Measures for Reducing the Rate of Breakout of Slab Casters

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Abstract: In order to reduce the rate of breakout of slab caster, improve the operating rate and ensure the stability of the caster, measures including the tundish casting auto-start, the mold level automatic control system optimization, the SEN one-button automatic quick-change technology, the mold breakout forecast system optimization, the mold oscillation parameters optimization, the mold taper measurement optimization and the mold powder management have been adopted by a steel plant of WISCO. As a result, the breakout rate of slab caster was significantly reduced to be zero level in the first 3 years, which is a new record for all steelmaking plant in China.

Key words: continuous casting; breakout accidence; measure

Breakout is a serious accident of continuous caster. It not only causes the interruption in production, the reduction of operating rate of the caster, more serious, the severe breakout can damage the major equipments such as the mold, the mold-oscillator and the segment of caster. A breakout of the slab caster can cause the loss of hundreds of million[1,2].

There are two double-strand straight-arc slab casters in the steel plant of WISCO in which the designed annual output is 3.6 million tons. The thickness of casting blank is 210 mm, 230 mm and 250 mm, and its width ranges from 800 mm to 1550 mm. The length of the mold is 900 mm, the metallurgical length is 34.5 m, the casting speed is from 0.8 m/min to 1.5 m/min. The mold has a breakout alarm system. The production mode of the plant is "two furnaces, two casters". Any abnormal condition of one equipment will affect 50 percent of capacity directly.

1 Measures of Breakout Prevention and Their Implementation Effect

In order to stabilize the production, improve caster operating rate and reduce economic loss, measures of equipment improvement, process optimization, production management were taken by the plant since the end of 2007. As a result, the breakout rate of the plant is satisfied.

1.1 Development and application of the technology of casting auto-start of tundish and casting automatically speed up

The technology of casting auto-start of tundish and casting automatically speed up are the important technologies to realize automatic production of continuous casting. These technologies are beneficial to improving the successful rate of the casting and the stability of continuous casting process, improving the quality of the slab, improving operating condition and reducing the labor cost[3]. The technology of casting auto-start of tundish is that the computer system controls the position of stopper and the pulling speed of withdrawal straightening machine to realize auto-casting. Based on the steel grade and casting blank's section, the system controls the start time and start pulling speed to ensure stability of the molten steel surface of the mold and to form a solidified shell uniform. The application of casting auto-start of tundish technology can prevent the breakout of casting start caused by improper manual operation, improve the success rate of casting start, control the mold level fluctuations and the slag entrapment caused by flow field disorder under non-steady-state conditions.

Production practice proved that the technology of casting auto-start of tundish and casting automatically increase speed can realize the liquid level fluctuation automatic control of continuous casting process and the liquid level fluctuation is reduced to less than ±5 mm casting start process. This measure improves the surface quality of start casting blank, reduces the breakout probability of start casting[4,5].

Fig. 1 gives details of the casting auto-start process, molten steel pour into mould and the level rise to 800 mm quickly but smoothly. The liquid level fluctuation within ±5 mm is considerablly steady and can prove the fine operation of the start process. Based on the level rising, the pulling rate reaches the target value according to the preinstall program.

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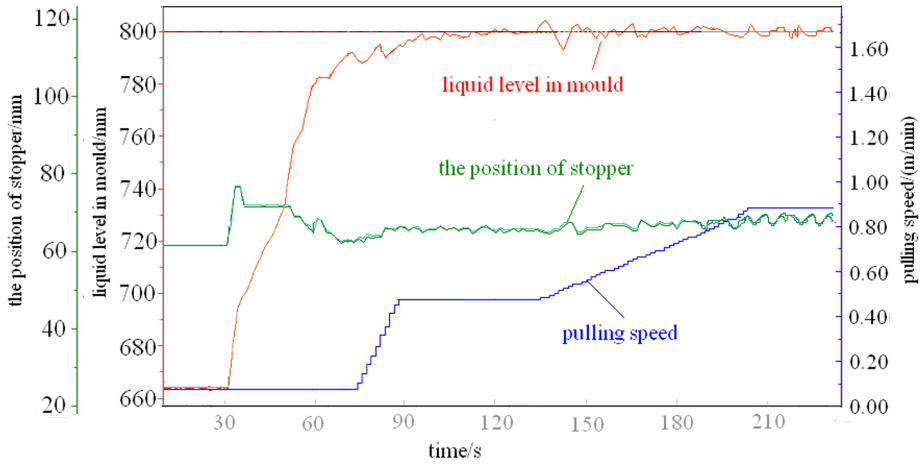

Fig. 1 Present screen of casting auto-start process

1.2 Optimization of auto-control system of liquid level in mold

The liquid level fluctuation in mould is one of the key factors that affect the quality of slab and breakout rate, and it is also an important content of continuous casting process control[6,7]. If the liquid level fluctuation in mold is more than ± 10 mm, the casting powder may be involved in the molten steel significantly, and then generate the slag inclusion under the surface of casting blank. The slag inclusion can reduce the quality and the product rate of slab, or even cause the breakout.

The liquid level control system (VUHZ) of the plant was supplied by SIMENS-VAI. It is the electromagnetic sensors system SH7-S10 having alternative subsystem with single signal and triple signals. Through a series of commissioning work, in the next year after the run of the plant, the liquid level control accuracy reached a high level, which is within ±3 mm (low carbon steel, medium carbon steel, electrical steel) and ±1 mm (ultra-low carbon steel). The stability of the system still has some problems. The excessive automatic control failure number is caused by the liquid level detecting out of work and the high deviation of liquid level detecting. As a result, the incidence rate of quality defects of hot rolled plate will be higher and the breakout accidents occurred.

The test analysis showed that the main reason for the inactivation of automatic control system was caused by the difference between the cold calibration of testing equipment and liquid level and the thermal compensation of the continuous casting process.

According to the above problems, it is necessay to build an error compensation curve of liquid level cold calibration, optimize the program of hot compensation revision in hot state, realize the automatic calibration function between the testing equipment and the system before casting start. After implementation of these measures, the fault occurrence rate of the automatic control system is from 17 times per year to 2 times per year, which means that the risk of breakout reduces effectively.

1.3 Development and application of automatic quick-replace technology of SEN

Replacing process of SEN always influence the production stability of continuous casting process, the quality of slab and the rate of breakout significantly. In course of traditional quick-replace action of SEN, the liquid level in mould will fluctuate violently and constantly, the casting powder layer would be damaged, the probability of surface slag inclusion of casting blank and breakout would be increased seriously.

On the basis of the automatic control system of liquid level in mold and the manual quick-replace process of SEN, the function of quick-replace SEN was realized by software development and improvement of operation. Cooperated with the automatic control system of liquid level, this technology keeps the liquid level STABLE in the replace process of SEN, which was an unsteady state process.

Fig. 2 shows the comparison of the automatic quick-replace and manual quick-replace process of SEN. The lower curve of the figure shows that the