ISRU 3D Printing of High Solid Suspensions for Off-Earth Construction. A. E. Marnot[1] and B. K. Brettmann[1,2], [1]School of Chemical and Biomolecular Engineering, Georgia Institute of Technology, 901 Atlantic Dr. NW, Atlanta GA, 30332, [2]School of Materials Science and Engineering, Georgia Institute of Technology, 901 Atlantic Dr. NW, Atlanta GA, 30332. (Contact: amarnot3@gatech.edu)

Introduction: With the upcoming return to the Moon and crewed missions to Mars in preparation, additive manufacturing techniques are becoming more prevalent within the construction space. In contrast to the processing difficulties that hinder the use traditional AM methods in low-temperature, low-gravity, and low-atmospheric environments, direct-ink-write (DIW) offers unique solutions to these challenges. When used to process locally-derived resources, DIW can facilitate the construction of operating bases on other planetary bodies through reduced waste, improved safety, and lower payload and transportation costs. However, formulation factors and their effect on extrudability, solidification and shape-retention are typically not well understood when the suspension is processed in an extreme environment. Here, we utilize a model particle system to stand in as regolith and assess the use of a polymeric binder for AM-enabled construction with in-situ resource utilization. An assessment of the rheology gives us insights into the printability of the suspensions as well as their shape fidelity. Our polymeric binder allows us to explore the potential of UV-cure to solidify dense suspensions and leverage lower costs and simpler operations for construction at low temperatures. We analyze the effects of particle loading, binder formulation and temperature on the achievable depth of cure, and utilize this method to set our printing parameters, showing successful prints with particles loadings up to 70 vol%. Through the deconvoluted characterization of these suspensions into both the extrusion and curing processes, we show that we can expand the range of printing materials and introduce cost-effective candidate binder formulations for off-Earth construction.