Alginate Aerogels for Textile Applications

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Aerogels are nanoporous materials with unique properties such as high surface areas, low densities and high pore volumes that can be adjusted during their synthesis. Recently, they are attracting increasing attention for development of a wide variety of products for textile applications due to their low thermal conductivities and high liquid absorbency. In this study, we produced alginate aerogels in three different forms for textile applications. These are alginate aerogel PET fibrous composite, alginate aerogel beads and alginate aerogel fibers. Alginate aerogel based PET fibrous nanoporous composite was produced by immersing the nonwoven PET fabric into an alginate solution followed by dripping a $CaCl_2$ solution which resulted in the formation of alginate gel between PET fibers. The composite was then dried by supercritical extraction at 308 K and 10 MPa. For synthesis of alginate aerogel beads, a burette was filled with an alginate solution and dripped into a solution of $CaCl_2$ to form spherical gel beads. These gels were dried by supercritical extraction at 308 K and 10 MPa. Alginate aerogel fibers were formed by extrusion of an alginate solution into a $CaCl_2$ solution using a syringe pump. The gel fibers were also supercritically dried. These materials were characterized by IR spectroscopy, SEM and nitrogen adsorption. Their thermal properties were measured by the hot plate method and their mechanical properties were determined by tensile and compression tests. These described forms of alginate aerogels had high surface areas and low densities i.e. 360 m^2/g and 0.06 g/cm^3 respectively. The pore size of these materials was in mesoporous range. Alginate aerogel beads and alginate aerogel fibers had more than 90% liquid absorbency. The diameter of an alginate aerogel single fiber was 0.9 mm and the compressive stress of fiber was 2MPa.The thermal diffusivity was reduced from 0.233 to 0.142 mm^2/s and thermal resistivity was increased from 83.4 to 110.6 $mK/W.m^2$ after the incorporation of alginate aerogel into the PET nonwoven fabric.