Non-toxic flame retardants

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Many multi-plug connectors pose a fire risk, as they can overheat if the current flow is high. Flame retardants in the connector can prevent fires or slow the spread of the blaze. Credit: © Fraunhofer LBF

Electronics, vehicles, textiles – almost all modern-day products contain some form of plastic. Its high combustibility means it must be protected from naked flames. New techniques simplify the production of environmentally friendly flame retardants.

Alarmingly, some 600 people die in household fires in Germany ever

year. Often started by nothing more than a small tea light, such fires can soon take hold. Once a few objects are alight, room temperatures shoot up as high as 800 degrees Celsius, and flames quickly spread to other rooms, leaving inhabitants with precious little time to escape after a fire has broken out – usually no more than around two minutes.

Modern-day apartments and offices contain considerably more combustible materials than they did a few decades ago. Items such as furniture, electronics and electrical equipment are predominantly made up of highly flammable materials that ignite easily, meaning such products would be ablaze in no time at all if it were not for addition of flame retardants. For instance, it only takes eight minutes for a television that has not been fire- proofed to go up in flames, whereas a TV set that has been treated with retardants remains undamaged. Prof. Dr. Manfred Döring and his team at the Fraunhofer Institute for Structural Durability and System Reliability LBF develop flame retardants for polymer materials. These are used inthe transport and construction industries, in electronics and electrical appliances, and many other applications. "Flame retardants prevent fires and slow the spread of the blaze. People are given more time to escape, sometimes up to 20 minutes, which significantly increases the chance of surviving a fire unharmed," says Döring.

Flame retardants must meet high standards

Flame retardants have to satisfy a number of challenging criteria. They must be environmentally friendly, non-hazardous to humans, animals and plants, and must not release any additional toxic fumes when they burn. These additives should not escape the finished product into the atmosphere, or when it comes into contact with water. And researchers must make sure the flame retardant does not react with the plastic or other components in unwelcome ways that might alter the material, influence its functionality or affect its appearance. "Flame resistant work

clothing, for instance, has to be machine washable, but cannot lose its protective properties every time it is washed. To prevent the chance of a short circuit developing into a fire, printed circuit boards in electronic devices must remain fully functional and flame retardant over many years, at temperatures that can range from -40 to +60 degrees Celsius," says Döring. He and his team of scientists only work with halogen-free, non-toxic flame retardant additives, and tailor each substance to the particular plastic in question. Depending on the intended application for the material, they use inorganic compounds and compounds containing nitrogen and phosphorous.

One such product will be on display at the K 2013 trade fair from 16 to 23 October in Düsseldorf. Fraunhofer LBF scientists are presenting a halogen-free, polymeric flame retardant for fibers that is suitable for use in flame retardant seat covers, for instance. What is unique about their product is that the scientists introduce the polymeric flame retardant as part of the extrusion process, a technique that is commonly used in the plastics industry. A polymer that is suitable for fiber spinning is mixed with a flame retardant polymer in the extruder. This is the machine that feeds raw plastic material along a jacketed screw that heats, melts and compacts the plastic before passing it through another tool under pressure to form a continuous profile. The flame retardant is evenly mixed into the base polymer by simple mechanical action. This method gives plastics manufacturers the advantage of being able to personally control the amount of flame retardant polymer that gets added, meaning that they are able to produce flame resistant polymers according to their own formulae for the very first time.

The research team at Fraunhofer LBF is in the process of setting up a fire safety laboratory that will offer a broad range of services towards the end of 2014. Chemists and engineers will then conduct efficiency tests on flame retardants found in polymers, and develop formulae for synthetic polymers such as thermoplastics, thermosets and composites.

They will examine and test the efficiency of multi-component systems, or what experts refer to as "synergetic mixtures" – compounds that multiply the inherent properties of their individual components. The scientists can also synthesize halogen-free fire retardants and scale up the synthesis as required. The range of possible applications is vast, given the growing share of components made of plastic, all of which have to be treated with flame retardants.

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