# Method for Waterless Lunar Concrete Using Enstatite or other Magnesium-Silicate.

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## INTRODUCTION

The most critical requirement of habitats on the moon are that they have suitable flexural strength, impact resistance and able to dissipate electrical charged particles Indigenous materials such as Enstatite are found on the Moon, and offer suitable resistance to puncture by small micrometeoroids, protection from radiation, and can be easily processed.

## PURPOSE

The purpose of this investigation are to determined the properties of enstatite, before and after FeS mineral inclusion.

## EXPERIMENT DESIGN

The selection of properties in this effort were focused upon selecting indigenous materials with high dielectric strength, low sintering temperature and low operating conditions for binder synthesis.

## ABSTRACT

**Introduction** The problem with using indigenous materials from the moon are that they can be difficult to process in microgravity. A few materials such as FeS and Enstatite ($MgSiO_3$) have reasonable low sintering temperatures and low pressures and can be easily processed. Techniques developed in this effort allow processing of enstatite at temperatures between 147 C and 1.45 Pa. The reported melting temperature of enstatite for low pressure is (1 GPa, 1400 C). We report that enstatite need only be elevated to a temperature at which water from the surrounding habitat enclosure can be captured, and then be plasticized. This would be an I indigenous simple cement binder for regolith. **The objective** of the experiment shall be to identify temperatures and pressures needed for enstatite processing, and determine the improvement, if any, by the addition of FeS. **Previous Research** Several research efforts have been completed which characterize enstatite minerals (Roussel et. al., 2022, Angel and Jones, 1994, Collins et. al., 2022, and Nevez et. al., 2020). Useful insights from these investigations have been adopted for this effort. **Methodology** ASTM Standards C 648-20, C 482 – 20,C 1505-15,C 1870 – 18, C 1337- 17,D 256 and C 483- 95, were used as sample preparation guidelines. Sample sintering impact strength, and pressure measurements were completed at De Astris Generation LLC. **Results and Discussion** Addition of FeS to enstatite while being heated improved impact strength, flexural strength and dielectric strength by an average of 43.7 percent.

## RESULTS

| SAMPLE | Is GPa | Fs dJ/mm | Dielectric Strength mV/mm |
|---|---|---|---|
| 1 | 1.00 | 5.32 | 110.66 |
| 2 | 1.10 | 4.89 | 112.01 |
| 3 | 1.20 | 5.28 | 105.44 |
| 4 | 1.30 | 5.41 | 119.12 |
| 5 | 1.50 | 4.99 | 121.47 |

| SAMPLE WITH FeS | Is GPa | Fs dJ/mm % increase | Dielectric Strength mV/mm |
|---|---|---|---|
| 1 | 1.0 | 43 | 299.08 |
| 2 | 1.20 | 39 | 254.57 |
| 3 | 1.30 | 44 | 277.47 |
| 4 | 1.40 | 46 | 313.47 |
| 5 | 1.50 | 51 | 328.30 |

## METHODOLOGY

Testing methodologies for each sample of synthetic enstatite were followed using the ASTM guidelines as closely as possible.

## CONCLUSIONS

When Enstatite is elevated to 147 C, under 1.5 atm pressure, and adding 20 percent FeS by weight to sintered enstatite offers a suitable cement for lunar construction.

## REFERENCES AND ACKNOWLEDGMENTS

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