NC STATE UNIVERSITY

JTATM

JOURNAL OF TEXTILE AND APPAREL, TECHNOLOGY AND MANAGEMENT

Volume 1, Issue 1, September 2000

FORMATION OF SHAPED/MOLDED MELTBLOWING NONWOVEN STRUCTURES

Yogeshwar Velu, Raoul Farer, Tushar Ghosh, Abdelfattah Seyam
North Carolina State University

ABSTRACT

Three dimensional (3D) fiberweb structures are useful in many applications. The Robotic Fiber Assembly and Control System (RFACS) being developed in this research allows precise control of fiber meltblown fiber deposition on a 3D mold surface. The effect of various process parameters on a number of polypropylene (PP) web characteristics is reported. Under the experimental range studied, the fiber orientation distribution was significantly impacted by the process parameters. The fiber diameter distributions indicate that they are unique to a particular process condition. The distributions do not overlap when a parameter is evaluated. In keeping with the long-term objective of developing chemical/biological barrier fabrics using RFACS technology, the pore distribution of the fiberwebs was characterized. Under the conditions explored, the average pore size of the analyzing web has decreased by 60% when the attenuating air pressure was increased from 0.7 bar to 2.8 bar. The pore size was decreased by 33% when the take up speed of the web was increased from 20 ft/min to 50 ft/min.

1. INTRODUCTION

Nonwoven webs can be produced as sheet structures by using meltblown technology [23]. In meltblowing, molten polymer is extruded through a series of orifices in a knife-edge die. The die is jacketed on both sides by high velocity laminar sheets of air. The polymer streams from the orifices are elongated by the air-drag to form fibers, which are collected on a drum or other suitable collecting surface. Fiber diameters can range from 500 microns to as small as 0.1 microns (µm). The extreme entanglement of fibers, characterizing meltblown fibrous webs, produces coherency and strength. The density of the web is such that it has the property to contain and retain particulate matter [12], thus qualifying such structures for filtration applications. The entanglement of these long fibers makes it impossible to remove one fiber from the web or to trace one fiber from beginning to end [7]. Meltblown webs are lightweight with a high surface area. They display a high insulating value and excellent filter characteristics [3, 17]. Meltblown technology can be used to produce efficient filter materials, filtering particles that are bigger than 0.5 µm [24].

The long term objective of this research is to develop technology to produce shaped protective garments, substantially to its final shape and using minimal seaming or joining. The latter usually constitute the “weak-link” in a protective system. The integration of meltblowing technology and robotics can achieve the proper formation of molded or shaped seamless structure that may be incorporated in a protective clothing system. In integrating the two technologies the fiber web collector is usually a mold object structure. The mold can be manipulated to rotate continuously so as to form the molded fabric. The size of the die width should be smaller than the size of the mold to have a good control over the deposition of the fibers on the mold.

The usefulness of molded fabrics so obtained depends on the performance characteristics of the web structures. The desired performance characteristics, globally and locally, can be enumerated as strength, abrasion resistance, tear