IAF SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations - IAF SPACE EXPLORATION SYMPOSIUM (IP)

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RECYCLING OF ALUMINUM FOR A MULTI-TOOL IN A LUNAR OR MARTIAN SETTLEMENT

Abstract

Sustainable, long-term human presence in space is currently limited by the high mission dependency from Earth, which includes the delivery of tools, spare parts, and other supply materials. Conversely, new recycling and re-use capabilities allow further exploration that would otherwise be prohibitive in terms of volume, mass, and costs. The ESA-founded project HARMONISE led by OHB System AG as Prime Contractor with Liquifer Space Systems Group, and Azimut Space as sub-contractors touches upon in-situ recycling and re-using of available resources in a future Lunar or Martian habitat.

The project investigated recycling of polyethylene packaging into a filament for fused filament fabrication applications, re-melting and casting of scrap aluminium to produce tools, and finally partial as well as complete re-utilisation of rack blind panels and cargo transfer bags dividers for furniture elements fabrication conceived for future habitat. The project aligns with ESA space debris mitigation policy towards environmentally sustainable space activities. Azimut Space GmbH has investigated the manufacturing of a multi-tool metal casting demonstrator, the materials, equipment, and methods used in the manufacturing process, as well as the testing and verification of the tool.

During this study, sand casting was used to recycle aluminum components and create a multi-tool that can

assist astronauts in the construction and maintenance of the habitat, such as by fastening bolts and nuts. The design of the tool was affected by additional factors given the challenging Lunar environment, the demand for minimization of post-processing efforts, as well as ergonomic requirements. This manuscript provides key insights gained during the metal recycling demonstrator, including technical challenges posed by the innovative combination of requirements, aspects related to manufacturing, as well as the outcomes of the test campaign and verification that lead to the next iteration of the multi-tool design.

Keywords: Moon, recycling, aluminum, casting, tools