COLD PRESS SINTERING OF SIMULATED LUNAR BASALT;

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In order to predict the conditions for which the lunar regolith may be adequately sintered, experiments were conducted in which samples of simulated lunar basalt (MLS-1) were pressed at high pressures and then heated in an electric furnace. This sintering process may be referred to as *cold press* sintering since the material is pressed at room temperature. Although test articles were produced which possessed compressive strengths comparable to that of terrestrial concrete, the cold press sintering process requires very high press pressures and sintering temperatures in order to achieve that strength. Additionally, the prospect of poor internal heat transfer adversely affecting the quality of sintered lunar material is a major concern. Therefore, the author concludes that cold press sintering will most likely be undesirable for the production of lunar construction materials.

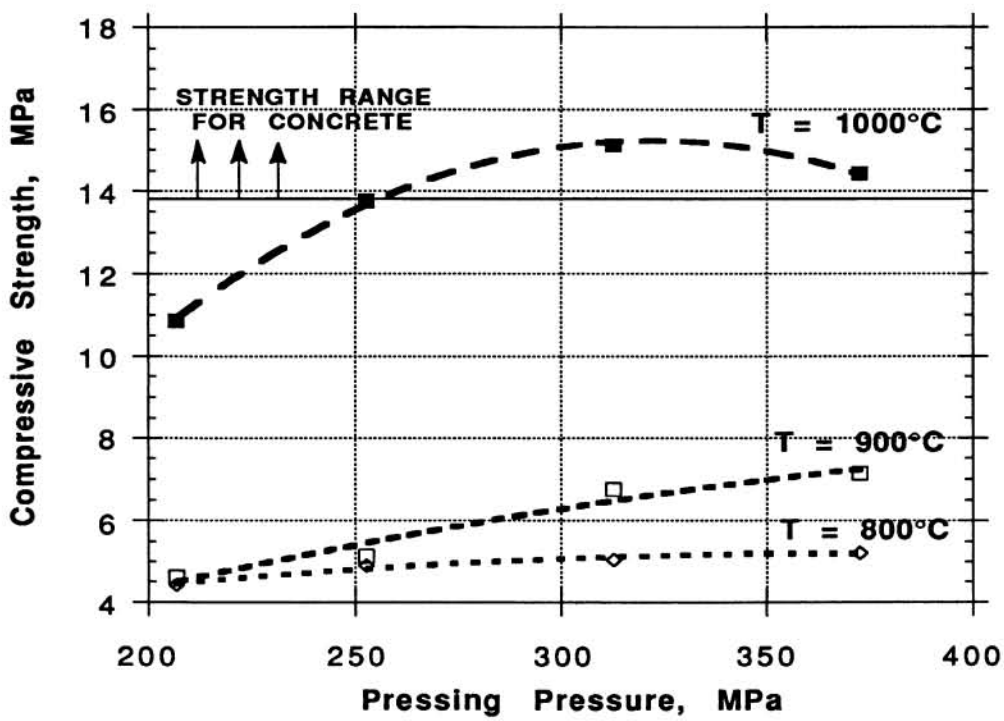

Figure 1. Compressive Strength of Simulated Lunar Basalt for Various Sintering Conditions.

According to the experimental results shown in Figure 1, sintered basalt with a compressive strength greater than 14 MPa may be produced by initially pressing the material at pressures above 253 MPa and subsequently heating it above 1000°C for 30 minutes. It should be noted that the samples originally possessed a maximum grain size of 500 μm and that the sintering process took place in an argon atmosphere at ambient pressure.

In addition to the experimental compressive strength results, theoretical predictions of heat transfer were made using a SINDA'85 numerical model. Assuming typical lunar soil thermal conductivities (~0.02 W/m*K for in situ conditions [1]), the heat transfer model suggests that severe temperature gradients are likely to occur for the radiative heating of lunar soil [2]. If similar temperature gradients occur during a real sintering process, then non-uniform properties will result in the sintered material and longer sintering times and/or smaller product dimensions will become necessary to alleviate the non-uniformity.

In summary, adequate compressive strengths were measured for sintered basalt. However, the need for extremely high pressing pressures, coupled with the issues related to poor heat transfer, will limit the viability of cold press sintering as a candidate process for the production of lunar construction materials. Therefore, alternative processes should be investigated.

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