Success Story
COMET

FFG

metallurgical competence center

K1-MET
Competence Center for Excellent Technologies in Advanced Metallurgical and Environmental Process Development
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COMET subproject, duration and type of project:
P 3.3 - Heat transfer measurements, 07/2015 – 06/2019, single-firm

Optimization of the secondary cooling zone of the continuous casting process

In the secondary cooling zone of the continuous casting process around 30 % to 40 % of the contained heat is removed from the material. The cooling has to be sufficient enough to ensure a certain shell thickness and finally the complete solidification of the material. Further a controlled and uniform cooling strategy is important to minimize the amount of defects in the solidified steel. To determine the cooling characteristics of different nozzles and different operation parameters the Nozzle Measuring Stand at Montanuniverstät Leoben is used.

Nozzle Measuring Stand at Montanuniversität Leoben

With the Nozzle Measuring Stand the cooling characteristic of nozzles used in the secondary cooling zone of the continuous casting process can be determined. The set-up and the size of the measuring stand allow the use of up to two cooling nozzles in an industrial scale. For that they are mounted inside the experimental chamber with variable distances to each other and to the experimental surface. Two separated water and air cycles are installed. Two pumps and a compressor ensure a controlled supply of the cooling medium. The water is stored in a 1000 l Tank. In addition a smaller tank is available to easily change the temperature of cooling water. On the top of the experimental chamber the heating and moving unit is located. It is used to heat the cylindrical sample to a defined temperature by inductive heating and to move it then through the spray. On the bottom of the chamber a measuring grid is placed to determine the water distribution.

Summarized the Nozzle Measuring Stand can be used to examine the spray characteristic of nozzles for variations of water flow/pressure, air flow/pressure, nozzle distances, cooling water temperature, sample surface temperature and sample velocity.

Currently the sample cylinder is manufactured from high alloyed, scale resident steel. In future also the influenced of scale formation on cooling performance of water/air nozzles should be investigated.

Nozzle characterization in two steps

The characterization of nozzles is done in two major steps. One is the measurement of the water distribution, the other one is the determination of the heat transfer coefficient, short HTC. The water distribution gives information about how much water impinges on the different positions of the surface. For that the nozzles are operated with certain parameters while they are

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adjusted in direction of the measuring grid. After a defined measurement time, the grid is removed and photos of its cross-sections are taken. From these photos, the complete water distribution is created by the use of digital image processing. Fig. 1 shows an example of such a distribution.

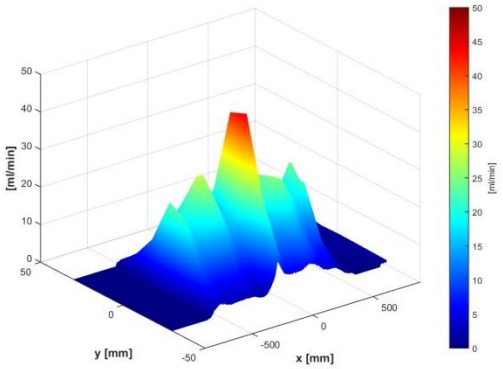

Fig. 1: Typical water distribution (Nozzle Measuring Stand, Leoben).

The second part of the experiment consists of the HTC measurement. The HTC is an important parameter in describing the cooling of a solid surface using liquid or gaseous cooling agents. The higher the HTC, the higher the cooling performance. To measure this parameter the nozzles are directed onto a sample cylinder which is then cooled down by the spray. The temperature drop at several positions inside the sample cylinder is recorded by thermocouples. From these temperature measurements, the HTC can be calculated by the use of an inverse heat conduction method.

Knowing the water distribution makes it possible to measure the HTC at interesting positions of the spray. This can be for example in the area of local maxima.

Fig. 2 shows a HTC measurement done at the Nozzle Measuring Stand at Montanuniversität Leoben.

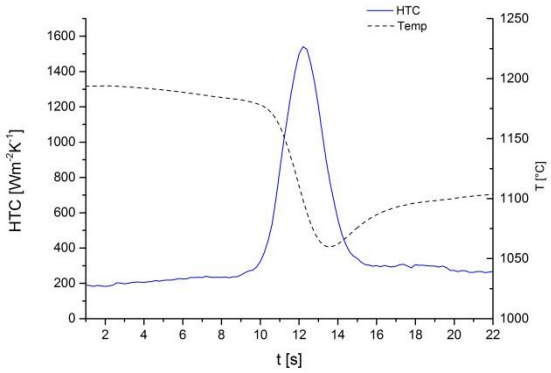

Fig. 2: Example for a HTC measurement (Nozzle Measuring Stand, Leoben).

Impact and effects

A controlled and uniform cooling of the strand during casting process can influence the quality in a positive way. Because of better quality some finishing processes can be reduced to save production time and money.

Another point is that secondary cooling consumes big amounts of water and air. A sophisticated cooling process, using the right nozzles with the right operation parameters can reduce the need of water and air. Thereby resources and money can be saved.

Contact und information
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