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Opinion
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Flame Retardancy of the Cellulosic Textile: Ancient to Modern Scenario of Invention

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Opinion

Recent market survey has revealed that consumers all over the world are willing for new textile products with functionalities i.e. with improved aesthetic feel with health and hygiene. Some of the examples of the improved functionality in apparels and home textile are wrinkle resistance, soil release, water repellence, anti-microbial, resistance to colour fading and fire retardant. Among these, fire retardant textile is considered to be one of the important parameter for its application in home furnishing, hospital, railway, and aircraft. Flame retardant textile is also important for workers, who are directly engaged in oil, gas, and petroleum industries. In all such applications, mostly cellulosic textiles are used because of its advantage of comfort, soft feel, good moisture management, biodegradable property. Cellulosic textile catches flame readily and generates high temperature (around 350-400C), afterglow and toxic flammable gases (levoglucosan, pyroglucosan etc.,) in the surrounding atmosphere during burning which resulting serious health risk (apparel textile) and the damage of the textile products. Significant efforts have been made from the past to improve the flame retardant property of the cotton textile using various synthetic chemicals. Salts like alum, borax-boric acid combination, sodium potassium tartarate, tetra sodium pyrophosphate based formulation, sodium silicate, zinc oxide, calcium carbonate, alluminium trihydrate etc., based composition, nitrogen and sulphur based chemicals like thio-urea, ammonium sulfamate have been used successfully by the researchers and cotton textile industries to make it fire retardant. However, in all the cases, treated fabric required more add-on% for self-extinguishment and the fabric turns stiffer, lost its aesthetic, hand and colour value. It has been found that phosphorous based flame retardant along with nitrogenous compound (diammonium hydrogen phosphate and urea mixture) is the effective treatment has been reported so far due to their synergistic effect. However, the cotton fabric treated with such formulation lost its tensile strength and larger quantity of the chemicals has been required for the treatment. Antimony in combination with halogen, though could impart good flame retardant property, still not very successful due to negative impact of halogen compounds in environment. Nitrogen and phosphorous based proban (tetrakis hydroxyl methyl phosphonium chloride) and the pyrovatex (N,N dimethyl phosphopropionamide) process are mostly popular in the textile industry due to their excellent fire retardant property and wash durability. However, connected to those aforementioned popular processes, larger quantity of the toxic formaldehyde based chemicals and acidic conditions are required and the treated fabric lost his tensile strength (around 30%) after the treatment. Therefore continuous research is going on to reduce the add-on% required for self-extinguishment. To this end, researchers have used different nano metal oxide based formulations of nano zinc oxide, nano titania, nano aluminium hydrate, carbon nano tube etc., Researchers have also used different phosphorous based plasma polymerising gases for making fire retardant cellulosic material at low add-on%. However, these applications are costly and the treated fabric showed poor durability to washing and the rubbing. Plasma exposed fire retardant fabric lost its extinguishment potential with time duration. Recently, different intumescent based chemicals like ammonium polyphosphate, guanidine phosphate, etc., have emerged into the market. These chemicals are comparatively eco-friendly and enhanced foam like char formation during burning. From last five years different plant and protein based bio-macromolecules are also have been used for making fire retardant cellulosic material. Among the plant based bio-molecule, spinach leaf juice, banana pseudo stem sap, coconut shell extract, pomegranate rind extract have been explored as fire retardant material for the cotton fabric because of their nitrogen based alkaloid composition and due to the presence of the phenolic based tannin, phosphorous, other polyphenolic compound etc., Protein based biomolecule like DNA, casein, whey protein, hydrophobin, neuclic acid based protein etc., also have been explored in detail for making fire retardant cotton fabric. Usage of the different bio-molecules have the promising aspect of the eco-friendliness. However, major disadvantage behind the usage of those aforementioned bio-molecules are the lack of uniformity of the finish, washing durability, high amount of add-on% requirement etc., Our research group is working dedicatedly in this promising direction for further improvement.

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