Title: Controlled Diffusion Solidification Processing: A Review

Authors: Mohammad Pourgharibshahi, Mehdi Divandari, Hassan Saghafian Larijani, Peyman Ashtari

PII: S0924-0136(17)30290-X
DOI: http://dx.doi.org/doi:10.1016/j.jmatprotec.2017.07.018
Reference: PROTEC 15315

To appear in: *Journal of Materials Processing Technology*

Received date: 17-1-2017
Revised date: 28-6-2017
Accepted date: 12-7-2017

Please cite this article as: Pourgharibshahi, Mohammad, Divandari, Mehdi, Larijani, Hassan Saghafian, Ashtari, Peyman, Controlled Diffusion Solidification Processing: A Review.Journal of Materials Processing Technology http://dx.doi.org/10.1016/j.jmatprotec.2017.07.018

Controlled Diffusion Solidification Processing: A Review

1. Mohammad Pourgharibshahi,
School of Metallurgy and Materials Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran, 16846-13114
2. Mehdi Divandari (divandari@iust.ac.ir)
School of Metallurgy and Materials Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran, 16846-13114
3. Hassan Saghafian Larijani
School of Metallurgy and Materials Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran, 16846-13114
4. Peyman Ashtari
Global Research Library, Niagara Falls, Ontario, Canada

Abstract

Shape-casting of the wrought grades of aluminum alloys is a relatively new concept in order to take advantage of the high strength of wrought aluminum alloys as compared to the strength of the cast alloys. It is almost impossible, however, to cast defect-free components from wrought alloys using a conventional solidification process and there remains a need for novel methods to enable integrated castings with these alloys. Dendritic morphology of the primary phase and tendency to hot tearing are the main reasons why some aluminum alloys (especially the wrought grades) are not castable using conventional solidification processes. A new, innovative process called Controlled Diffusion Solidification (CDS), has been developed to overcome the challenges faced when attempting to cast such alloys. CDS involves diluting a low temperature concentrated liquid alloy with a given amount of a higher temperature same-base liquid solvent. Mixing of such liquid metals which are different in their mass, temperature and composition can result in a complex solidification condition with thermal, solute and density gradients in the resultant mixture, causing it to solidify with non-dendritic morphology of the primary phase. Unlike the most common semi-solid processes, CDS is a simple process and does not require heavy investment in equipment. To facilitate investigation, the process is usually divided into three discrete stages of mixing, nucleation and growth. Since its development in 2003, few attempts have been directed toward identifying factors influencing the CDS process and understanding the underlying mechanisms in the different stages of the process. This review encompasses the established knowledge of the process, together with those areas that are still relatively unknown and need further research.