Development of Geopolymers for Application on Mars

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Abstract. Geopolymers have emerged as a promising material option for in-situ construction on Mars due to their inherent material properties and availability of raw materials across the globally consistent basaltic composition of Martian regolith (Fackrell et al., 2021). This review presents the current state-of-the-art geopolymer research, which primarily investigates the various base compositions of geopolymers, factors influencing the Geopolymerization process. These investigations encompass considerations such as binders, water availability, energy sources, aggregate options, properties of fresh materials, structural requirements, and durability concerns (Reches, 2019), which encompass both compression and flexural strength assessments, pivotal for evaluating the efficacy of geopolymer materials in Martian conditions. The subsequent research aims to extend current understanding by conducting experiments and testing real-scale prototypes in controlled environments, including the collection of volcanic ash from Sicily to simulate Martian basalt soil. Further testing with 1:1 scale aggregates and fibers will be crucial to optimize the composition ratio, while material characterization will provide insights into enhancing the performance and durability of geopolymers in extraterrestrial environments. This approach aims to contribute to the development of resource-efficient construction practices through working prototypes and material characterization for future Martian exploration and habitation.

Keywords: In-situ resources; Geopolymer; 3D Printing; Off-earth habitats;

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