

In-situ viscoelastic characterization and modeling of ice cream

ABSTRACT

Hard ice cream has been mechanically characterized in-situ by using compression stress relaxation tests. However, the main challenge in the study of ice cream mechanics is the need to perform analyses at low temperatures ($-20\text{ }^{\circ}\text{C}$). Therefore, in this study, a customized compression test device was developed, which can be used for experimental analysis at low temperatures ($-20\text{ }^{\circ}\text{C}$) inside a freezer. The viscoelastic behavior of hard ice cream was analyzed using the test device, as observed from the reduction of stress at holding deformation. Viscoelastic modeling was then performed using the finite element method by using user material subroutine. The model agreed to the tests results at small deformation (1mm deformation), but it required the use of a softening function at large deformation. The findings of this study suggest the non-linear viscoelastic behavior of hard ice cream under low temperatures.

Keyword: Mechanical characterization; Ice cream; Compression test device; Viscoelastic behavior