Mini-Thixoforming of Low-Carbon High-Alloy Steel

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Semi-solid processing allows novel microstructures to be produced even in conventional materials. This is thanks to the peculiar conditions of the process and the rapid solidification. Despite that, semi-solid processing is not widely used in practice due to its technological complexity. Mini-thixoforming is an innovative method of processing metals in the region between their solidus and liquidus temperatures. With its small volume of the metal feedstock, it is a very precise and highly dynamic process. Consequently, it can be employed for materials with a very narrow freezing range which, until now, were impossible to thixoform conventionally. The present experiment focused on one of such materials: the low-carbon high-alloy age-hardenable X5CrNiCuNb16-4 steel. Owing to the low carbon level, the relevant temperature interval was 1380 – 1420 °C which, together with the need for strict control, posed a technological challenge. Once the semi-solid processing parameters were optimized, the die cavity was filled as required and the final products showed good surface quality. The resulting single-phase microstructure consisted of ferrite. Hence, given the 17% level of dissolved chromium, there is a potential for excellent corrosion resistance and, possibly, for subsequent age hardening of the material

Keywords: Mini-thixoforming, semi-solid state, X5CrNiCuNb16-4 steel, single-phase structure

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