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MACROSEGREGATION, MICROSTRUCTURAL AND MICROHARDNESS EVOLUTIONS ALONG THE LENGTH OF A DIRECTIONALLY SOLIDIFIED Zn-Mg ALLOY CASTING

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Zn-Mg alloys are used as sacrificial anodes due to their inherent corrosion stability, besides their potential of applications in biomedical implants mainly due to the presence of Mg, a non toxic and biodegradable material. Despite the importance of such alloys, studies on the evolution of both solidification microstructures and macrosegregation, and their effects on the resulting mechanical properties are scarce in the literature. In the present investigation, solidification experiments were carried out in which the casting assembly consists of a water-cooled mold with heat being extracted only from the bottom, promoting vertical upward directional solidification of a near-eutectic Zn-5wt%Mg alloy. A normal macrosegregation profile has been observed with the composition ranging from 3.6 to 6.3wt%Mg. At the bottom of the casting, a complex microstructure characterized by a eutectic phase growing simultaneously with a Zn dendritic structure was observed and at the top, due to the normal segregation, the eutectic phase growing with an idiomorphic $MgZn_2$ phase. Experimental growth laws are proposed correlating the evolution of the lamellar eutectic spacing with the experimental cooling and growth rates. Vickers hardness (HV) tests were performed on transverse sections of the samples and, a decreasing profile of HV with coarsening of grain size was ascertained. Furthermore, the highest cooling rate in the casting is shown to be associated with a microhardness of about 130 HV.