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High-Temperature, Multi-Functional, Ceramic Insulation

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Increasing technological demands have prompted the development of multifunctional materials that balance competing properties to deliver optimal performance in a single material. This investigation focuses on the development of a castable, thermally insulating ceramic that is capable of serving in light structural applications. The goal was to produce a material that could compete with the properties of a commercially available product called Johns-Manville Super Firetemp M calcium silicate insulation (which will be referred to as Mboard in this report). The approach involved the modification of a wollastonite ceramic through the inclusion of additives such as starches, dispersants, and powderized competitor product to achieve a strong, low-density material. The results demonstrated that additives were capable of reducing density and increasing flexure strength in isolation. Optimizing the trade-off between these proved more difficult. This is owed to the intrinsic properties of the wollastonite phase, as well as the ability to control flaw size and disperse fillers. The collected data shows that the inclusion of a powderized material improves strength through a reduction in critical defects and increase in density. Lowering the density is best accomplished with a course starch material or through the inclusion of hollow, glass spheres. Of the samples tested, the best composition (one with a coarse starch) showed an average flexure strength of 4.6 MPa and an average density of 0.71 g/cc. Limited sample sizes and a high amount of scatter, however, result in a high amount of uncertainty in the results. The data collected through these experiments lay the foundation for more details optimization approaches going forward..