

Viscoelastic Properties of Sn-15%Pb Measured in an Oscillation Test

Authors : Gerardo Sanjuan Sanjuan, Ángel Enrique Chavéz Castellanos

Abstract : The knowledge of the rheological behavior of partially solidified metal alloy is an important issue when modeling and simulation of die filling in semisolid processes. Many experiments for like steady state, the step change in shear rate tests, shear stress ramps have been carried out leading that semi-solid alloys exhibit shear thinning, thixotropic behavior and yield stress. More advanced investigation gives evidence some viscoelastic features can be observed. The viscoelastic properties of materials are determinate by transient or dynamic methods; unfortunately, sparse information exists about oscillation experiments. The aim of this present work is to use small amplitude oscillatory tests for knowledge properties such as G' and G'' . These properties allow providing information about materials structure. For this purpose, we investigated tin-lead alloy (Sn-15%Pb) which exhibits a similar microstructure to aluminum alloys and is the classic alloy for semisolid thixotropic studies. The experiments were performed with parallel plates rheometer AR-G2. Initially, the liquid alloy is cooled down to the semisolid range, a specific temperature to guarantee a constant fraction solid. Oscillation was performed within the linear viscoelastic regime with a strain sweep. So, the loss modulus G'' , the storage modulus G' and the loss angle (δ) was monitored. In addition a frequency sweep at a strain below the critical strain for characterized its structure. This provides more information about the interactions among solid particles on a liquid matrix. After testing, the sample was removed then cooled, sectioned and examined metallographically. These experiments demonstrate that the viscoelasticity is sensitive to the solid fraction, and is strongly influenced by the shape and size of particles solid.

Keywords : rheology, semisolid alloys, thixotropic, viscoelasticity

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