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Lunar rock-like material may someday house moon colonies

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A composite of simulated lunar regolith and powdered aluminum heats up via wires as part of the fusion process that forms a brick. A team of Virginia Tech students, under the advisement of Kathryn Logan, a professor in the materials science and engineering department, designed the brick as a potential building tool for future colonies on the moon. The NIA carved into the stands for National Institute of Aerospace, which includes Virginia Tech.

(PhysOrg.com) -- Dwellings in colonies on the moon one day may be built with new, highly durable bricks developed by students from the College of Engineering at Virginia Tech.

Initially designed to construct a dome, the building material is composed of a lunar rock-like material mixed with powdered aluminum that can be molded into any shape. The invention recently won the In-Situ Lunar Resource Utilization materials and construction category award from the Pacific International Space Center for Exploration Systems (PISCES).

The award was one of two prizes given out this year by the research center, which is dedicated to supporting life on the moon and beyond.

Design work on the early-development lunar bricks was based on previous work by the College of Engineering student team's adviser Kathryn Logan, a professor of materials science and engineering and the Virginia Tech Langley Professor at the National Institute of Aerospace (NIA) in Hampton, Va. The seven-member student team works with Logan at the NIA.

Logan's prior research entailed mixing powdered aluminum and ceramic materials to form armor plating for tanks funded through a Department of Defense contract. "I theorized that if I could do this kind of reaction to make armor, then I could use a similar type of reaction to make construction materials for the moon," Logan said.

Since actual lunar rock, known as regolith, is scarce, the students used volcanic ash from a deposit on Earth along with various minerals and basaltic glass, similar to rock on the lunar surface, according to Eric Faierson, a doctoral student who led the Virginia Tech team.

During initial experiments, the simulated regolith and aluminum powder were mixed and placed inside a shallow aluminum foil crucible. A wire was inserted into the mixture, which was then heated to 2,700 degrees Fahrenheit triggering a reaction called self-propagating high-temperature synthesis (SHS), Logan said. The reaction caused the material to form a solid brick. A ceramic crucible was used in later experiments to form complex curved surfaces.

Once the student team had created a brick, they found that it was almost as strong as concrete under various pressure tests. Faierson said one-square inch of the brick could withstand the gradual application of 2,450 pounds, nearly the weight of a Ford Focus. This strength would enable it to withstand an environment where gravity is a fraction of the pull on Earth. The more than yearlong ongoing research has included studying the bricks reaction to solar radiation and their effectiveness as a construction material for lunar applications.

The research team chose small bricks -- about one-third the size of a regular mason's brick, or roughly 5 inches by 2.5 inches by 1 inch, and weighing about an eighth of a pound -- for quality control and to conserve materials. "Theoretically the material can be made in any size and shape, however performing the reaction on a larger scale increases the potential for" flaws in the end product, Faierson said. "Large scale implementation might be more appropriate in applications such as landing pads, roadways, and blast berms, where flaws are less of a concern."

The group formed several brick shapes to demonstrate the concept of forming an igloo-like dome component, but did not build the full structure. Creation of larger bricks, about cinder block size, including those closer to perfectly formed shape, are forthcoming, Logan said. Also to be studied is the harnessing of large quantities of heat derived from the SHS reaction to produce electricity, and extract volatiles for the lunar colony.

One of the team members, Michael Hunt, a graduate student, studied the chemical composition of the aluminum powder and the regolith before the fusion process, and then the resulting brick compound. "It's definitely exciting to have worked on the lunar brick project," he said. "I never would have thought that I'd be a part of something like this," Hunt said.

Judging by members of the Japan-United States Science, Technology and Space Applications Program, which included scientists from NASA and industry, was based on the novelty and thoughtfulness evidenced by the teams, their commitment to PISCES goals and objectives, and their compliance with the rules of the competition. PISCES is located in Hawaii, where volcanic geology gives scientists a landscape similar to the moon that can be used to test technology prior to possible lunar use.

Provided by Virginia Tech