How to avoid dangerous alternative to banned chemicals in a safer approach: screening of Flame Retardants by the cumulative PBT Index in QSARINS

PAOLA GRAMATICA, ALESSANDRO SANGION,STEFANO CASSANI

QSAR Research Unit in Environmental Chemistry and Ecotoxicology, DiSTA, University of Insubria, Via J.H.Dunant 3, 21100 Varese, Italy, paola.gramatica@uninsubria.it, http://www.qsar.it.

During the last decades, Brominated Flame Retardants (BFRs) were widely used in various industrial products in order to prevent or slow down a fire. The use of some of these BFRs, such as the well-known polybrominated diphenyl ethers (PBDEs), is now restricted or prohibited under various legislations, due to their hazardous properties regarding Persistence, Bioaccumulation and Toxicity (PBT). So, nowadays PBDEs are replaced by other different New Flame Retardants (NFRs) such as new BFRs (NBFRs) or OPFRs (OrganoPhosphorous Flame Retardants). Nevertheless, the information about the chemical properties of these substitutes are often not available and these substances were commercialized without complete information regarding their PBT properties, that are based on long-term behaviors and require complex, expensive, prolonged experiments. However, the PBT assessment is expressly required in the context of REACH regulation and PBT chemicals require an authorization.

In this study, several new compounds, proposed and used as ”safer alternatives” to PBDEs, such as NBFRs and OPFRs, were analyzed with multivariate evaluation tools and screened with the cumulative PBT Index model (PAPA & GRAMATICA 2010), now implemented in QSARINS (QSAR-INSubria) (GRAMATICA et al. 2013, 2014), a new software for the development and validation of multiple linear regression (MLR-OLS) Quantitative Structure-Activity Relationship (QSAR) models. A rigorous check of the chemicals that are included in the model Applicability Domain (AD), and for this reason with the most reliable predictions, has been done. The results, obtained directly from the chemical structure for the three properties altogether, have been compared with those obtained by the US-EPA PBT profiler (US-EPA 2006) and a good agreement (73%) between the two different approaches was found, resulting in a more precautionary assignment of PBT Index. A consensus approach in these screenings is highly recommended. A priority list of the most dangerous chemicals, predicted by both the approaches, has been proposed, highlighting that some compounds, proposed as safer alternatives, are detected as intrinsically hazardous for their PBT properties (GRAMATICA et al. 2015). Moreover, this study also shows that the Insubria PBT Index model could be an effective decision-making tool to evaluate appropriate and safer substitutes, immediately from the chemical design in a benign by design approach, thus avoiding unnecessary and expensive synthesis and tests.