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Feasibility Study on Preventing Sedimentation and Agglomeration in Blast Furnace Slag Washing Suction Tank

Haojie Mu

Zenith Steel Group Company Limited (Nantong), Nantong, Jiangsu 226000, China

Abstract

This paper discusses the method of preventing sand setting and hardening in the blast furnace slag flushing suction basin. This method is to lengthen the water supply riser of the suction basin and install the stainless steel filter screen anti-blocking nozzle. When it is necessary to replenish water each time, open the butterfly valve on the water pipe of the pipe network to make the nozzle on the horizontal water supply pipe start to spray water, blow the water slag far away from the slurry pump to the slurry pump, so that the slurry pump can suck the water slag away, and make it difficult to deposit slag at the bottom of the pool far away from the slurry pump. This method can effectively prevent water slag from depositing and solidifying at the bottom of the pool, ensure the circulation of slag flushing water, reduce the workload of employees, and reduce the labor intensity of employees.

Keywords

Blast Furnace; Slag Flushing Suction Tank; Water Purging; Prevent Hardening.

1. Introduction

The smelting process of blast furnace is conducted in a closed shaft furnace. The smelting process of blast furnace is characterized by the completion of a variety of chemical reactions and physical changes that are intricately interwoven during the counter-current movement of the charge and gas. Since the blast furnace is a sealed container, except for the input (charging) and output (iron, slag and gas), the operator cannot directly observe the reaction process, and can only observe it indirectly with instruments and meters. [1]

The main purpose of blast furnace smelting process is to use iron ore to obtain liquid pig iron with required temperature and composition economically and efficiently. For this reason, on the one hand, it is necessary to realize the chemical separation of metal elements (mainly Fe) and oxygen elements in ores, that is, the reduction process; On the other hand, it is necessary to realize the mechanical separation of the reduced metal and gangue, that is, the melting and slagging process. Finally, the interaction between temperature and liquid slag iron is controlled to obtain qualified liquid iron with temperature and chemical composition. The whole process is completed in the process of close contact between the charge from top to bottom and the gas from bottom to top. The low-temperature ore is reduced by the gas gradually capturing oxygen from the outside to the inside during the descending process, and at the same time, it gets heat from the high-temperature gas. When the ore rises to a certain temperature limit, it will soften first, and then melt and drop to realize slag and iron separation. Many reactions occur between molten slag and iron and in the process of contact with solid coke, and finally adjust the composition and temperature of molten iron to reach the end point. Therefore, it is the key to complete the smelting process with high quality to ensure the uniform and stable drop of the burden and control the uniform and reasonable distribution of the gas flow. [2]

During blast furnace tapping, the slag flushing pump room is to pass the water with a certain amount of water, water pressure and chute slope through the slag flushing pump to form a certain intersection

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between the water and slag flow, impact granulation into qualified water slag, flow into the slag pool through the slag ditch, and then be recycled, which has a lot of economic benefits for iron and steel enterprises. The blast furnace slag flushing system includes a slag flushing tank and a suction tank. When the water level in the slag flushing tank reaches a certain height, the water will overflow into the suction tank. During the flow process, some water slag will inevitably flow into the suction tank together. Due to the poor fluidity of the suction tank, the water slag will accumulate at the bottom of the suction tank for a long time and become hard and difficult to clean, resulting in a smaller space in the suction tank and affecting the circulation of slag flushing water. At the same time, the water slag needs to be cleaned regularly after it is hardened, which increases the workload and labor intensity of employees. [3]

There are three slurry pumps in the suction pool of an ironmaking plant, one of which is always in operation. The pump is switched every two hours and three pumps are circulated every six hours. When the slurry pump is working, the water at the suction port will flow, and the water slag will also flow into the slurry pump along with the water flow and discharge to the slag flushing ditch, so there is a certain size circular range at the suction port of each slurry pump without slag accumulation. The temperature of blast furnace slag flushing water is very high and the water evaporates quickly, so it is often necessary to replenish water into the suction tank. Under normal circumstances, when the liquid level of the suction tank is lower than 3.2m, it needs to replenish water. When it is higher than 3.5m, it can stop replenishing water. It needs to replenish water about 12 times a day.

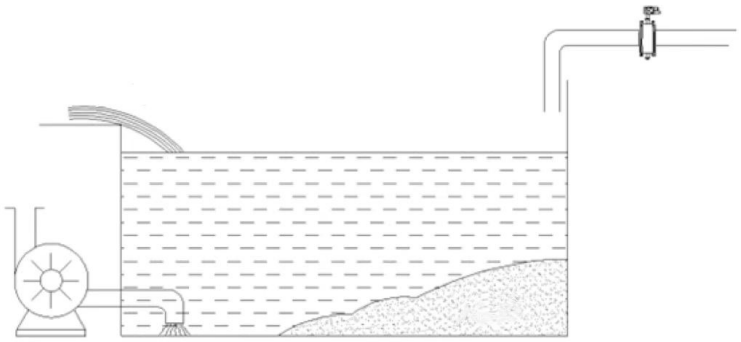

Figure 1. Schematic diagram of the status of the slag flushing suction tank before improvement

2. Scheme for Preventing Sedimentation and Agglomeration in Blast Furnace Slag Washing Suction Tank

In the face of the problem of sand settling and hardening in the blast furnace slag flushing suction pool, we propose a prevention plan. The specific plan is as follows: we lengthen the water supply vertical pipe of the suction pool to a certain distance from the bottom of the pool, about 100 mm, and weld it with the water supply horizontal pipe. The two ends of the water supply horizontal pipe are suffocated, and the holes are equidistant on the water supply horizontal pipe, with a spacing of 500 mm, and install the stainless steel filter screen anti-blocking nozzle. When it is necessary to replenish water each time, open the butterfly valve on the water pipe of the pipe network to make the nozzle on the horizontal water supply pipe start to spray water, blow the water slag far away from the slurry pump to the slurry pump, so that the slurry pump can suck the water slag away, and make it difficult to deposit slag at the bottom of the pool far away from the slurry pump. [4]

The pipe pressure of the pipe network is 4kg, and the depth of the suction tank is less than 10m, according to the liquid pressure formula P= ρ Gh, it can be seen that the pressure at the bottom of the pool is less than 1kg, so the water sprayed by the nozzle on the water make-up horizontal pipe has enough pressure to blow the water slag. [5]

Slurry pump model: HS400-350-400A, lift: 32m, matching power: 220KW, flow: 1700 ^{3}/ h. Rotating speed: 1480r/min, can effectively absorb water slag; The suction port of the slurry pump is downward to prevent eddy current; The nozzle is made of stainless steel with a diameter of DN40 and a filter

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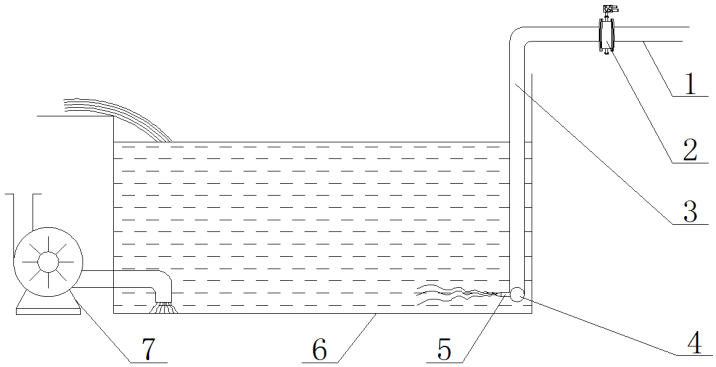
screen, which is corrosion resistant and can prevent the nozzle from being blocked; Make-up pipes are φ 108 pipes, on a limited length of horizontal water supply pipe, have sufficient water supply pressure.

This scheme, which combines water replenishment and slag flushing, effectively avoids the deposition and solidification of water slag at the bottom of the pool, ensures the circulation of slag flushing water, reduces the workload of employees and reduces the labor intensity of employees.



In the figure: 1. Pipe network 2. Butterfly valve 3. Make-up riser
4. Horizontal water supply pipe 5. Nozzle 6. Water absorption tank 7. Slurry pump

Figure 2. Schematic diagram of methods to prevent sand settling and hardening in the blast furnace slag flushing suction tank

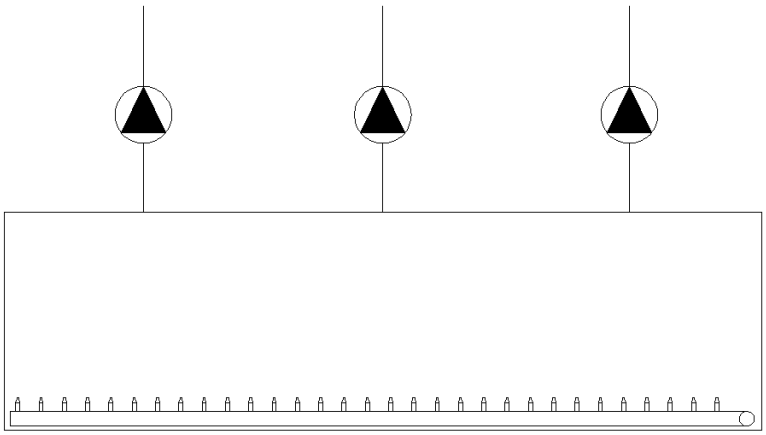


Figure 3. Top view of improved slag washing suction tank

3. Conclusion

To sum up, this method of preventing sand setting and hardening in the blast furnace slag flushing suction tank is effective. The method is to lengthen the water replenishing vertical pipe of the suction pool, and install a stainless steel anti-blocking nozzle with a filter screen on the water replenishing horizontal pipe. After refitting the water make-up pipe, open the butterfly valve on the water pipe of the pipe network every time it is necessary to make up water, so that the nozzle on the water make-up horizontal pipe starts to spray water, and blow the water slag away from the slurry pump to the slurry pump, so that the slurry pump can suck the water slag away, making it difficult to deposit slag at the bottom of the pool away from the slurry pump. This method can effectively avoid the deposition of water slag at the bottom of the tank, ensure the circulation of slag flushing water, reduce the workload of employees, reduce the labor intensity of employees, and ensure the stable production of the blast furnace.

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References

[1] Wang Jungen. Waste heat utilization of blast furnace slag flushing water [J]. Anhui: Industrial water and wastewater, 2008.

[2] Zang Chuanbao. Application of waste heat heating by blast furnace slag washing water [J] Shandong: Shandong Metallurgy, 2001.

[3] Geng Jingchun, Li Xun, Zhu Qiang. Feasibility study of blast furnace slag flushing water power generation project [J] Harbin: Energy Saving Technology, 2005.

[4] Yan Yunjin, Ironmaking Machinery. Beijing: Metallurgical Industry Press, 2001.

[5] Wang Qingchun, Metallurgical General Machinery and Smelting Equipment. Beijing: Metallurgical Industry Press, 1996.