Development of in-situ Fabrication Techniques of Martian Construction Material

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Future Martian explorers will require construction material to build structures and shelters. The cost and lengthy process of shipping material from Earth to Mars makes it an impractical approach to solving this problem. The goal of this research project is to develop a method by which astronauts can fabricate construction material on-site in addition to suggesting landing sites where materials are abundant. The first phase of this research project involved finding the optimum conditions for manufacturing bricks using simulated Martian regolith. A load of 6 tons was applied via cylindrical die to the simulated dirt contained in a compression mold to form circular “bricks”. Bricks made of various grades of regolith were tested under compression to understand the effect of soil particle size on brick strength. It was found that bricks formed with superfine grade regolith (< 500 microns diameter particulate) had the greatest ultimate compressive strength. The second phase of this research investigated the effect of adding organic (potato starch and cornstarch) and inorganic (Sulfur) binders. Sulfur was chosen as the inorganic binder because Mars is a sulfur-rich planet and the plant-based binders were chosen based on their ability to be grown on the planet. It was found that regolith mixed with molten Sulfur and then compressed into a brick produced a composite material that had the greatest ultimate compressive strength out of all our samples - similar to that of conventional concrete. Sulfur samples also proved to best withstand harsh Martian conditions according to hardness, and impact tests done.

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