PP6 FLUOROCHEMICAL MELT ADDITIVE MIGRATION AND REPELLENCY IN NONWOVENS

Joseph Lavoie, Saad Khan, Behnam Pourdeyimi, Eunkyoung Shim
North Carolina State University

Bulk polymer additives are commonly used in the nonwovens manufacturing industry for a variety of applications. One such application is the modification of surface properties for controlled repellency of fluids. This is particularly relevant in the field of electret air filtration materials, which have been shown to be rapidly discharged in the presence of oil and alcohol vapors or aerosols. Increased resistance to wetting by these low surface tension fluids can be challenging, but the use of additives to create nonwoven fabrics capable of repelling oils and alcohols allows these products to be manufactured cheaply and easily. Unfortunately, while the use of melt additives is established in the prior art, there are many factors in the efficacy of the additives on the resultant properties of the final product, not all of which are well understood. Chief among these is the impact of additive migration on surface properties of manufactured fibers. In this work we seek to explore the effects of melt additive migration on meltblown nonwoven fibers as well as the kinetics and resultant microstructure of additive migration in the polymer matrix.

Fibers containing fluorochemical melt additive compounds were characterized by several different analytical techniques in order to investigate the resultant impacts of additive content on fiber properties. Scanning Electron Microscopy (SEM) images of nonwoven fiber mats allow for the quantitative evaluation of median fiber diameter. By monitoring changes in fiber diameter with respect to additive concentration and fiber manufacturing parameters, we are able to elucidate the correlation between these critical parameters. X-ray Photoelectron Spectroscopy (XPS) was used to characterize the kinetics of the changing surface composition of the fiber mat, as migration of the additive to the surface occurs over time. In an effort to gain a more thorough understanding of the migration process, Time-of-Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) was used to generate compositional maps of fiber cross-sections. These 2D maps of fluorine content throughout the core and surface of fibers offer a unique view of additive migration and allow for additional understanding of the role of fiber diameter and nonwoven manufacturing methods on the resultant surface properties of the material.

Migration of additives was monitored over several months, allowing for the evaluation of compositional changes over multiple timescales. This changing composition was then related to repellency of alcohol solutions via contact angle data. By collecting composition and contact angle data in tandem, thresholds in surface fluorine content for repellency were identified, as well as protection of charge against isopropanol vapor discharging methods.