Student Checklist (1A)

This form is required for ALL projects.

1. a. Student/Team Leader: Matt Murno Grade: 12

   Email: mattmurno@gmail.com Phone: (914)-980-1611

   b. Team Member: _____ c. Team Member: _____

2. Title of Project:

   Optimizing Strength and Impermeability of Martian Sulfur Concrete for Building Structures

3. School: Harrison High School School Phone: (914)-630-3095

   School Address: 255 Union Avenue
   Harrison, NY 10528

4. Adult Sponsor: Randy Gunnell Phone/Email: gunnellr@harrisoncsd.org

5. Does this project need SRC/IRB/IACUC or other pre-approval? ☐ Yes ☑ No Tentative start date: _____

6. Is this a continuation/progression from a previous year? ☐ Yes ☑ No
   If Yes:
   a. Attach the previous year's ☐ Abstract **and** ☐ Research Plan/Project Summary
   b. Explain how this project is new and different from previous years on
   ☐☐ Continuation/Research Progression Form (7)

7. This year's laboratory experiment/data collection:

   10/30/19 (Actual Start Date: (mm/dd/yy))

   12/4/19 (End Date: (mm/dd/yy))

8. Where will you conduct your experimentation? (check all that apply)

   ☑ Research Institution ☐ School ☐ Field ☐ Home ☐ Other: _____

9. List name and address of all non-home and non-school work site(s):

   Name: Leo Engineering Building

   Address: 3825 Corlear Ave
   The Bronx, NY 10463

   Phone/email: (718)-862-7177

10. **Complete a Research Plan/Project Summary following the Research Plan/Project Summary instructions and attach to this form.**

11. **An abstract is required for all projects after experimentation.**

Rationale:

Mars is a possible planet for human life in the future. One problem that humans have encountered when considering Mars as an option for human life is the distance. The distance plays a large role in the way that the planet can be used in the future, since the cost of shipping 1 kg of materials to Mars costs $22,000 dollars. So, in order to build a structure on Mars, other methods are being researched, like a Martian Ice house, made by 3d printed ice, which protects from radiation. Another alternative, which is preferable considering the amount of the material on Mars, is making sulfur concrete with the regolith on the planet. This is more cost effective, and can provide safety for the astronaut when outside of the EVAC suit (the space suit, used for exploring the plant, usually a heavy suit with everything required for supporting life). The ultimate goal is to prevent air from escaping the structure, which could harm the astronaut if it does escape, because oxygen will seep through the sulfur concrete if it was permeable. The reason for researching sulfur concrete made with martian soil regolith is that the concrete is made from materials that are on the planet and very abundant, where some of the problems would be the physical strength and the impermeability of this mixture.

Research Question, Hypothesis

To what extent is sulfur concrete made with Martian Soil Regolith impermeable and how can the impermeability be utilized for building structures on Mars?

Sulfur concrete made with Martian soil simulant will be impermeable, and a possibility for building structures on Mars.

Outcomes

The hypothesis and research question are based on the rationale, since it demonstrates how the concrete needs to be impermeable in order for the astronauts to live on the planet, or at least stay there for a short period of time. The tests will determine how much air would escape, if any, or stay in the building, because of the impermeability of the sulfur concrete, or lack thereof. When it is discovered that the sulfur concrete will be impermeable, the uses for it in space will increase tremendously.

Procedure

1) Calculate the percentage of sulfur and regolith by weight to add to the mold, for the values of 80% regolith and 20% sulfur, 70% regolith and 30% sulfur, 60% regolith and 40% sulfur, and 50% regolith and 50% sulfur
2) Place each mixture into five cylinders per mixture
3) Place the cylinders into a high temperature oven for 24 hours

Data Analysis

For each sample, a mass will be taken, and then a buoyant mass and saturated mass. Using the following equations, the apparent density, bulk density and the percent voids will be calculated:

(Dry Mass / Saturated Mass - Buoyant Mass) = Bulk Density

(Dry Mass / Dry Mass - Buoyant Mass) = Apparent Density

Apparent Density - Bulk Density / Apparent Density = percent voids

Then, all the values will be put into a bar graph and the trends will be analyzed.

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