FIRE RETARDANTS AND FIRE SMOKE TOXICITY

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Interest in the toxic effects of fires has been rapidly increasingly, with the development of a number of international standards for its assessment. The variation in the quantity and types of toxic effluents that fires produce and the different methods that exist to assess fire toxicity, emphasise the fact that fire toxicity is dependent on both material and fire conditions. The majority of fire deaths result from the inhalation of toxic gases. The asphyxiant gases, carbon monoxide and hydrogen cyanide have yields which vary considerably with fire conditions, and this has proved difficult to replicate on a laboratory scale. In addition, fire gases contain respiratory irritants which inhibit breathing, causing flooding of the lungs. Coupled with the visual obscuration of smoke, the effects of irritants on the eyes and lungs can prevent escape, although the cause of death is almost always ascribed to asphyxiant gases, usually to carbon monoxide.

Two significant developments have helped to raise the profile of fire toxicity. The first is the development of the steady state tube furnace (ISO/DIS 19700:2013) which has been shown to replicate the toxic product yields corresponding to the individual stages of fires. The other is the acceptance of performance based fire design as an alternative to prescriptive fire regulations, so that architects can specify the components within a building based on a safe escape time within which toxic and irritant gas concentrations must not approach a lethal level (ISO 13571:2012).

Thus fire hazard is a combination of flammability and fire effluent toxicity. Halogen-based flame retardants generally increase the fire toxicity, since they interfere with the gas phase processes, increasing the yield of carbon monoxide and hydrogen halides. Many other fire retardants also affect the fire toxicity, but do so in unpredictable ways, with different patterns of behaviour for different polymers and different fire conditions. In most cases, however, no large increases in fire toxicity have been observed in the halogen free fire retarded systems we have studied.