A solution with methyl orange dye concentration of 10 mg/L was selected, and high entropy alloy nanomaterial was used as catalyst for microwave catalytic degradation of dye. As can be seen from fig. 2, when the composition of FeCoNiTiCr alloy powder is 20 g/L filler, the adsorption removal rate is 90 %, and after microwave catalysis, the dye removal rate is about 94 %. Subsequent analysis combined with liquid chromatography showed that the methyl orange dye had been degraded.

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磁场下连铸过程模拟及新型磁流体制备研究

王彦强（Wang Yanqiang）
东北大学（Northeastern University）
e-mail: 2050550942@qq.com

Summary. *This study aims to simulate the flow behavior of molten steel in an electromagnetic field using magnetorheological fluid and investigate the influence of the magnetic field on the flow behavior of molten steel during continuous casting. Magnetorheological fluids exhibit good flowability and magnetic responsiveness, allowing their rheological properties to be controlled by adjusting parameters such as magnetic field strength, concentration, arrangement of magnetic particles, and direction of movement. A new type of highly transparent magnetorheological fluid was developed for this study, and optical observation using traditional water models was employed. Leveraging its transparency and non-toxicity at low temperatures, the study examined the impact of the electromagnetic field on molten steel flow behavior during continuous casting.*

Continuous steel casting, commonly referred to as continuous casting, not only improves production efficiency and product quality but also reduces costs. Furthermore, it enhances energy efficiency and sustainability by increasing steel utilization and reducing fuel consumption, thus contributing to energy savings and emissions reduction goals. Serving as a crucial element in the steelmaking process, continuous casting plays a pivotal role throughout modern steel production.

Nonetheless, several challenges persist, including internal defects in steel billets, particularly the Oxidation slag phenomenon during the initial stage of continuous casting. During the casting process, as molten steel flows from the submerged nozzle, a transition turbulent region is formed between the localized jet and the surrounding stagnant flow, leading to the formation of a hydraulic jump within the crystallizer and causing adverse effects like fluctuations in the liquid level. Therefore, this experiment aimed to investigate the formation of a circular hydraulic jump in the electromagnetic process during unsteady casting.

The research can be divided into three main parts: preparation of a novel transparent magnetorheological fluid suspension to simulate molten steel flow, conducting simulation experiments using permanent magnet-based magnetic fields, and data collection and analysis.

Improvements in the preparation of magnetorheological fluids, using a dry method, have yielded magnetorheological fluid suspensions with adequate flowability and transparency, making them suitable for large-scale production. The viscosity of the magnetic suspension was measured using an NDJ-1 digital rotational viscometer, resulting in a viscosity of 2.27 mPa×s. In addition, the surface tension of the solution was determined using the maximum bubble pressure method, and the experimental results yielded a liquid surface tension of 30.693 $mN \cdot m^{-1}$. It was found that the addition of carbon powder particles to the solution was conducive to high-speed camera-based image analysis, facilitating subsequent image processing. Consequently, carbon powder particles were used as tracer particles.

The experiment primarily focused on the influence of unsteady electromagnetic casting on the behavior of circular hydraulic jumps under different conditions of weirs and magnetic fields. A series of individual Halbach array bar magnets were arranged and assembled to create desired patterns, such as triangles, and the magnetic field strength distribution was measured using a tesla meter. Using the new transparent magnetorheological fluid to simulate molten steel flow, changes in the behavior of the circular hydraulic jump with weirs were studied, and particle image velocimetry (PIV) techniques in MATLAB software were used to measure the velocity of the hydraulic jump. Changes in the velocity characteristics and size and shape of the hydraulic jump during the transient casting were analyzed by altering the shape and side length of the weir.

Qualitative conclusions regarding experimental observations include the interaction of two hydraulic jumps when two jets impinge vertically onto a horizontal plate, forming an interaction region between the two hydraulic jumps. The velocity of the hydraulic jump in the jump front region gradually decreases as one moves from the jet center towards the interaction region. When the jet spacing decreases, the velocity from the jet center to the interaction region also decreases. When the jet spacing is less than the radius of the hydraulic jump, the addition of a magnetic field to the interaction region results in changes in the hydraulic jump's profile, widening the interaction region and reducing the hydraulic jump height, causing the hydraulic jump to become the dominant feature. The hydraulic jump typically starts to disappear when it reaches the wall, which is referred to as a circular hydraulic jump.

The magnetic field significantly influences the velocity of the magnetic jet hydraulic jump. Before the weir, the magnetic weir generates a magnetic field in the horizontal direction, attracting magnetic particles in the jet, thereby increasing the average velocity of the jet. In the moment right after contacting the weir, the jet velocity typically decreases with the increase in weir side length, and the velocity shifts from being higher than the average velocity without a magnetic field to being distinctly lower. This phenomenon occurs because the magnetic weir generates a magnetic field in the vertical direction, resulting in the attraction of magnetic particles in the magnetorheological fluid. When the side length of the weir remains constant, increasing the number of sides in the geometric shape of the weir leads to a gradual reduction in the average velocity of the transient hydraulic jump, indicating a more pronounced weakening effect on the velocity characteristics of the transient hydraulic jump.

The magnetic field also has a significant impact on the height of the magnetic jet hydraulic jump. By analyzing the selection of the highest point of the hydraulic jump, it was found that when a magnetic weir is present, the highest point of the transient hydraulic jump is lower than that of a non-magnetic weir. This phenomenon is also attributed to the magnetic weir generating a magnetic field in the vertical direction, which results in the attraction of magnetic particles, reducing the height of the hydraulic jump. Typically, when the side length of the weir remains constant, increasing the number of sides in the geometric shape of the weir leads to a gradual reduction in the height of the transient hydraulic jump, indicating a more pronounced weakening effect on the height characteristics of the transient hydraulic jump.

The final research findings demonstrate that the magnetic field can exert systematic influence on the form and velocity of hydraulic jumps. By adjusting the magnetic field distribution as needed, it is possible to control the behavior of hydraulic jumps and thereby reduce internal defects in steel billets.

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一种基于铁纳米簇的新型可视化葡萄糖传感器

葛菁（Ge Jing），张慕琪（Zhang Muqi），王馨仪（Wang Xinyi），
毛文璐（Mao Wenlu），芦静怡（Lu Jingyi）
东北大学（Northeastern University）
e-mail: 2943055992@qq.com

Summary. *In this paper, a novel fluorescent sensor for glucose detection based on fluorescent iron clusters (Fe NCs) and glucose oxidase is developed. With the increase of glucose concentration, the red fluorescence of iron nanoclusters decreases gradually, and the glucose content can be detected in the range of 0–100 $\mu mol \cdot L^{-1}$. In addition, in order to facilitate the detection of glucose, this paper investigated the coating of Fe NCs and glucose oxidase by agarose and further preparation of agarose gel test strip for glucose detection. Under ultraviolet lamp, the change of glucose content can be identified through the color change of agarose gel.*

The application of glucose testing in biomedicine is of great significance. In clinical medicine, diabetes mellitus seriously jeopardizes human health, and its diagnosis and treatment has been a major challenge in the medical community. Diabetes can be effectively monitored and treated by accurate measurement of glucose content in diabetic patients. Currently, enzyme biosensors for measuring glucose content can be categorized into electrochemical enzyme biosensors,