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DESIGN OF A DEVICE CAPABLE OF REPLICATING THE ENVIRONMENTAL CONDITIONS OF MARS FOR TESTING MARTIAN REGOLITH SIMULANTS.

Abstract

Over the past decades, the exploration of Mars has become a distinguished area in space research on account of its potential to provide insights into habitability and human adaptability on the exploration of the planet. Nevertheless, the extreme climate conditions of the red planet, such as solar radiation, pressure, gravity, humidity, and temperature poses significant challenges to human survival, making its exploration efforts more complex. The following study emerges in response to these challenges, aimed at calculating and designing a mechanical device capable of simulating those environmental conditions. This

mechanism simulates Martian gravity via a centrifuge equipped with a platform at an inclination of 43.48 degrees and a constant rotation speed of 4.313 rad/s. By counteracting the centripetal force, this approach diminishes the horizontal component of local gravity within the system, while the vertical component is mitigated by the normal force reaction resulting from the platform's inclination. Additionally, the device incorporates ultraviolet light emissions to emulate radiation, HVAC to regulate temperature and humidity, and a vacuum pump to control pressure; all enclosed hermetically through insulating materials. Such a method allows for the simulation of Martian regolith surface conditions while enabling the design of the mechanical systems at a reduced cost, due to its simplicity when compared to more complex counterparts in the market. This will establish the groundwork for innovative and equitable space exploration, thus promoting its replication in a way that democratizes space research accessibility in developing countries, for instance, Costa Rica.