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Additive Manufacturing Process Development of Geopolymer Based Habitable Construction on Space

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Abstract

Extraterrestrial travel and housing are topics that have come up in recent times. There is a possibility of living on the moon. In order to do that while keeping costs at a minimum, we are researching and developing a geopolymer using lunar dust to 3D print houses on the moon. Because we are using lunar dust, the number of materials that need to be shipped out gets cut dramatically. We are studying the composition of both lunar mares and lunar highlands in order to fully understand what needs to be added to make a strong durable geopolymer that can withstand the varying factors and temperaments of the moon. By looking at aluminum and silicon ratios, as well as KOH, we aim to create a geopolymer that can make houses on the moon.

Proposed Project

The manufacturing of cement demands the burning of vast quantities of fuel, as well as significant emissions of CO2 resulting from the decomposition of limestone.

Geopolymers and Geopolymeric materials

History and Background of Geopolymers

1950-2000	Viktor Glushko, 1950 (USSR)	Joseph Davidovits, 1990 (France)
	Si:Al=1 (1-Si-O-Al-O-)	Si:Al=1 Polyaluminum silicate
	Si:Al=2 Aluminum-silicate (2-Si-O-Al-O-Si-O-)	Si:Al=2 Polyaluminum silicate
	Si:Al=3 Polyaluminum silicate (3-Si-O-Al-O-Si-O-Si-O-)	Si:Al=3 Polyaluminum silicate
	Si:Al=4 Silicate Link	Si:Al=4 Polyaluminum silicate

Geopolymers are inorganic polymeric materials with three-dimensional network being composed of cross-linking [AlO₄] and [SiO₄] tetrahedral units and alkali metal cations



Geopolymer Production

Geopolymer production is made by reacting aluminate and silicate bearing materials with a caustic activator, such as fly ash or slag from iron and metal production.

Proposed Process Flow Diagram for Geopolymer Production

1. Aluminosilicate precursors
2. Activators
3. Water
4. Additives

Mixing → Curing → Geopolymer

Aschematic flow diagram for the geopolymer production

Conclusion

The end goal of creating a lunar based geopolymer for the construction of habitats off-world will be understood further through testing of mechanical characteristics as well as other types of material testing.