In situ Resource Utilization of Martian Regolith for Construction, Year Four

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On Mars, there must be a method for construction which uses the available resources, a process known as “in situ resource utilization”. While regular concrete is composed of water, aggregate, and cement, sulfur-concrete requires only aggregate and sulfur heated and mixed together. This limits the use of valuable water and unavailable cement by instead using sulfur and regolith as the aggregate, both available on Mars. Prior research studied sulfur-concrete’s creation, compressive strength, and reinforcement with various aggregates and iron. Last year, additive manufacturing, the process of 3D printing layers of material, was proposed as the method of construction. A System for Additive Manufacturing on Mars (SAMM) was built. However, the extrusion system was driven by gravity and required hot water run through prior to sulfur-concrete. To adapt to Martian conditions, with colder temperatures and different gravity, heated tubing and a pumping system were suggested. This year, a new extrusion system was designed and built incorporating a heated reservoir, heated tubing, and a peristaltic pump. The heating elements allowed the sulfur-concrete to better flow through the system, as sulfur-concrete remains in molten form when at sulfur’s melting point of 115°C. Peristaltic pumps are based on the principle of peristalsis, the squeezing motion in the digestive tract, allowing for the movement of viscous liquids such as sulfur-concrete. The peristaltic pump extrusion system was able to extrude and build up sulfur-concrete along a 20 cm wall, demonstrating the effectiveness of the pump system as an extrusion method for sulfur-concrete in SAMM.

Awards Won:
American Institute of Aeronautics &amp Astronautics: First Award of $2000.00