Modification of Wool Fibers by Atmospheric Pressure Plasma Treatment

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Abstract

Wool fabrics were treated by pulsed atmospheric plasma in six different periods between 0.1 min and 5 min of residence time. The treatment parameters like power and flow rate of processing gas kept constant.

Shrink-proofing property, deep dyeing property, change of fabric handle, and water-absorbing property were investigated for the samples. As the results, shrink-proofing property, deep dyeing property and water-absorbing property increased linearly with the radiation period, however, those properties saturate at the condition of the period larger than 3 min. On the other hand, hysteresis of shearing property; 2HG5, which is one of the major mechanical parameter of fabric handle, becomes larger with the radiation duration period. This value is related to the improvement of shrink-proofing and other properties.

Shrink-proofing processing of the wool by Vacuum plasma is studied all over the world for many years, and there are many researches.

On the other hand, research aiming at Shrink-proofing of wool fabrics is also already done from around 1966 by the corona discharge performed under atmospheric pressure, and the low-temperature electric discharge process improved further is being brought into the limelight as technology which extends a new applicable field from the simplicity and validity.

This research is related with the method of making woolen shrink-proofing and an improvement of stainability most effectively economically using air without using special carrier gas.

Experiment

It is reported by Mori that keratin protein fibers such as wool fibers are improved their washability, deep dyeing property and water-absorbing property by low temperature plasma treatment. Excellent elastic property of wool fibers did not lose by the treatment. Chlorination treatment was generally carried out for obtaining shrink-proofing and deep dyeing property, however, it had environmental and safety problems. Although these problems were solved by the low temperature plasma treatment, the treatment was carried out in the conditions of vacuum state, large equipment is necessary and productivity was low. Therefore, plasma treatment in atmospheric pressure conditions at low temperature is spotlighted for practical application in various fields recently.

In this paper, wool fabrics were treated by Dielectric Barrier Discharge (DBD) equipment and changes of their characteristics were studied. In this experiment a DBD system of Institute of Textile Technology Denkendorf with four ceramic rods on the high voltage side and a ceramic coated roller on the grounded side of discharge gap is used. The processing gas was ambient air, which is sucked by an exhauster through the gap. The textile is guided several times through the discharge by rotating the substrate together with the roller.