Five plastics materials, with and without fire retardants, were studied to compare the fire hazards of non-halogenated fire retardant additives with halogenated flame retardants.

The plastic materials were identified by the sponsors as unsaturated polyesters, thermoplastic high density, low density and cross-linked low density polyethylenes, polypropylene, flexible and rigid poly (vinylchlorides), and cross-linked and thermoplastic ethylene-vinyl acetate coploymers.

The non-halogenated fire retardants tested were aluminium hydroxide (Al(OH)3), also known as alumina trihydrate (ATH), sodium alumino-carbonate, and magnesium hydroxide. The halogenated flame retardants were chlorine or bromine/antimony oxides.

The plastics were studied using the Cone Calorimeter and the cup furnace smoke toxicity method (high density polyethylene only). The Cone Calorimeter provided data on mass consumed, time to ignition, peak rate and peak time of heat release, total heat released, effective heat of combustion, average yields of CO, CO2 HCl, and HBr, and average smoke obstruction.

The concentrations of toxic gases generated in the cup furnace smoke toxicity method were used to predict the toxic potency of the mixed thermal decomposition products. The data from the Cone Calorimeter indicate that the non-halogenated fire retardants were, in most of the tested plastic formulations, more effective than the halogenated flame retardants in increasing the time to ignition. The non-halogenated fire retardants were also more effective in reducing the mass consumed, peak rate of heat release, total heat released, and effective heat of combustion, and in reducing the amount of smoke produced.

The use of halogenated flame retardans increased smoke production and CO yields and, additionally, produced the known acid gases and toxic irritants, HCl and HBr, in measruable quantities.

The chemical analytical data for the high density polyetylene samples decomposed via the cup furnace smoke toxicity method in the non-flaming mode indicated that the levels of CO and CO2 were insufficient to cause death of the test animals (rats), but deaths did occur with all samples except the one containing the halogenated flame retardant.

In the flaming mode deaths occured during exposure to the combustion products from the non-fire retarded control and from the halogenated sample; only in the latter case were the CO and CO2 concentrations high enough to cause the within exposure deaths. These toxicity are unusual, but do not indicate a need for concern, since the LC50 values are in the range typical of many common materials.