The Strength Analysis of Altered Magnetorheological Fluids Compared to Industrial Types in Silicone Oil Based Carrier Fluids Induced via a Magnetic Flux

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Magnetorheological fluids (MRFs) are non-newtonian liquids that can transform into a quasi-solid with the manipulation of a magnetic/electromagnetic field. MRFs have several applications as the fluids' ability to rapidly change in rheological behavior makes them attractive for use in shock suppressors (brakes, dampers) and for military applications in armor. However, industrial MRFs, composed of a Silicone Oil base with Iron Carbonyl Particles (ICP), have shown substantial degradation in both yield strength and solidification of the substance over time and in higher temperatures. Moreover, the lack of strength in current MRFs restricts the material's ability to be used for the long-term and with large loads. That is why in the experiment, various fluids were tested against the industrial base: silicone oil. In an attempt to find the most effective alternative, 3 tests were conducted, including a yield strength test, temperature degradation evaluation, and a sedimentation performance indicator. The hypothesis was that Ethylene Glycol would yield a higher yield strength across the tests. However, the hypothesis was disproved as the most effective variable is the Lyotropic Liquid Crystalline Solution with an average rank of 1.333 across the tests. After the conclusion of the tests, the top three variables were further evaluated alongside two additional solutions at 5 alternative ICP to base volume ratios. The findings suggest that the Solution 1 MRF, composed primarily of LLCS, is the most effective MRF with a lower optimization point and a higher yield strength, making the material more promising for industrial and military applications.

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