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NASA, Boeing, and Defense Activities: For the Use of Geopolymers for Space Construction

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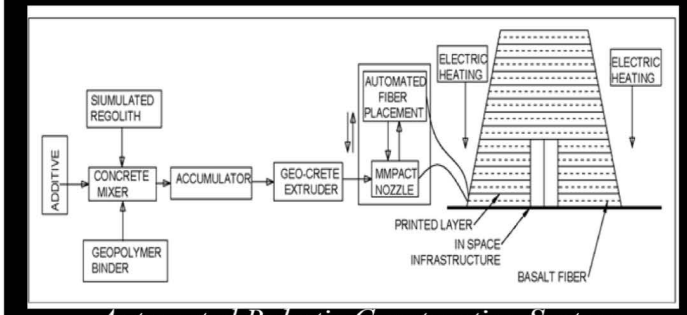
BackGround

Construction generally comprises inert minerals materials such as concrete, bricks, tiles, and ceramics. Furthermore, using Geopolymer in space construction is very much needed at this time - due to humanity developing a multi-planetary approach towards civilization. Very interestingly, Geopolymers are very high conductive inorganic materials to electromagnetic radiation. Therefore, geopolymer production will require a plasticizer and a concrete-like based material.

Geopolymer Development Concept



Automated Robotic Construction System

- Under the Moon to Mars Planetary Autonomous Construction Technology (MMPACT) project, the MMPACT nozzle is developed to use geopolymer in 3D construction, as shown in the figure.

Method

- A combination of fly-ash as the pre-curser Barite ($BaSO_4$) and Hematite as the aggregate and metallic chip produced the Geopolymer material.
- Geopolymer showed the ability to oppose radiation penetration after being exposed to several levels of radiation.
- Potassium can be used as an activator on the moon. Potassium is a component of KREEP - and is concentrated in the mare regions in minerals such as orthoclase. For example, in Apollo 12 sample 12013, a KREEP breccia, a granitic rock type that makes up a portion of the sample, contains approximately 50% by volume of orthoclase. Granitic compositions have been located via remote sensing using the Diviner Lunar Radiometer Experiment in the Procellarum KREEP terrain at Gruithuisen Domes, Aristarchus, Hansteen Alpha, Montes Riphaeus, Helmet, and Lassel Massif features. Potassium is also found in some glasses in the regolith. It is thought to form from very late-stage magmatism
- Sodium-rich phases on Mars include sodium perchlorate, sodium metasilicate ,sodium chloride, sodium feldspar, sodium borate, sodium sulfate, sodium montmorillonite (a clay from the smectite group), sodium carbonate, and additional sodium silicates.
- Sodium activator-based geopolymer is a potential building material in Mars/Moon.
- A secondary method of geopolymer production is a mixture of H_2O and lunar regolith comparable to the soil on earth. The mixture will produce a concrete-like geopolymer.

A future moon base, built out of geopolymer concrete.

Results

From this research. The results proved that geopolymers are very effective in blocking out electromagnetic waves of frequencies that are greater than 1 GHz.

Conclusion

The findings of this research showed that geopolymers are highly conductive materials. That is capable of opposing electromagnetic penetration of more than one (1) GHz. Which further proves that these materials are suitable for usage in space construction.

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