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# BARCELONA ZERO-GRAVITY CHALLENGE 2024 EDITION WINNING STUDY: SHEAR-THICKENING FLUID AS A CUSHION FOR FORCE ABSORPTION IN MICROGRAVITY

**Abstract**

Non-Newtonian fluids, specifically shear-thickening fluids (STF), are fluids that increase in viscosity as the shear rate increases. This property, which allows the fluid to act as a solid when shear stress is applied and as a regular fluid otherwise, has been utilized in impact protection applications due to its flexibility and effectiveness in absorbing shock. Certain STF compositions classify as suspensions, in which particles are suspended in a fluid; in the presence of gravity, the particles in a contained suspension are expected to settle at the bottom inside, in a process called sedimentation. Whereas the absence of gravity prompts the expectation that sedimentation effects are absent as particles remain suspended throughout, with the pull of a downward force. With this, the researchers hypothesize that STFs may be suitable for developing protection and cushioning systems for objects in microgravity and zero-gravity environments, due to this key characteristic. In the experimentation to demonstrate this, two samples of dried sheep flat bone, one encased in an STF-filled pouch and one not encased, were placed in a container along with a weighted object, and subjected to an experience of hypergravity, microgravity, and zero-gravity, as simulated through parabolic flight on an aerobatic plane. Post-flight observations showed both control and experimental samples had no alterations in color, surface texture, and structural integrity after the flight, and that the STF in the encasing of the protected sample had sedimented, presumably from the hypergravity conditions caused by the landing of the plane. Further, a replication of the experiment under normal gravity conditions on ground found that the STF used in its non-sedimented state had a force reduction of 10.59%, and a force reduction of 4.88% in its sedimented state.