Deoxidation of Al- and Si-killed Steel

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ABSTRACT

To keep up with the tough competition today and to be able to offer the customers competitive prices, it is desirable to shorten the ladle treatment and still keep a high quality of the product. To be able to shorten the ladle treatment under these restrictions, a faster deoxidation process is demanded. This master’s thesis investigates what influences the reaction coefficient, which describes the separation rate of oxygen. A higher reaction coefficient indicates a faster separation rate. Special attention has been taken to the factor reoxidation, with regard to the nitrogen pick up after tapping and an increase of the oxygen content after degassing.

The reaction coefficient has been calculated for four steel groups, two silicon deoxidised groups, one silicon and aluminium deoxidised group and one aluminium deoxidised steel group. The apparent deoxidation is in the reality the sum of two phenomena: deoxidation and reoxidation. An increase of the deoxidation rate or a decrease of the reoxidation rate would result in a higher reaction coefficient. A small increase of the reaction coefficient could gain minutes in the process of oxygen removal, which would result in economical benefits.

The deoxidisers have a natural strong effect on the oxygen content and thus on the reaction coefficient. The fastest separation – the highest reaction coefficient – after tapping is found for steel groups deoxidised with the strongest deoxidiser: aluminium.

Reoxidation occurs after tapping/before degassing due to the breakthrough eye – a hole in the top slag - caused by the strong gas injection. By using nitrogen as a tracer for reoxidation from the atmosphere it was possible to determine if reoxidation had an effect on the deoxidation rate, which it had since the reaction coefficient decreases as the nitrogen content increases. Stirring makes deoxidation quicker, but on the other hand, too intensive stirring retards the deoxidation rate somewhat due to reoxidation. An optimisation of the gas flow rate might be useful to get an optimum relation between deoxidation and reoxidation, where the fastest separation of oxides is reached.

The deoxidisers have an effect on the oxygen content after degassing and in the tundish. Reoxidation can occur during these time steps too, but most probably not due to reactions with the atmosphere, since the nitrogen content is stable. The oxygen content increases for the silicon deoxidised heats after degassing due to a higher iron oxide content in the top slag. Thus, the FeO content in the slag is too high to keep the low oxygen content in the steel stable. The heats with higher amount of deoxidisers in the steel tend to be able to stay at a lower oxygen concentration too. Though, in the later parts of the process additional alumina formation should be avoided for the best separation.
PREFACE

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