Salt-Metal Interaction in Magnesium Recycling

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Abstract

Magnesium recycling is typically based on the use of fluxes, mostly containing $MgCl_2$, KCl, NaCl and CaF_2. Salt flux has the role of separation of surface oxides, gases or other contaminations from metal. It is state of the art that application of salt flux in contact with magnesium scrap leads inevitably to the formation of a sludge so called "black dross" containing both metallic and oxidic magnesium as well as salt components. In this paper - based on a newly finished and defenced PhD thesis at IME/ RWTH Aachen [1] - it has been tried to investigate the influence of chemical composition of salt fluxes applied in magnesium recycling on coalescence ability of that salt with the aim of minimization of metallic magnesium loss in black dross. The results represent the general increasing effect of fluorine containing components as well as magnesium chloride inside fluxes. The value of 5 wt.% of fluoride components appeared to have the best effectivity on coalescence and CaF_2 is the best economical/technical choice because of its reasonable price against LiF and MgF_2 as well as its high coagulation effectiveness in comparison with KF and NaF.

Keywords: Flux, Salt, Coalescence, Black Dross, Magnesium

1 Introduction

Use of a salt flux in an Al/Mg recycling furnace helps to strip away and suspend the oxide film so that coalescence of the droplets increases and dross formation decreases. The salt flux wets the oxide film and initiates disintegration of the film, stripping it from the surface of the molten aluminum droplets. Fragments of the oxide film stripped from the aluminum remain suspended in the flux. The flux also prevents further oxide formation by keeping the metal protected from the atmosphere of the furnace.

The coalescence ability of a salt is an important factor to define its suitability as flux in the recycling of aluminum and magnesium. The coalescence of metal drops leads to an increase in the droplets diameter, leading to an increase in the probability of their separation from the salt flux. Therefore, the better the coalescence ability of a salt, a higher yield of recycling process will be achieved [2]. Generally speaking, a salt used for recycling of aluminum and magnesium should possess some common properties. This includes a lower melting temperature than that of Al and/or Mg (although it has not been achieved for Al so far), low densities (that is not easy to be achieved in the case of Mg, due to the extremely low density of Mg), low viscosity, no reaction with or contaminate the molten metal, no attacking against the refractory walls, non-poisonous, inexpensive or easily recycled with low costs and easily separable from the melt. On the other hand, there are still four main requirements for each salt as follows [3][4]:

- cover the metal to prevent oxidation
- dissolve or suspend oxide and other non-metallic contaminations, which adhere to the metal