

## Investigation of Gas Formation Processes in Cotton Fabrics Impregnated with Binary Compositions of Ethyl Silicate - Flame Retardant System

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**Abstract.** The use of complex fire-retardant coatings based on ethyl silicate gel - diammonium hydrogen phosphate reduces the process of smoke formation during thermal exposure to treated tissue samples, which is promising for improving the fire safety of textile materials. The compositions are easy to obtain, they do not require specific processing conditions, do not contain toxic substances. This allows us to offer developed compositions for fire protection of textile materials used in facilities with a large number of people.

### Introduction

Textile materials are dangerous at an early stage of fire development primarily due to the formation of toxic gaseous products of thermal oxidative decomposition and combustion, as well as due to high smoke-forming ability. The smoke observed during the combustion of textile materials consists mainly of microdroplets of resinous substances and carbon particles with a size of 0.1–10 μm. Therefore, to increase the level of fire safety of textile materials it is necessary in addition to reducing the flammability of the material and the rate of combustion, to decrease the number of gaseous decomposition products.

The mechanism of thermal oxidative decomposition reactions is of the greatest importance in the process of smoke formation [1], so the ability to regulate this process makes it possible to develop materials with reduced smoke formation.

In practice, the reduction of smoke formation during the combustion of polymeric materials is achieved, as a rule, by introducing reactive additives that transfer the decomposition reactions towards the formation of a carbonized residue and enrich the pyrolyzate with products that can interrupt gas-flame reactions of carbon formation [2].

Textile materials differ in composition, method of manufacture, structure and structure of fibers and threads, as well as the density and thickness of the fabrics, which affects the choice of fire protection [3]. The main requirements for fire-resistant coatings on fabrics are elasticity, high adhesion to fabric fibers, abrasion resistance, fire resistance, hydrophobicity.

There are several ways to obtain fibers and textiles with low flammability [4, 5]:

- a) the use of highly heat-resistant fiber-forming organic polymers;
- b) use of inorganic fibers;
- c) modification of the fiber-forming polymer at the stage of its synthesis;
- d) modification of the fiber at the stage of its formation by using stabilizers and flame retardants of the reaction and additive type;
- e) surface or bulk treatment of fibers, fabrics or finished products with the formation of insoluble compounds on their surface.

The most common method of fire protection is surface treatment or impregnation with the use of flame retardants of the reaction or additive type [6].