Paper ID: 25900
student

SPACE EXPLORATION SYMPOSIUM (A3)
Moon Exploration – Poster session (2D)

Author: Mr. Aaron Olson
University of Wisconsin, United States, adolson3@wisc.edu

DESIGN OF A HEAT EXCHANGER FOR THE EXTRACTION OF LUNAR SOLAR WIND VOLATILES

Abstract

The use of helium-3 fuel could radically improve the prospect of clean and economical nuclear fusion power. The power producing fusion reactions using helium-3 are promising for future reactors due to their high energy output, low emission of neutrons, higher energy conversion efficiency, increased safety and potential ease of maintenance compared to the more studied fusion fuel cycles. Unfortunately, there is not a sufficient quantity of terrestrial helium-3 to support its use for power generation. It was realized in 1985 by researchers at the University of Wisconsin's Fusion Technology Institute (FTI)that there is at least a million tonnes of helium-3 embedded in the lunar regolith from over 4 billion years of bombardment from the solar wind. Currently at the FTI, a research effort to develop a small scale helium-3 and lunar volatiles miner is under way. This research effort is geared toward demonstrating the process of acquiring helium-3 from lunar regolith in a manner that will lead to large scale acquisition of the rare isotope for future nuclear fusion reactors. There have been previous FTI miner designs. These designs employ a continuous volatile extraction process where regolith is excavated with a bucket wheel excavator, beneficiated in a series of sieves and screw conveyors, and fluidized before entering a heater where the volatiles are released. The heater is a heat exchanger system that drives the overall system design. With this in mind, the design of an experimental regolith heat exchanger system is the primary focus of the FTI lunar volatiles mining research effort. The envisioned system consists of three sections of heat pipes. Concentrated solar energy would be transferred to the heat pipes from a solar collector on the Moon, but for simplicity of operation the experimental system will use an electrical heater. The first two sections of the heat pipes heat a flow of fluidized regolith particles that are smaller than 100 microns to 700 C to evolve the embedded volatiles. The third section of pipes is heated by the spent regolith as it exits the first two sections, and acts as a recuperative section of the heat exchanger by transferring heat back to the first section of pipes. In what follows, a detailed account of the heat exchanger system's design is presented.