ABSTRACT

Title: Development of Fire Resistant ECO-Mg alloys with process diversity

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Abstract: ECO-Mg alloys, CaO added Mg alloys, will be described in terms of fire resistance and melt cleanliness/part soundness. The background of alloy design for fire resistant Mg alloys are described by the segregated tendency of alloying elements, the Wigner-Seitz radius and the melting points of unary and binary oxides on the surface. The improved fire resistance can be explained by multilayered dense oxides in Fig. 1 and fast healing nature of ECO-Mg alloys, which are investigated by (1) artificial oxidation test, (2) DTA (Differential Thermal Analysis) for globular specimen, and (3) part fire test by LPG (Liquefied Petroleum Gas) and also are confirmed by (4) FAA standard fire test in Fig. 2. Besides of the improved fire resistance, ECO-Mg alloys are expected to reduce or eliminate SF_6 and SO_2 protective gases; eliminate Be addition; and improve melt cleanliness. Special attention is also paid to the improved melt cleanliness of ECO-Mg alloys not only for improved mechanical properties but also for enhanced castability and formability. The main point of ECO-Mg alloys in terms of microstructure is that CaO is reduced to form Mg_2Ca (C14) in pure Mg and Al_2Ca (C15) and/or $(Mg, Al)_2Ca$ (C36) in Mg-Al alloys with α-phase of having almost no Ca solid solution in it. The CaO on the oxide layer is not CaO powder incorporated to make ECO-Mg alloys but the re-oxidized CaO from initially reduced Al_2Ca.

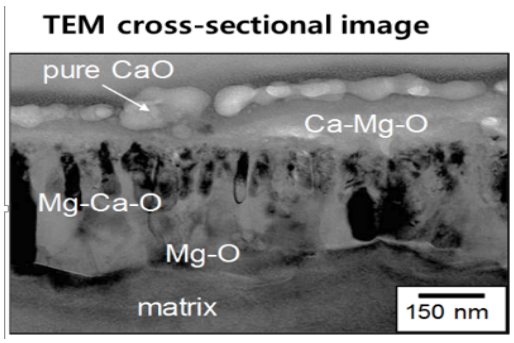

Figure 1

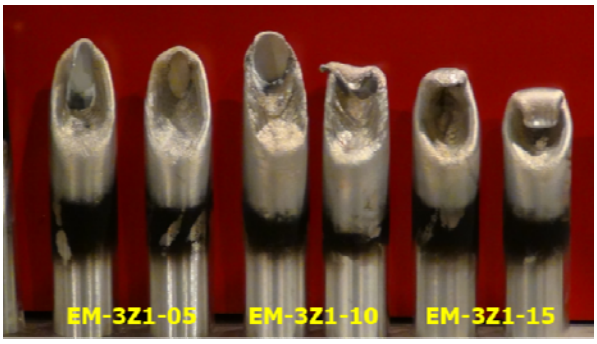

Figure 2

Fig. 1 TEM cross section of 0.5% CaO added AZ31 ECO-Mg alloy after artificial oxidation.
Fig. 2 Results of FAA fire test for CaO added AZ31 ECO-Mg alloys.