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USE OF IN SITU SALT ICE TO BUILD A SUSTAINABLE RADIATION SHIELDING HABITAT ON MARS

Abstract

Currently responses towards sending humans to Mars are being developed by governmental and private companies. This ambitious and exciting goal demands a broad range of new technologies, innovations and considerations of reflections of the current challenges we are facing on Earth. These reflections also apply to the field of Architectural and Building Technology.

In order for humans to stay safely on the surface of Mars they need a radiation shielding habitat. The use of In Situ Resources (ISRU) is critical to reduce the cost and lower the environmental impact of the mission. Literature study shows that H2O provides an excellent shield against radiation. Moreover, ice is widely present on Mars. At the moment, little is known about the building properties of ice, especially in a Martian environment. However, building with ice does add quality to a living environment as it lets light through; as opposed to regolith. This paper researched the feasibility to build with ice to create a sustainable Martian habitat. Hence, a number of experiments were performed to test the feasibility of using ice as a building material. These included a mixing test, a melting test and a compressive strength test. The results for all three tests were the same: adding sodium chloride salt (NaCl) does improve the building properties of the ice. The outcome of the experiments indicates that up to 15 ppt of NaCl increases the compressive strength from an average of 1 MPa to 4 MPa. The experiments also indicated that the colder the testing environment (up to -70C), the higher the compressive strength of the NaCl ice is. A further challenge to building a habitat on Mars is that it has to be built semi-remotely. This research singles out the use of robotic technology, which can perform all tasks necessary to build the habitat, ranging from mining the ice to assembling the building. Preliminary studies and experiments have been conducted on additive manufacturing techniques for sodium chloride ice. The main outcome is that the ice structure has a greater overall strength due to the freezing of the ice layer by layer. This technique also enables the possibility of crack repair during the building phase.

The aim of this paper is to highlight the use of salt ice to build sustainable structures on Mars and to reflect the research back to Earth and re-frame the use of materials and energy in response to sustainability challenges.