

Response to Reviewer 1 Comments

Dear Reviewer,

Thank you so much for your time in reviewing our manuscript and your valuable suggestions. The manuscript has improved after addressing your comments. Please you can see the changes made in the manuscript marked with the “Track Changes” option. You will find the answers to your feedback points below.

1. Please double check the grammar and spelling throughout the text.

e.g Figure 2. (typo) representation

Done: thank you for the correction, the change has been made in line 138.

e.g. line 412. (typo) Martian soil

Done: thank you for the comment, here ‘Martian sol’ refers to one solar day on Mars. The sentence is made clear in the manuscript in line 440.

2. Line 254. the goal of the experiment is to have a mixture to fabricate a solid block for construction on Mars.

Done: thank you for the comment. This sentence has been made clear in the manuscript in line 262. The main goal of our experiment is to demonstrate, the curation of Martian soil simulants when mixed with composite products at different concentrations it can be cured under simulated Martian environment and fabricate a solid block.

Line 299. The samples with a high binder to soil ratio form conglomerate. However, as shown in Figure 5, the samples are quite loose and dispersed. Please discuss the feasibility and physical meaning of the experimented mix as a construction material for Mars habitation.

Done: Thank you for this comment. This comment has been addressed now in the lines 315-320. In this study, we were able to mix and form solid grains for the samples with a higher binder to soil ratio, unlike in figure 5d and figure 5e, which was quite loose and dispersed. In addition to the granular binding properties, it is important to mould the material into a solid unit. So, next, we used a smaller beaker for the mixture to form a solid block.

The mixture used in this study were based on literature and previous experiments conducted under ambient laboratory conditions mentioned in line 264. So, we wanted to demonstrate if these samples can be cured under simulated Martian conditions and form a solid block. The meaning of the mixture was to have a maximal amount of soil to guarantee that with a mixture of binder, it can create a solid block. The idea being more the soil, better the resistance for the structure. Also, we have added a new material called the superabsorbent polymer (SAP) which can hold water and still be solid. It can also reduce the weight of the structure.

4. Please explain in more detail of Figure 6. Sample (a) becomes solid? Does it have structural integrity for actual construction?

Done: Thank you for the comment. Yes, the sample in the figure 6a becomes solid after it is exposed to the Martian conditions. As mentioned in line 262-267, our experiment is to demonstrate, if the previously tested samples at Earth ambient conditions can be cured under simulated Martian conditions forming a solid block. Now that this procedure allows us to fabricate a solid block curing at Martian conditions our next step in this investigating process will be to test the characterization such as tension and compression strength of the cured material (line 349-351).

5. Please provide a comparison of the environmental chamber with similar products available on the market. What is the core novelty of the utilized chamber?

Done: Thank you so much for the comment. This review has been addressed from line 59-73. The novelty of our chamber compared to other facilities, (added in line 429-435) is that it can simulate the near-surface water cycle as on Mars and to mimic diurnal/seasonal variation. SpaceQ is more versatile to test instrumentation under representative space conditions and log the data in real-time. Especially our chamber is unique for investigating the effect of water on the surface of Mars and the role of intense, direct, UV radiation on these processes.

6. Researchers have developed sulfur-based martian concrete. Is it possible to study the material in this chamber? Please discuss and elaborate.

Done: Thank you for this comment, this comment is addressed on line 346-349. As SpaceQ chamber is more resourceful, it can be used to test the other binders, and this will be done in the continuation part of the material study experiments. Now that we have demonstrated the procedure to test and cure regolith and binders inside SpaceQ chamber under Martian conditions and form a solid block, we can study the sulfur-based Martian concrete as described by Lin Wan et al., 2016 [1] in the future experiments, we have added this reference. We shall also study the degradation of the cured materials when it is exposed to the UV light inside the chamber.

Reference:

1. Wan, L.; Wendner, R.; Cusatis, G. A Novel Material for in Situ Construction on Mars: Experiments and Numerical Simulations. *Constr. Build. Mater.* 2016, 120, 222–231. <https://doi.org/10.1016/j.conbuildmat.2016.05.046>

Best regards,

Vakkada Ramachandran. A et al.,