SECTION 3. METALLURGY

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ASSESSING THE QUALITY OF IRON ORE PELLETS USING VARIOUS BINDERS

ОЦІНКА ЯКОСТІ ЗАЛІЗОРУДНИХ ОКАТИШІВ ПРИ ВИКОРИСТАННЯ В'ЯЖУЧИХ РЕЧОВИН РІЗНИХ ТИПІВ

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As steel production volumes increase, demand for iron ore materials is growing. In addition, the quality requirements for materials, including iron content, strength and recoverability, are increasing [1]. Among the main iron ore materials, pellets have some significant advantages: homogeneous particle size, high strength, suitability for long-distance transportation and long-term storage, and high iron content. The percentage of pellets in blast furnace charge can range from 80% to 90% and in some cases up to 100%.

In Ukraine, pellet production is one of the key metallurgical processes, with the bulk of pellets produced being exported, primarily to the European Union, and therefore pellets must meet high-quality requirements.

Binders are an important component of pellet production. Not only the pelletizing process and the properties of raw pellets but also the success of heat treatment and the quality of finished pellets depend on the properties of binders [2]. Inorganic binders, organic binders, and composite binders are used.

The main inorganic binders are bentonite, colmanite, and lime. [3] Currently, bentonite is the most common binder in pellet production, with an average consumption rate of 0.5 ~ 0.7% [4]. The main components of inorganic binders – aluminium, silicon, and calcium oxides – react with iron-containing minerals of the concentrate and waste rock during heat treatment and remain in the finished pellet. Therefore, the disadvantage of using inorganic binders is a decrease in the iron content of pellets [5].

Organic polymers are a newer type of pellet binder and can fully or partially replace bentonite. At the stage of high-temperature pellet firing, polymeric binders are converted to the gas phase by thermal decomposition, which improves the metallurgical properties of pellets, i.e., the amount of waste rock is reduced and the iron content is increased [6].

The main tasks of binders in pellet production are to improve the pelletizing process, i.e. to increase the pellet formation rate, increase their strength in the raw and dried state, and reduce pellet destruction during drying.

When distributed evenly in the charge, organic binders improve the pelletizing process compared to bentonite, while achieving a significantly lower specific consumption of binders [7]. Due to the increasing requirements for iron ore raw materials, including higher iron content in pellets, iron concentrate often needs to be subjected to additional processing, such as flotation. This process reduces the average particle size of the concentrate and increases the specific surface area, which leads to an increase in the concentrate moisture content. Unlike bentonite, which can absorb excess moisture by swelling, organic binders are designed for a certain moisture content and, if it increases, the consumption of binders must be increased.

In the process of drying pellets, binders increase the maximum allowable temperature without destroying the pellets. Bentonite significantly increases the breaking point of pellets due to the high strength of dry granules and relatively high porosity. Compared to bentonite, the organic binder has a higher viscosity during pellet drying, which not only ensures high dry pellet strength, but also can effectively reduce the diffusion rate of free and capillary moisture, evaporation rate, and shrinkage. The conversion to the gas phase of the organic binder at high temperatures will increase the porosity of the granules, which will promote the rapid diffusion of steam, thus reducing the pressure inside the granules and increasing the granule bursting temperature.

However, the addition of a large amount of organic binder will not allow the water vapour inside the pellet to reach the surface in time, increasing the pressure inside and thus reducing the bursting point [8]. With an increase in the specific consumption of organic binders, the permissible maximum temperature for drying pellets decreases.

Also, the cost of organic binders is several times higher than the cost of bentonite. Therefore, it is important to use composite binders to improve the quality of pellets without significantly increasing their cost. In this case, the use of bentonite improves pelletizing conditions at higher moisture content of the concentrate and increases the drying temperature without destroying the pellets. In turn, the use of organic binders improves the pelletizing speed and strength of raw pellets, increases the iron content in pellets and reduces the content of waste rock in them.

The use of organic binders in the production of pellets for direct iron recovery is particularly noteworthy. Due to the strict requirements for iron content in pellets to be at least 68 to 69%, the use of bentonite is undesirable, as it reduces the iron content by 0.5 to 0.8%. Therefore, in this case, it is more appropriate to use only organic binders.

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IMPROVEMENT OF THE COLD ROLLING TECHNOLOGY OF THE HEADQUARTES TAKING INTO ACCOUNT THE ANISOTROPY OF THE PLASTIC FLOW OF LOW-ALLOY STILLS

УДОСКОНАЛЕННЯ ТЕХНОЛОГІЇ ХОЛОДНОГО ПРОКАТУВАННЯ ШТАБ З УРАХУВАННЯМ АНИЗОТРОПІЇ ПЛАСТИЧНОЇ ТЕЧІЇ НИЗЬКОЛЕГОВАНИХ СТАЛЕЙ

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Розвиток металургійної промисловості постійно ставить нові завдання з підвищення продуктивності металургійних машин та агрегатів, економії матеріальних та енергетичних ресурсів, що потребує подальшого дослідження та удосконалення технологічних процесів металургійного виробництва.

Холодне прокатування є одним із найважливіших процесів виробництва сталевих матеріалів, особливо низьколегованих сталей. Цей процес використовується до виготовлення різноманітних металевих виробів, таких як листи, стрічкі, штаби, труби та профілі. Однак, при холодному прокатуванні низьколегованих сталей виникає проблема анизотропії пластичної течії, яка може призвести до недоліків у властивостях кінцевого продукту.

Анизотропія пластичної течії визначається нерівномірністю розподілу деформації в матеріалі під час прокатування. Це може