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Prospects for the use of Nature Alumosilicates in Textile Chemistry

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Abbreviations: FAS: Fluorinated Aluminum Silicate

Short Communication

Different types of silicates and alumosilicates are the largest class of widespread minerals. This substances due to specific properties are used in various fields of industry, but information about the practical application in the textile industry is very limited. However, the unique properties of these minerals can be served for needs of textile chemistry. Textile finishing production includes three main stages: preparation, coloring (dyeing and/or printing) and the final finishing. Each of these stages has its own tasks and includes various processes. The number and sequence of operations influence the material quality. Taking into account the specific properties of insoluble silicates and alumosilicates, we try to use them in various technologies. We used natural minerals, which have a different chemical composition, impurities and particle size distribution. These factors influence the properties and colour of minerals. Also synthetic fluorinated aluminum silicate (FAS) is used. It is a by-product in manufacture of aluminum fluoride and contains AlF3 as an impurity up to 2-8 %. In this paper the results of investigations in using of various alumosilicates at different needs are presented to your attention.

Preparation

The bleaching with hydrogen peroxide is the most important stage of preparation technology. But the instability of the peroxide solutions requires the presence stabilizer in bleaching bath. Usually soluble sodium silicates are used for these purposes. But they form hard removal precipitants on the equipment and fabric and they can cause the increase in toughness, shrinking and high fiber destruction. We studied the stabilizing effect of insoluble silicates. It was showed that natural silicates can influence the hydrogen peroxide stability in different ways. If mineral contains impurities of polyvalent metals it catalyzes the decomposition of hydrogen peroxide. The other alumosilicates stabilize peroxide solutions. It is known that decomposition of hydrogen peroxide is catalyzed by polyvalent metals. And therefore sorption activity of insoluble silicates was estimated in order to clear a question on the mechanism of their action. With this purpose the analysis water on the maintenance different metals was made. According to the received data, soluble silicates are active absorbers of all metals. But it is necessary to take into account, that Ca^{2+} and Mg^{2+} possess stabilize activity. It was established that the presence of nature silicates in a bleaching bath increases the content of Ca^{2+} and Mg^{2+} and decreases concentration of polyvalent metals. It is a consequence of the ionic exchange reaction between solid silicates and solution. This fact shows a high absorption ability and stabilize activity of some native silicates.The bleaching increases the whiteness of fabric, gives addition of weight, reduces destruction and does not cause increase hard tissue and shrinkage.

Coloring

Different classes of dyes are used for the dyeing and printing of textile materials. And this dyes can enter in the wastewater of textile manufactures. High sorption activity of insoluble alumosilicates can be used for wastewater purification. The alumosilicates absorb the pigments, acid, chromic and direct dyes actively, but the react dyes are absorbed in the less step. The sorption of dyes does not lead to dye destruction. It is accompanied by solution discouloration and colour change of precipitated minerals. The addition of hydrogen peroxide to the dispersion of minerals, having polyvalent metal impurities, improves solution discoloration. In this case dye solution is discoulored very quickly. The reason of this phenomena is the catalytic decomposition of hydrogen peroxide, which causes the destruction of the dye chromophoric structure up to colorless safe substances.

The Final Finishing

The purpose of this process step is to improve the quality or making new consumer properties. Modification of the wool fiber properties. It is known that the wool fiber has a number of positive properties: (it is elastic, retains heat well etc.) but wool is destructed under the action of light and heat, moisture and microorganisms. At the same time wool fiber has a unique structure (surface scaly layer and pores and voids up to 12 mkm.). On the other hand, alumosilicates are polydisperse and contain particles of different sizes. The smallest fraction can be fixed on the wool surface and give the new properties. In our work the wool ability to absorb aluminosilicate powders was investigated. It was established, that two processes take place in the processing of the wool fiber in water alumosilicates dispersion:

a) Sorption of tiny particles, which is accompanied by an increase in the fiber weight;

b) Abrasion of fiber by "hard" particles of minerals. It leads to weight loss.

Processing of wool fiber in minerals dispersions is accompanied by a monotonic increase in mass during 25-30 min. At this stage nanosize particles of minerals are absorbed by wool very actively. However abrasion process dominates after filling the voids of fiber. Larger abrasive particles and impurities of minerals damage the scaly layer. This causes a decrease in the mass of fiber. The sorption of minerals causes a change of colour (lightness) fibers, improves resistance to UV exposure and decay. The use of different minerals allows affect the colour of the fiber, its felting, shrinkage and resilience to unfavorable external factors. Synthetic alumosilicate (FAS) contains insoluble and water-soluble (AlF_3) fractions and has the properties of the catalyst and hydrophobizator. This allows to use it in the final finishing of cellulose textile materials (waterproof, shape stability etc.). And we can choose the results of this using: This are

a. Improvement of the technical result and reduction of the degradation; or

b. Decrease the fixation temperature up to 120°C without quality worsening.

Application of FAS in these processes reduces the fixation temperature up to 120°C, improves the technical results and keeps the soft neck of fabrics. Thus insoluble silicates and alumosilicates can be applicated in textile industry both for technological needs and for waste water purification.

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