

Screening of potentially toxic additives in electronic plastic products

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The chemical safety of materials is an issue of emerging social concern. Many additives present in consumer products are suspected to cause environmental and health problems such as cancer, reproductive disorders, and severe allergies. This is the case of some phthalates, flame retardants and plasticizers. The list of toxic compounds in electronic equipment, furniture, paper, textile, etc., is long and continuously growing, since some of these contaminants are as yet unknown. For example, studies from 2012 show that manufacturers throughout the world who were using the hormone-disrupting chemical bisphenol A may have simply switched to an equally toxic analogue known as bisphenol S, to evade regulatory oversight. High concentrations of BPS were found in paper (printer paper, toilet paper, currency bills, etc.), human urine and indoor dust. In order to elucidate which compounds are present in house plastic products in the Netherlands we have analyzed a variety of electronic appliances (e.g. electrical adaptors, computer casings, heaters...). In this study, we developed wide screening methods to elucidate compounds with very different physico-chemical properties. We prepared a mass spectrometry (MS) database of plastic additives (n=250) that was used for screening the samples. The analysis was done by solvent extraction followed by liquid chromatography coupled to high resolution time-of-flight mass spectrometry (HR-TOFMS) with different ionization sources, namely electrospray ionization (ESI), atmospheric pressure ionization (APCI) or directly onto the solid by ambient mass spectrometry (direct probe-APCI-HR-TOFMS). The different ionization methods showed different selectivity and sensitivity for the different compound classes and were complementary. A variety of antioxidants, phthalates, UV filters and flame retardants were found in many of the samples. Furthermore, some recently reported impurities or degradation products coming from flame retardants were identified. Predicted values of toxicity and persistence of the compounds found in the samples were calculated with the in silico software Toxtree.