

Dear Reviewers! On behalf of all co-authors, I would like to thank you for your valuable comments and suggestions. They helped to improve our manuscript and to increase its value for the Readers.

Please consider, that the presented study introduces a robust model which is developed for the extended studies in the future, which will include additional phenomena such as, for example, 3D-flow effects, magnetohydrodynamic forces during the electromagnetic brake, etc. Thereby, the current paper does not include wide range of the results.

Section 2 is renamed and restructured according to the request from the Reviewers.

The curves in Figures 10 and 11 are now labeled, and those markings are used in the description text.

Additional Figure 12 is added to quantify some of the results.

The abstract, introduction and conclusion sections are restructured and improved.

Additional English spell checking was performed by a certified proofreader.

Sincerely,

Dr. Alexander Vakhrushev

Reviewer #2 comments:

REVIEW on article

On Modelling Parasitic Solidification Due to Heat Loss at Submerged Entry Nozzle Region of Continuous Casting Mold

Alexander Vakhrushev, Abdellah Kharicha, Menghuai Wu, Andreas Ludwig, Yong Tang, Gernot Hackl, Gerald Nitzl, Josef Watzinger, and Jan Bohacek

SUMMARY.

The article is devoted to the mathematical modeling of the problems associated with the continuous casting of steel. Improvement of the technological process of continuous casting of steel, its optimization to obtain a higher quality product is an important scientific problem. Experimental study of the processes of forming continuous ingots is related to significant difficulties. Therefore, theoretical study plays an increasing role, in particular, in methods of numerical modeling using modern high-performance computers.

Important technological factors that determine the quality of the surface and the central zone of the ingot are the stable casting speed, control of the secondary cooling modes to stabilize the temperature of the ingot surface.

The authors proposed a mathematical model for the numerical analysis of the continuous casting process, based on a modification of the classical equations of fluid flow. Physically, the process takes place in several stages and is a multiphase medium; therefore, the

analysis was carried out numerically. Next, the authors focused on the clogging of submerged entry nozzles (SEN) and parasitic solidification, which is logical, since it is associated with the stability and quality of the continuous casting process.

The reference list contains 82 items.

Title, Abstract, and Conclusion correspond to the content of the article.

(Answer): Thank you for the detailed summary!

However, there are shortcomings and ambiguities that need to be corrected.

COMMENTS.

The authors have to redo the Abstract and bring it in line with the requirements of the Metals journal. The scientific novelty is poorly defined. The authors need to highlight it. Editors strongly encourage authors to use the following style of structured abstracts, but without headings: (1) Background: Place the question addressed in a broad context and highlight the purpose of the study; (2) Methods: Describe briefly the main methods or treatments applied; (3) Results: Summarize the article's main findings; and (4) Conclusions: Indicate the main conclusions or interpretations. The abstract should be an objective representation of the article.

(Answer): Thank you for your comment! We restructured the Abstract to meet the Metals journal requirement and to stress the novelty of the study.

Equations 1-4 have a rectangular element, apparently a typo.

(Answer): A rectangular element in the Eq. 1-4 is a Math-Type bullet symbol for the divergence operator, which is correctly reflected in our Word version. Unfortunately, it cannot be correctly rendered in the PDF version, so it was substituted by the “c-dot” operator.

The Introduction is too long, maybe split it into subsections and shorten it. The Introduction is well written, reflects contemporary and relevant articles on the topic. However, I recommend reflecting on the purpose of the study in the concluding part of the Introduction.

(Answer): The introduction is restructured and shortened.

It is unclear whether the authors used standard software or developed their own?

(Answer): The used solver is an inhouse code utilizing the OpenFOAM finite volume method library. The PIMPLE-like algorithm is applied to couple the flow and the solidification. The enthalpy-porosity method is implemented by the authors to reflect the formation of the solidified shell in the mold and a parasitic solidification inside the SEN. Corresponding drag terms are applied to reflect the solidified shell withdrawal in the CC mold and in the strand regions and a static mush near the SEN wall. We have added corresponding description to the manuscript.

Section 3.1. Material properties and case setup is logical to place in section 2 Materials and methods

(Answer): Thank you! We reorganized corresponding sections and moved Material properties and case setup to the section 2, which also renamed as “Materials and methods” to meet its content.

Figure 11 is hard to read. I recommend numbering the curves and describing them in the text of the article.

(Answer): The curves in Fig.10-11 are now labeled and the markings are used in in the results discussion for these figures.

In the Discussion section, the authors need to compare the results obtained with those of other researchers. It is desirable to show the limits of applicability of the model.

(Answer): The results are compared, and the applicability of the model is defined.

In the Conclusion section, I recommend quantifying the results.

(Answer): The results are additionally quantified in Figure 12.

In general, the article is devoted to an interesting and important scientific problem that will undoubtedly attract the attention of readers.

(Answer): Thank you for your kind response!

However, there are many corrections. I recommend the article for publication after a major correction.

(Answer): We have revised the manuscript to implement the required corrections.