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Process Metallurgy

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Areas of Research

Process development: development and optimisation of metallurgical processes regarding efficiency, material and product properties.

Transport phenomena in metallurgical processes: Mixing and transport of momentum, heat and mass in single and multiphase flow; Magneto-Hydrodynamics; heat transfer, diffusion and transformation.

Modelling: of fluid flow heat and mass transfer; solidification/transformation, segregation, precipitation, structure formation and materials properties; on-line modelling for process control and quality monitoring.

Current research activities and projects:

DSC-strip casting

Process development: The DSC process has been developed during the last 10 years. In this process the liquid steel is fed from the dispenser system onto the moving belt which is cooled from below by water. After total solidification the strand leaves the machine and is transported via a roller table where further cooling and temperature homogenization takes place to a rolling stand. The in-line rolled strip is afterwards coiled. The further development of this process is subject of an ongoing project.

Casting and processing of TRIP/TWIP steels: TRIP- and TWIP-steels especially those with high contents of Mn, Al and Si exhibit an extraordinary combination of strength and ductility. Such grades cannot be produced by conventional continuous casting. In an ongoing project casting of such steels by the DSC-process is investigated.

Casting of steels with increased contents of tramp elements: Enrichment of tramp elements like Cu in steel produced from scrap is a problem of growing importance. A key effect in this respect is the segregation of such elements at the surface due to selective oxidation, which can be avoided if casting and processing at elevated temperatures is performed in an inert atmosphere, like in the DSC-process. Subject of an ongoing project is the investigation of that and of related questions.

Initial solidification in the continuous casting mold

The heat transfer from the solidifying steel to the mold is investigated in an experimental project with special regard to the influence of casting oil properties.

Scale formation in continuous casting, heating and cooling processes

The scale formation of steel is of crucial importance for the product quality because of its direct effect on the surface properties and of its interaction to heat transfer. The mechanism of scale formation under several specific process condition is investigated in a newly started project.

Metallurgical processes for the production of steel melts with high contents of Mn, Al and Si

For the TRIP/TWIP steels already mentioned above efficient metallurgical processes for melting and refining have to be developed. This is the objective of recently started research work

Investigation and modelling of the solidification, transformation and structure formation for TRIP/TWIP steels with high contents of Mn, Al and Si. Investigation and modelling of the resulting material properties

This is the objective of recently started research activity.

Representative Publications

[1] K.-H. Spitzer, “Application of Rotating Magnetic Fields in Czochralski Crystal Growth”, Progress in Crystal Growth and Characterization of Materials, 38 (1999) 39

[2] J. Holzhauser, K.-H. Spitzer, K. Schwerdtfeger, „Study of Heat Transfer through Layers of Casting Flux. Experiments with a Laboratory Setup Simulating the Conditions in Continuous Casting“, Steel Research, 70 (1999) 252

[3] K.-H. Spitzer, O. Pesteanu, „Application of Travelling Magnetic Fields in Metallurgy“, Proc. EPM-2000, Nagoya, Japan, April 3-6. 2000, 409

[4] J. White, R. Nyström, M. Magnusson, K.-H. Spitzer, “Measurement and Modeling of Crater End Position and Shape in Bloom Casting for Application of Soft Reduction at INEXA PROFILE AB”, Proc. 6th Japan Nordic Countries Steel Symposium, Nov. 28-29 2000, Nagoya, Japan, 165

[5] K.-H. Spitzer, R. Scholz, J. Kroos, K.H. Hower, R. Nyström, E. Burström, W. Reichelt, M. Dubke, „Entwicklungsstand beim DSC-Bandgießverfahren“, Stahl u. Eisen, 121 (2001), Nr. 5, 73