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IMPROVEMENT OF THE PROCESS OF BLOWING METAL WITH ARGON IN A STEEL-POSING LADLE TO IMPROVE ITS QUALITY

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Annotation
This article is devoted to out-of-furnace processing of liquid steel, namely, to purging metal with inert gases in order to improve its quality. The main advantages of purging with inert gases, the efficient arrangement of purging units, as well as the dependence of the time of homogenization of liquid steel on the volumetric flow rate of inert gas are considered.

Keywords: liquid steel, argon purge, mathematical modeling, purge block, homogenization.

One of the main tasks that metallurgists set themselves is to reduce production costs while maintaining the high quality of the metal. This goal is achieved by optimizing the ongoing technological processes. The generally accepted technology of steel homogenization with inert gases is an important step in steel production. Blowing inert gas (argon) into the melt in a steel ladle is the most affordable. Homogenization processes during purging with argon into the melt on a ladle have been studied by many scientists.
It is usually recommended to blow from below. Purging is carried out in the ladle with an inert gas, mainly argon, which facilitates the purification of liquid steel. Gaseous argon (Ar) is preferred for refining due to its inert nature, in addition to its very low

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solubility in liquid steel. The transported inert gas moves from the bottom of the bucket to the top, i.e. to the slag and expands due to heating and reduction of ferrostatic pressure along the rise. However, the purge process will require a much lower gas flow rate. Gaseous argon is blown at a moderate speed, less than 0.6 Nm3/min, which is the extreme to achieve homogenization of liquid steel in temperature and chemical composition. The intensity of gas agitation is of great importance because steel mills want to relate the quality and composition of the steel to the agitation effect.

The main advantages of purging liquid steel with inert gases are:

• removal of dissolved gases from liquid steel;
• homogenization by temperature and composition;
• removal of non-metallic inclusions;
• uniform dispersion of alloying elements and additives;
• increasing the rate of a chemical reaction.

Due to the lower cost of refractory materials, a better efficiency and simpler installation is the purging of the melt with inert gases from below than the top-dipping lance method.

The purpose of this work was to obtain data on the influence of the volumetric flow rate of the inert gas and the position of the purge block on the bottom of the ladle during the homogenization process. Figure 1 shows the positions of the purge block under investigation. Only positions O, A, D, E were studied in the work. The definition of physical similarity conditions was based on proven and used procedures.

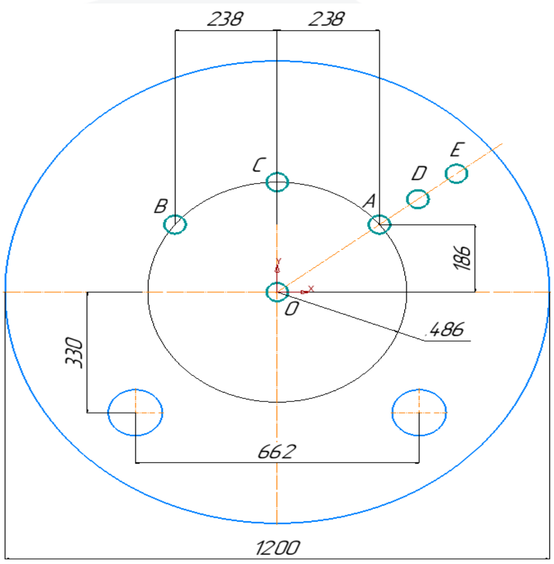

Figure 1 - The positions of the elements of the mixers on the bottom of the ladle used for modeling

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The obstacles that arise in physical modeling, in most cases, can be overcome with the help of mathematical modeling of the process. More recently, mathematical modeling has been the most widely used tool, encouraged by the dynamic development of IT technology and the emergence of more accurate numerical procedures and computer software. In mathematical modeling, the process of mixing a metal bath is based on the Navier-Stokes equations. In 1979, Julian Szekely et al. attempted to numerically stimulate the phenomenon of turbulent flow in a ladle during gas blowdown using the Navier-Stokes equations. Since then, the mixing modeling problem has been developed in numerous publications; and a separate line of research was devoted to this issue, described as CFD (computational fluid dynamics). The studies were carried out using numerical simulations (computational fluid dynamics - CFD). Figure 2 shows the mathematical modeling of steel blowing in a steel ladle with a blowing block.

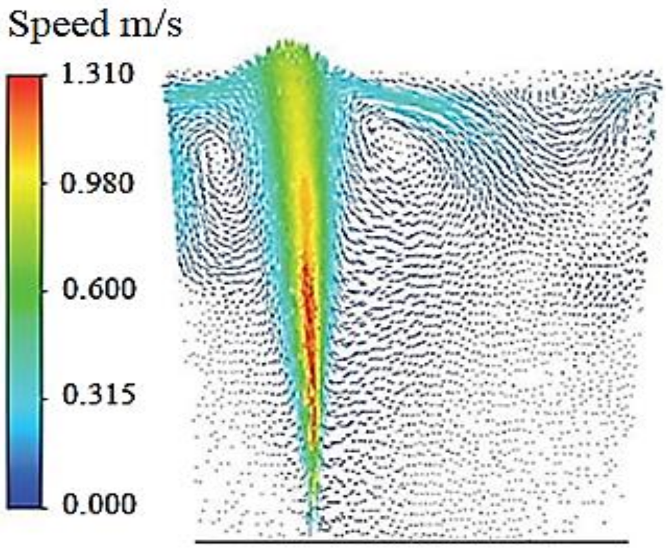

Figure 2 - Simulation of steel blowing in a steel ladle

Modern mathematical modeling based on CFD allows you to get acquainted with the flow of liquid steel present in the ladle, therefore, determine the time required for the homogenization of liquid metal.
For purposes of industrial interpretation, the homogenization time measured on the model is plotted and shows the effect of argon volume flow to achieve homogenization time for the four positions of the purge blocks in the bottom of the ladle labeled O, A, D, and E; The resulting regression functions and their determination coefficients for individual modeled options are shown in Figure 3.

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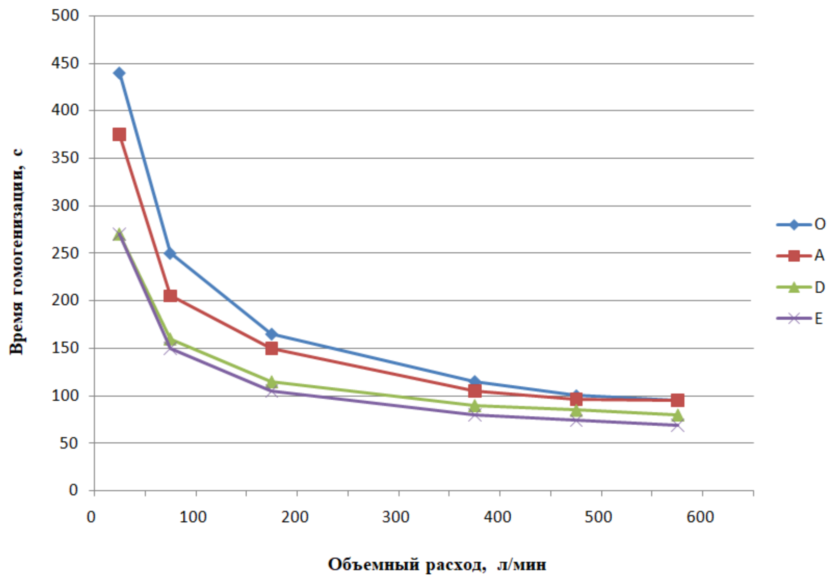

Figure 3 - Dependence of the homogenization time on the volumetric flow rate of inert gas

As can be seen from the figure, with an increase in the volumetric flow rate of argon, the homogenization time decreases. This reduction is not too significant and the value of the homogenization time varies from 75 to 125 seconds in the area above 400 l/min. In spite of this, the value of the homogenization time increases sharply up to 440 seconds depending on the position of the purge block when the flow is 50 l/min.

In terms of homogenization time, the curves also indicate that there are clear differences between the purge with the purge blocks in their positions. Positions O and A are the worst, while positions D and E show relatively similar and short homogenization times. Position D can be considered as the most advantageous position of the purge block because it has the shortest homogenization time compared to other positions.

Conclusion: The method of mathematical modeling is used for various studies. The main modeling factors are argon purge through purge blocks located in the bottom of the ladle. The dependence of the homogenization time on the volumetric flow rate of the inert gas was obtained for various purge options.

It is shown that the calculations performed on the basis of a mathematical model made it possible to predict the state of motion of liquid steel in a steel-pouring ladle. According to the Navier-Stokes equation, purging with argon can reduce the amount of non-metallic inclusions.

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References

1. Турсунов, Н. К., &Тоиров, О. Т. (2021). Снижение дефектности рам по трещинам за счёт применения конструкции литниковой системы.

2. Тен, Э. Б., &Тоиров, О. Т. (2020). Оптимизация литиковой системы для отливки «Рама боковая» с помощью компьютерного моделирования. In Прогрессивные литейные технологии (pp. 57-63).

3. Toirov, O. T., Tursunov, N. Q., Nigmatova, D. I., &Qo'chqorov, L. A. (2022). USING OF EXOTHERMIC INSERTS IN THE LARGE STEEL CASTINGS PRODUCTION OF A PARTICULARLY. WebofScientist: InternationalScientificResearchJournal, 3(1), 250-256.

4. Toirov, O. T., Tursunov, N. Q., &Nigmatova, D. I. (2022, January). REDUCTION OF DEFECTS IN LARGE STEEL CASTINGS ON THE EXAMPLE OF" SIDE FRAME". In International Conference on Multidimensional Research and Innovative Technological Analyses (pp. 19-23).

5. Toirov, O., &Tursunov, N. (2021). Development of production technology of rolling stock cast parts. In E3S WebofConferences (Vol. 264, p. 05013). EDP Sciences.

6. Кучкоров, Л. А. У., Турсунов, Н. К., &Тоиров, О. Т. У. (2021). ИССЛЕДОВАНИЕ СТЕРЖНЕВЫХ СМЕСЕЙ ДЛЯ ПОВЫШЕНИЯ ГАЗОПРОНИЦАЕМОСТИ. Orientalrenaissance: Innovative, educational, naturalandsocialsciences, 1(8), 831-836.

7. Toirov, B. T., Jumaev, T. S., &Toirov, O. T. (2021). OBYEKTLARNI TANIB OLISHDA PYTHON DASTURIDAN FOYDALANISHNING AFZALLIKLARI. Scientificprogress, 2(7), 165-168.

8. Тен, Э. Б., & Тоиров, О. Т. (2021). Оптимизация литниковой системы для отливки. Литейное производство, (10), 17-19.

9. Riskulov, A. A., Yuldasheva, G. B., Kh, N., & Toirov, O. T. (2022). Derivation processes of fluorine-containing wear inhibitors of metal-polymer systems. Web of Scientist: International Scientific Research Journal, 3(5), 1652-1660.

10. Riskulov, A. A., Yuldasheva, G. B., & Toirov, O. T. (2022). Features of fluorocomposites obtaining for wearing parts of machine-building purpose. Web of Scientist: International Scientific Research Journal, 3(5), 1670-1679.

11. Мухаммадиева, Д. А., Валиева, Д. Ш., Тоиров, О. Т., & Эркабаев, Ф. И. (2022). ПОЛУЧЕНИЕ ПИГМЕНТА НА ОСНОВЕ ОСАДКОВ ЭЛЕКТРОХИМИЧЕСКОЙ ОЧИСТКИ ХРОМАТСОДЕРЖАЩИХ СТОКОВ. Scientific progress, 3(1), 254-262.

12. Kayumjonovich, T. N. (2022). Development of a method for selecting the compositions of molding sands for critical parts of the rolling stock. Web of Scientist: International Scientific Research Journal, 3(5), 1840-1847.

13. Kayumjonovich, T. N., Pirmukhamedovich, A. S., & Teleubaevich, U. T. (2022). Justification and choice of rational operating current frequency in induction crucible furnaces. Innovative Technologica: Methodical Research Journal, 3(06), 40-47.

14. Kayumjonovich, T. N. (2022). NON-METALLIC INCLUSIONS IN STEEL PROCESSED WITH MODIFIERS. Web of Scientist: International Scientific Research Journal, 3(5), 1848-1853.

15. Kayumjonovich, T. N. (2022). Research and improvement of steel refining modes in induction furnaces in order to improve the products quality. Web of Scientist: International Scientific Research Journal, 3(5), 1713-1719.

16. Kayumjonovich, T. N., & Zokirov, R. V. (2022). The metal refining problem and technical solutions for the active slag formation in induction furnaces. Web of Scientist: International Scientific Research Journal, 3(5), 1755-1760.

17. Sh, V. D., Erkinov, S. M., Kh, O. I., Zh, A. S., & Toirov, O. T. (2022). Improving the technology of manufacturing parts to reduce costs. Web of Scientist: International Scientific Research Journal, 3(5), 1834-1839.

18. Toirov, O., Tursunov, N., Alimukhamedov, S., & Kuchkorov, L. (2023). Improvement of the out-of-furnace steel treatment technology for improving its mechanical properties. In E3S Web of Conferences (Vol. 365, p. 05002). EDP Sciences.

19. Kuchkorov, L., Alimukhamedov, S., Tursunov, N., & Toirov, O. (2023). Effect of different additives on the physical and mechanical properties of liquid-glass core mixtures. In E3S Web of Conferences (Vol. 365, p. 05009). EDP Sciences.

20. Тоиров, О. Т. У., Турсунов, Н. К., & Учкун, Т. У. Р. (2022). РАЗРАБОТКА ТЕХНОЛОГИИ ПО СНИЖЕНИЮ ИЗЛОМА КРУПНЫХ СТАЛЬНЫХ ОТЛИВОК ДЛЯ ЛИТЫХ ДЕТАЛЕЙ ПОДВИЖНОГО СОСТАВА. Central Asian Academic Journal of Scientific Research, 2(4), 243-248.