

HYDROPHOBIZATION OF VISCOSE FIBERS WITH POLYACRYLATES AND POLYSILOXANES

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Introduction

On the textile market the demand for fibres that repel water has been increasing in recent years. Hydrophobic fibres have become important for the production of clothing, home and technical textiles. Many common hydrophobization agents are based on fluorocarbons, which are contested because of their environmental

persistence and toxicity^{1,2}.

In this work different hydrophobization agents were applied on viscose fibres including emulsions of different polyacrylates and solutions of a trimethoxysilane.

Experimental procedure

For the preparation of distinct polyacrylate emulsions, 3 different monomers, butyl, 2-ethylhexyl and lauryl acrylate (Fig. 1) were polymerized via emulsion polymerization respectively.

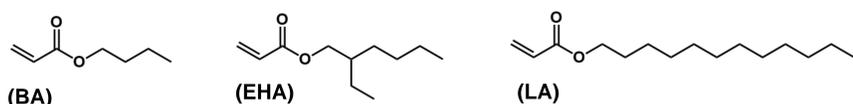


Figure 1: The monomers butyl acrylate (BA), 2-ethylhexyl acrylate (EHA) and lauryl acrylate (LA) used for the preparation of different polyacrylate emulsions.

Therefore, a round bottom flask was loaded with an aqueous solution of 1 wt% sodium dodecyl sulfate as emulsifier. For each polymer emulsion the respective acrylate was mixed together with an aqueous solution of 1 wt% sodium dodecyl sulfate and 0.1 wt% sodium peroxodisulphate acting as initiator. The obtained monomer emulsion was added dropwise to the emulsifier solution in the flask and heated up to 60 °C (Fig. 2a). The overall ratio of water to monomer was 4:1. After 6 hours the reaction was stopped by cooling the resulting polymer emulsion to room temperature. For each emulsion the polyacrylate content was determined gravimetrically by precipitating (Fig. 2b) a small fraction of emulsion with methanol, filtering it off, and drying it. (Fig. 2c).



Figure 2: Reaction apparatus for the synthesis of a polyacrylate (a), the precipitation of polyacrylate (b), and the filtered and dried polyacrylate (c).

The viscose fibers used for experiments were obtained from Kelheim Fibres. The fibers were treated with the different polyacrylate emulsions with a dilution to 1 wt% of polymer content. The duration of impregnation was 10 minutes at a temperature of 60 °C. Afterwards the fibers were dried with a certain temperature program in the oven. For the treatment of viscose fibers with polysiloxane, an aqueous solution of 1 wt% 3-aminopropyltriethoxysilane (Fig. 3) was used accordingly the same procedure as for the treatment with polyacrylates.

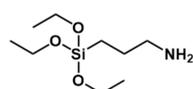


Figure 3: 3-aminopropyltriethoxysilane (APS).

Untreated, as well as treated fibers were analyzed by tensiometry in order to characterize their hydrophobic traits. Therefore, all fiber samples were screened using the solvents *n*-hexane, toluene, ethanol, ethylene glycol and water. The increase of the solvent's mass was recorded over time. According to the Washburn method, the polar (σ_p) and disperse (σ_d) fraction of the surface energy was calculated for each fiber sample.

Results

All polyacrylate emulsions obtained from polymerization reactions had a polymer content of 17 wt%.

For determining the performance of the different hydrophobization agents the ratio of σ_p and σ_d was used as a measure for the sample's hydrophobicity. The lower the value, the higher the hydrophobicity (Fig. 4, left). To better illustrate the hydrophobic characteristics of the treated fibers the measured tensiometry curves for water are depicted (Fig. 4, right).

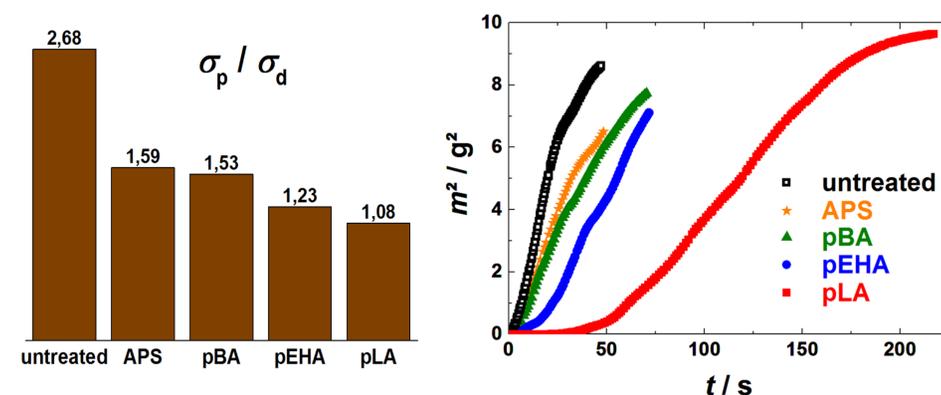


Figure 4: Ratios of polar and disperse surface energy fractions of viscose fibers untreated, and after treatment with different hydrophobization agents (left). Tensiometry curves for water, investigating viscose fibers untreated and treated with 3-aminopropyltriethoxysilane (APS), polybutyl- (pBA), polyethylhexyl- (pEHA) and polylauryl acrylate (pLA) (right).

Comparing the results of untreated and treated fibers, all agents had led to a lower σ_p / σ_d value and thus enhanced hydrophobicity of viscose fibers. Comparing the fibers treated with the different polymer emulsions, the hydrophobicity is increasing with increasing length of the alkyl chain of the polyacrylates. The hydrophobicity of the fibers modified with 3-aminopropyltriethoxysilane is comparable with the value for polybutyl acrylate. Altogether, best performance regarding hydrophobization was achieved by treating the viscose fibers with a polylauryl acrylate emulsion.

References

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