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CONCEPT FOR A LUNAR STATION MADE OF ISRU PRODUCED FIBRE MATERIALS

Abstract

Renewed interest by space agencies in returning to the Moon and creating a permanent colony on its surface raises an old question – how should a lunar habitat be built? Lunar habitat for the initial missions are likely to be produced on Earth and placed on Moon's surface pre-integrated. However, as the mission length and crew size increase, larger habitats will be needed. Launching them from Earth will be too expensive and thus unsustainable. This is why In-Situ utilization of lunar resources is a preferred approach to build lunar surface structures. Types of such resources are fibre-based materials. MoonFibre project of RWTH Aachen University aims to create various fibre-based resources such as continuous fibres from lunar regolith on the Moon's surface itself. The production process from the lunar regolith to the MoonFibres is presented here. Application cases for these fibres are derived and explained. This paper outlines the advantages of using MoonFibre for thermal insulation purposes, such as the production of rock wool or vacuum insulated panels (VIP) with glass-fibre core material. Appropriate assumptions for the thermal characteristics of MoonFibre were developed to enable numerical simulation of the shielding. A performance comparison between raw regolith layers and MoonFibres leads to the interesting result that, for the sole purpose of thermal insulation, the MoonFibre products could be a better choice. The expected thermal diffusivities are similar, however, a much smaller density is presented by MoonFibre based insulation. This shall allow obtaining thermal insulation components which have the same thermal shielding properties of raw regolith but outstand it in terms of mass. Therefore, mass-sensitive types of equipment, i.e. rovers, requiring a thinner, lightweight thermal insulation of the apparatus could benefit from this product. Furthermore, a moon habitat constructed with MoonFibres is examined. In contrast to common habitat concepts, this new method saves costs as lunar resources are used. Finally, a conceptual structural analysis of a relevant load case for a so-built lunar base is presented.