# NOVEL HALOGEN FREE FLAME RETARDANTS FOR TEXTILE FINISHING

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## ABSTRACT

Natural and synthetic polymers such as cotton (CO), polyester (PET), or polyamide (PA) are used for textiles and are omnipresent in our daily life. Besides apparel, typical indoor applications are curtains, carpets, bedding, or upholstered furniture. The disadvantage of these materials is their high flammability; therefore they represent a potential hazard for goods and life.

Flame retardant textiles are achieved by blending or finishing the polymers with inorganic salts (e.g., nontoxic aluminium or magnesium hydroxide), organohalogens (e.g., chloroparaffins, bromobiphenylether, and bromobisphenols), or formaldehyde-based flame retardants. Because of their high toxicity, the political pressure is growing steadily to replace halogen- and formaldehyde-based flame retardants. Conventional bromine-based flame retardant are highly effective but listed under REACH for there perizte and CMT properties. Several halogen-free substitutes have been developed, e.g., polyphosphates, organic phosphates, or nitrogen compounds. But for textiles there is still a lack of suitable substitutes.

Therefore, new halogen free flame retardants are requested. We established two routes for flame-retardant coatings of textiles, on the on side we used poly- and cyclophosphazen and on the other side nitrogen and phosphorous silanes.

The combination of phosphonic acid with amino-silanes is leading to a good flame-retardant finish. The disadvantage of this method was the missing washing resistance. By binding the phosphonic acid to a silane the washing resistance is increased. With commercially available amino- or isocyanato-silanes and different phosphor-compounds we build a broad library of flame retardants.

Polyphosphazenes, inorganic rubbers, are well known for their flame retardant properties, depending on their phosphorus-nitrogen backbone. On basis of this knowledge we developed new photo-graftable poly- and cyclophosphazene (PPZ), which is applicable on textiles and give them permanent flame retardant properties.

For cotton, PET, PA and blends of them we can achieve a flame retardant effect. For both classes (silanes and phosphazenes) of flame-retardant materials we find that after the first washing cycle the add-on is stable over at least six washing cycles and the modified materials withstand various standardized flammability tests.