Designing Impact Resistant STF Composites for Various Weather Conditions

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Millions of sports and recreation-related injuries occur each year. Shock absorbing composites using shear thickening fluids (STF) or dilatant materials were fabricated and tested with the goal of exploring their potential as protective sportswear. The effect of varying weather conditions on STF composites made of Silica and Propylene Glycol and the role of additives in the STF mix in mitigating impact shock were studied. Drop tests were conducted by releasing a 1.1 lb weight from an electromagnet on fabricated STF composites. The impact force for each sample was measured with an electronic sensor. The shock absorption percentages for each sample was calculated from the forces obtained from the drop tests. The weight and height of the drops were chosen based on typical forces of an impact that would cause injury in sports. The samples were also subjected to 0 degrees F, 70 degrees F, and 105 degrees F before testing. A composite of Nylon fabric and Silica-propylene glycol-carbon nanoparticles STF mix displayed better shock absorption behavior than other fabricated STF composites with different additives in all tested temperatures. The Silica-PG-Carbon composite also performed 10% better than commercial proprietary shock absorption materials such as D30, Poron, Sorbothane, and Auxadyne. STF composites were deteriorated at higher temperatures, but the carbon and cerium oxide additives greatly reduced the amount of degradation. The study successfully demonstrates that STFs can be used to fabricate high-performing protective composites for sportswear and other shock-absorbing applications.

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