Journal of Fiber Bioengineering & Informatics 4:4 (2011) 403–411
http://www.jfbi.org | doi:10.3993/jfbi12201110

Hydrophilic Properties of PP/CHA Nonwoven Fabrics

Lingling Fan, Deshan Cheng, Xiangyu Jin*

Engineering Research Center of Technical Textiles, Ministry of Education
Donghua University, Shanghai 201620, China

Abstract

This paper presents the preparation of PP/CHA melt-blown nonwoven fabric and the studies on its hydrophilic property. The property of polymer materials was investigated at the first place by differential thermal analysis (DSC) and rheology analysis. SEM was used to study the web structure affected by the hot air temperature. Wide-angle X-ray Diffraction (WAXD) was used to study the degree of crystallization of PP/CHA melt-blown nonwovens produced at different hot air temperatures. The hydrophilic property of PP/CHA melt-blown nonwoven fabrics was studied by testing the static water contact angle, the liquid wicking rate and the multiple liquid strikethrough time. The static contact angle test proves that hydrophilic properties were obtained by means of using the Commercial Hydrophilic Additive (CHA), while the addition of the Traditional Hydrophilic Additive (THA) did not. The liquid wicking rate test shows that PP/CHA nonwoven fabric has the highest liquid wicking rate due to its hydrophilic groups transferred to the surface and forming a hydrophilic film. The multiple liquid strikethrough time indicates that the nonwoven fabric treated by THA loses its wettability after 3 insults, while nonwovens containing 5.5% CHA remained hydrophilic even after 12 insults. It can be concluded that PP/CHA melt-blown nonwoven fabrics have durable hydrophilic property.

Keywords: PP/CHA Melt-blown Nonwoven; Preparation; Additive; Hydrophilicity; Static Contact Angle

1 Introduction

Nonwovens have become one of the fast growing industries in the textile world. Nonwoven fabrics are processed by web forming and web consolidation, which are different from the processes of conventional textile fabrics. Melt-blown nonwovens possess a 3-dimentional network structure fabricated by ultrafine fibers, which gives them small pore size, high porosity, good filtration and absorption properties [1].

With nonwoven products moving into more technical end-uses, Polypropylene (PP) fibres have grown to be one of the dominant materials in the nonwovens industry. It is estimated that over 90% of all Melt-blown (MB) nonwovens are made from Polypropylene (PP), because of its low

*Corresponding author.
Email address: jinxy@dhu.edu.cn (Xiangyu Jin).

cost, ease of processing, favorable chemical and physical properties, such as lack of heat shrinkage, impact strength, tensile strength, and its ability to be drawn into very fine fibers [2].

However, PP is a typical hydrophobic polymer, so its melt-blown nonwovens have poor hydrophilicity, which limits their use in some areas. To improve wettability and increase the surface energy of PP nonwoven fabrics, many techniques have been studied to introduce polar groups to the surface and enrich surface functionality. Chemical treatments have been used to create hydroxyl and carboxylic acid groups on PP nonwoven fabrics [3-7]. Surface coatings with a solution containing hydrophilic substances have also been used to improve the hydrophilic properties [8, 9].

Besides these modification techniques, the use of migratory additives, i.e., materials added to the melt that exhibit controlled migration to the surface of the PP nonwoven fabrics, have been recognized as low cost materials and reliable method to generate desirable surface properties without altering the bulk properties [10]. Migratory additives have been of great interest for several reasons. They are efficient, as only a small quantity of additive is needed to significantly change the polymer surface property [11]. Furthermore, compared with other techniques such as plasma treatment [12-14], surface grafting [15-18], and solution coating [8, 9], migratory additives do not require post processing and solvent handling.

Many nonionic surfactants have been used as migratory additives to render PP nonwovens' surface hydrophilic. Examples include lauric acid diethanol amide [11], and polyethylene glycol (PEG) lauryl ether [19]. An ionic surfactant, sodium alkenesulfonate with 15 carbons, was used to hydrophilize PP fabric as well [20]. Although a lot of surfactants are reported to be able to change the surface properties of PP films, there has been a little work reported to systematically study the effects of hydrophilic additives on the surface hydrophilicity of PP melt-blown nonwoven fabrics.

In this article, we investigate the properties of PP melt-blown nonwoven fabrics modified by blending with a Novel Hydrophilic Additive (CHA) in different melt-blown process conditions.

2 Experiments

2.1 Materials

Polypropylene was obtained from Shanghai Expert Company as the base polymer for this study. The Novel Hydrophilic Additive (CHA) was a pre blended mixture of 40% PP and 60% active ingredients, which structure as $CH_3CH_2(CH_2CH_2)_aCH_2CH_2(OCH_2CH_2)_bOH$, in which a=9-25 and b=1-10. A Traditional Hydrophilic Additive (THA), which probably contains a substance structured as HO $(CH_2CH_2O)_nH$.

2.2 Polymer Characterization

2.2.1 Thermal Analysis

Thermal analysis was carried out using the Differential Scanning Calorimeter (DSC). Polymer materials were heated from room temperature to 200℃ at a heating rate of 10℃/min in the N_2