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Prevention of leaks in hot air line valves at Isdemir 4th blast furnace stoves

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In this study, stoves used in heating the air blown to the blast furnace in Iskenderun Iron and Steel Co. (ISDEMIR) in 4th blast furnace are examined by using pattern instead of welding method in order to eliminate leakages in the valves on the side of the hot air line of the stoves. The new implementation started in June 2019.

In İSDEMİR Blast Furnaces, blast furnace gas and coke gas are mixed in the combustion chamber of the stoves at approximately 600 ºC. With the heat generated by the combustion of the gas, the checker bricks in the stoves are heated. The heated air is blown into the blast furnace by opening the valves on the side of the hot air line of the stoves. By closing the valves on the side of the hot air line, the connection between the blast furnace and the stove in use is disconnected. As a result, the primary function of the valves on the hot air line side of the stoves is to ensure the passage of hot air between the stoves and the hot air line through which the hot air is transported to the blast furnace.

Gas leakage occurs due to axial mismatches in the flanges at the connection points of the stoves with the valves on the hot air line side. The leakages are growing with time and cause bigger problems. When the leakeges occurred, leaks are prevented by welding and the leakage was removed.

Keywords: İSDEMİR, İskenderun Iron and Steel Co., Blast Furnace, Blast Furnace Stove, Blast Furnace Stove Valves.

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1. Introduction

4th Blast Furnace started production on 17 August 2011 and the working volume of the 4th Blast Furnaces is 2500 m3. Daily average pig iron production amount in 4th Blast Furnace is 6500 tons/day.

İSDEMİR 4th Blast furnace stoves are used to obtain the hot air required for the reduction of iron oxides. The special bricks in the stoves are heated by mixing blast furnace gas and coke gas with air at a certain ratio (0.7-0.8). The heated air is blown into the blast furnace due to the opening and closing of the valves on the side of the hot air line of the stoves.

2.-Stove System Used in Blast Furnaces

İSDEMİR 4th Blast Furnace have 4 stoves, which are called external combustion, which have 4 combustion chambers and 4 checker sections connected to the dome and each stove which provides connection of these stoves with hot air line, has a total of 4 valves.

3.-Valves Connecting the Hot Air Line to the Stoves

See ***Figure 1***, with the new method that is being implemented, a circular pattern is placed on the flange regions without welding to the leaked areas and concrete is poured into the interior of the pattern and leaks are eliminated. This situation shown in ***Figure 2.***

Figure 1. *Leak area that is tried to be removed by welding*

Figure 2. *Circular pattern*

The valves that connect the stoves with the hot air line are technically manufactured according to DN1700 standards. The surfaces of these valves that come into contact with the hot air line are covered with special refractory bricks. The valves have a system which operates with chain mechanism and the tongue in the valve can move up and down. With the commands given by the blast furnace control room, the movement of the tongue in the valve is provided and hot air passes into the furnace. On the inner surface of the valves, there are lines that pass cooling water against heating. These lines are responsible for providing heat transfer in the valves. These valves are shown in ***Figure 3***.

Figure 3: *Valve to be assembled*

4. Causes of Valve Leaks

There are some factors that cause gas leaks. These factors are axial mismatches in the flanges at the connection points of the valves between stoves, leakages caused by seals and wear of refractory material in valve. Figure 4 shows the leakage at the flange connection points of the valves. ***Figure 5*** shows the time-related damage to the refractory material.

Figure 4: *Leakage from the flange connection areas of the valves*

Figure 5: *Wear of refractory materials in flanges areas*

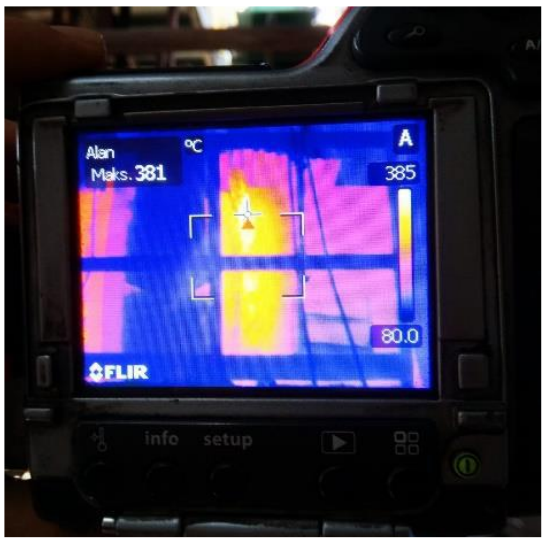

Figure 6: *Leaked areas are detected by thermal camera*

Gas leakages are detected by thermal camera and this situation shown in Figure 6. In order to prevent gas leaks, the blast furnace needs to be put to a standstill and this causes production losses.
Blast furnace stops due to leakage of these valves are shown in ***Table 1***

Table 1: Production losses as a result of leaks

Date	Duration (min)	Area of the Leakage	Production Loss (ton)
08.01.2019	62	Stove No. 3 Hot Air Line Connection Valve	139
29.04.2019	110	Stove No. 1 Hot Air Line Connection Valve	239
27.05.2019	77	Stove No. 4 Hot Air Line Connection Valve	198
29.05.2019	71	Stove No. 4 Hot Air Line Connection Valve	184
01.06.2019	185	Stove No. 4 Hot Air Line Connection Valve	798
15.06.2019	54	Stove No. 2 Hot Air Line Connection Valve	114

5. -Old Methods Used to Prevent Leaks

In order to eliminate leaks occurring in the hot air line connection valves of the stoves, the 4th Blast Furnace had to reduce the production speed or stop. After proper working conditions were ensured, the welding process was applied to the leaked area if it could be covered with illegal welding. If a seal change is required, the furnace is stopped and the seal is replaced. All these operations caused production losses. These procedures for removing leakage are shown in **Figure 7**.

Figure 7*: Seal and welding applications in the flange regions of the valves*

6.-New Implementation to Prevent Leaks in Valves

In order to eliminate the leakage occurring in the valves without decreasing the production speed, a solution was searched and firstly the seals used in the present situation was replaced with a new seals with more advanced features. Secondly, steel gaskets were used instead of standart gaskets to prevent leakages, but due to the deformations in the flanges, the standart gaskets and steel gaskets could not withstand the pressure of the hot air line and

frequently caused leaks that caused production to stop. Finally, a pattern were prepared to surround the flange areas that were leaked and concrete was poured into the pattern to prevent leaks. Pattern application and concrete pouring photos are given in ***Figure 8.***

AL95 has been selected as the concrete to be used and properties of poured AL95 concrete are given in ***Table 2*** and ***Table 3***

Table 2: Chemical Properties of AL95

Chemical Properties	Typical Value	Testing Method
Al_2O_3	Min 95	EN ISO 12677 / EN ISO 26845
Fe_2O_3	0,1	EN ISO 12677 / EN ISO 26845
SiO_2	Max 5	EN ISO 12677 / EN ISO 26845

Table 3: Physical Properties of AL95

Physical Properties	Typical Value	Testing Method
Main Raw Material Type	Corundum	
Bulk Density (g/cm^3)	2,64	ASTM C 830
Grain Size (mm)	0-5	ASTM C 92-95
Working Temperature (°C)	1700	

Figure 8: *Flange areas of valves are molded with pattern and concrete is poured into pattern*

Conclusion

As a result of the concrete pouring application which started to be applied against the leakages occurring in stove valves in İSDEMİR 4th Blast Furnace, there was not appeared leakage that would decrease production speed for 5 months regime with while it is inactivated beyond threshold voltage. The extracted threshold voltage and the electric field mobility were also found to be thermally activated.

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