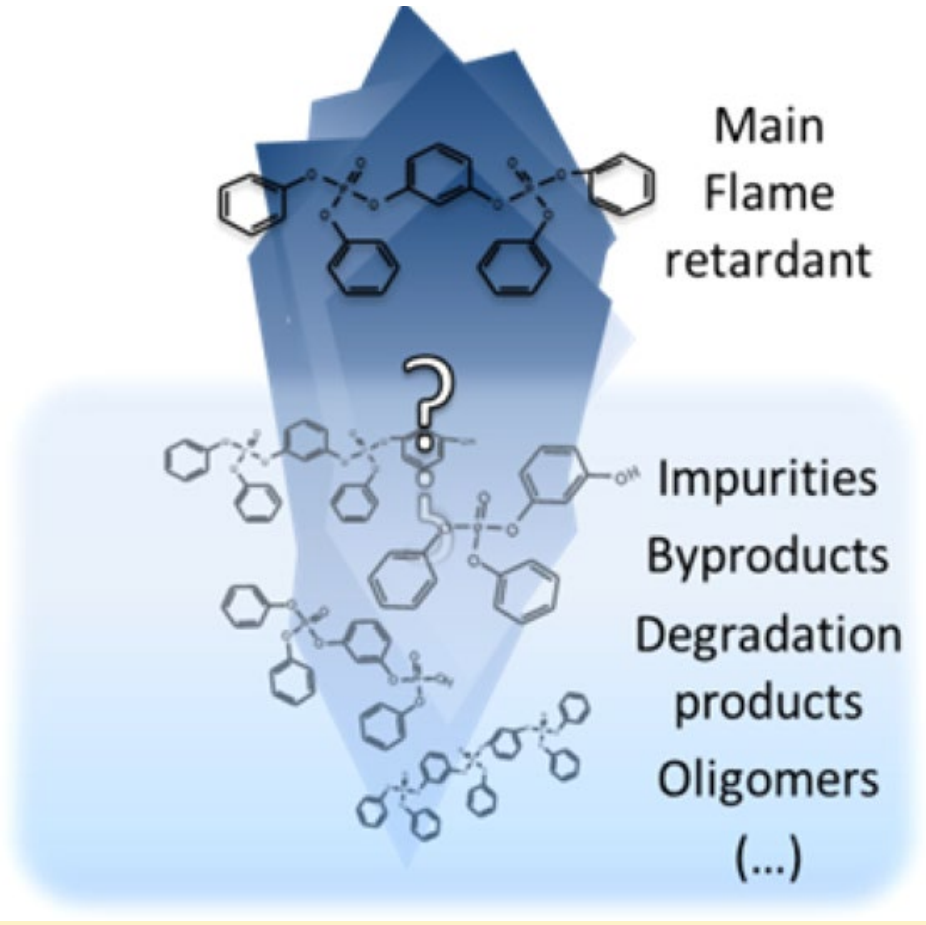
- 8 electronic casings tested
- 4 out of 8 tested positive for estrogenic activity
- Unclear if activity is from FR use, plasticizer use, or impurity



Jonker et al. 2016 (Environ. Sci. Technol.)

FR Associated Chemicals in Electronics

- Little information is available on the potential chemical impurities present in some of the newer flame retardant formulations
- Detected 7 other analogues in plastic component that were likely impurities or degradation products
- Could some of them have higher hazard profiles?



Ballesteros-Gomez et al. 2016; 2017 (Environ. Sci. Technol.)

Health Concerns

- Some of the “newer” brominated FRs are being evaluated for neurotoxicity and endocrine disruption
- With the exception of RDP/TPHP, not many OPEs used as FRs in electronics
- We should be thinking strongly about end of life issues and electronic recycling. Leslie et al. 2016 estimated that 22% of PBDEs in WEEE were expected to be found in recycled plastics

http://www.theatlantic.com/features/archive/2014/03/the-toxins-that-threaten-our-brains/284466/

Concluding Points

- There are different types of flame retardants (FRs) used in electronic products (particularly TVs), but information on specific use and application levels is limited to a few studies

- Research studies have found significant correlations between FR treatments in TVs, and levels in house dust

- Levels of FRs in hand wipes & house dust have been found to be associated with levels in blood/urine

- Some of the FRs used in TVs are considered possible endocrine disruptors