Study of Sheeting Behavior During Continuous Casting of Medium-Carbon Steels in a Thin-Slab Caster

Sheeting is a phenomenon observed in continuous casting that leads to large deviations in heat flux. Such large deviations can lead to loss of lubrication, resulting in sticker breakouts and quality issues.[1] Ozgu et al.[2] postulated that sheeting was attributed to cracking of the solid flux layer which eventually falls out, leaving behind a thin layer between the slab and the mold. Similar behavior was noted when casting medium-carbon steel grades (0.17–0.24%C) on a thin-slab caster. This article investigates the influence of various operational conditions on sheeting behavior. Mold flux composition was found to be the most influential on sheeting intensity. Various mold flux chemistries were studied to find mold flux with the least amount of sheeting. Of the powders investigated, the version with 5% zirconia addition was found to be most effective.

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Introduction

Mold heat transfer in the continuous casting process is an important process parameter since it controls the thickness of the shell, strand quality and productivity of the operation. Compared to conventional casting, thin-slab casting operates at 3–5 times higher speeds and consequently requires 3–5 times higher mold heat flux.[3] Heat transfer in the mold can be divided into vertical (heat being extracted upwards from the meniscus) and horizontal (heat extraction from the shell to the water-cooled mold). Mold fluxes are an effective tool to control horizontal heat flux in thin-slab casting. Functions of mold flux are to control horizontal heat transfer, to reduce vertical heat transfer, to prevent reoxidation of steel, to lubricate steel shell and to absorb inclusions.[3]

Mold flux is added in powder or granulated form at the top of the mold and makes its way down toward the meniscus where it is completely molten. Molten slag fills the gap between the steel shell and copper mold during negative strip time. This molten slag provides lubrication to prevent sticking of the shell on the mold and causing a breakout. The molten slag film forms a crystallized layer closest to the mold and a liquid layer closer to the steel with a transient layer in between. Mold flux chemistry controls the thermophysical properties like slag viscosity, break temperature, crystallization temperature and amount of crystalline phases. These factors influence heat removal and lubricity which in turn dictate strand quality (sensitivity to cracks) and productivity (casting throughput, breakouts).[4]

Mold flux sheeting is a phenomenon that leads to large deviations in heat flux. Ozgu et al.[2] proposed that sheeting is attributed to cracking of the solid flux layer which eventually falls out leaving behind a thin layer of flux between the slab and the mold

Table 1

Nucor Steel–Berkeley Caster Capabilities

Chemistry (carbon content %)	Slab width (inches)	Slab thickness (mm)
0.005–0.500	40–75	55–65