NEW GAS CLEANING SYSTEM OF THE BLAST FURNACE "A" AT ARCELORMITTAL MONLEVADE [1]

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Abstract
The blast furnace 5 was shutdown in the end of 1999 and its gas cleaning system equipment was utilized in the blast furnace "A" (BF-A). The levels of free droplets and dust contents were excessively high, affecting the hot stoves performance since BF-A started up on December 19th, 1999. The new gas cleaning system of the blast furnace "A" is provided with a cyclone, reducing the amount of mud to be treated and causing minor impact to the environment. With the new gas cleaning system, ArcelorMittal eliminated a bottleneck and prepared the blast furnace "A" to the production of 1.2 Million tons of hot metal / year, assuring the blast furnace gas quality within the required standard.
Key words: Blast furnace; Gas cleaning; Dust handling; Telescopic loading bellows.

[1] *Technical contribution to the 3rd International Meeting on Ironmaking, September 22 – 26, 2008, São Luís City – Maranhão State – Brazil*
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1 INTRODUCTION

Blast furnace 5 was shut down on November 11 th, 1999. Its gas cleaning system was adapted to be used in blast furnace "A" (BF-A), which has 1,186 m^3 of working volume and nominal capacity of 1,040,000 tons of hot metal (THM)/year. BF-A started up on December 19th, 1999. Since the BF-A started up the gas cleaning system caused production losses due to the equipment maintenance. On the other hand, the levels of free droplets and dust content in the gas were high disrupting the hot stoves performance. In order to solve this problem ArcelorMittal Monlevade decided to replace the gas cleaning system aiming to guarantee blast furnace gas quality.

2 THE NEW GAS CLEANING SYSTEM OF THE BLAST FURNACE

The gas cleaning process comprises the main equipment, as follows:

a) dust catcher or cyclone:

the dust catcher makes part of the old gas cleaning system and was kept only as a downcomer support structure, i.e., the input of gas in the dust catcher was isolated and the gas led to a cyclone which has the same function as the dust catcher. The dust catcher has a yield of about 50%, while the cyclone yield is higher than 80% and consequently permitting the reduction in the quantity of mud to be treated;

b) scrubber:

in order to achieve the recommended dust concentration, the "dry segregation" must be complemented with "wet segregation". In the "wet segregation" system, the combination of nozzles with one (Figure 1) and two outlets (water jet splashing towards the top or bottom, or both directions simultaneously) located in the centre of the scrubber; it creates a quasi-homogeneous distribution of extremely fine drops. This process permits withdrawing even smaller diameter dust particles that are still present in the gas flow. The water, which contains these dust particles, is taken to the water treatment system through pipes. The gas after passing through the water curtain becomes pre-washed.

Figure 1- Water spray considering the use of one nozzle outlet

Table 1. BF-A gas cleaning system operational parameters before and after the start-up of the new gas cleaning system.

Parameters	Unity	Before	After
Hot metal production	ton/ year	1,120,000	1,200,000
	ton/ day *	3,130	3,355
Top gas temperature	°C	80 to 200	80 to 200
Top pressure	bar	1.5	1.7
Scheduled maintenance	-	-	(2 x 24h)/ year
Wet gas flow rate	Nm^3/ h	225,000	225,000
Inlet dust content	g/ Nm^3	12 (normal)	12 (normal)
		30	30 (maximum)
Clean gas pressure	bar	0.15	0.20
Outlet dust content	mg/ Nm^3	15.2 **	5.0 (maximum)
Clean gas free droplets content	g/ Nm^3	14.2 **	5.0 (maximum)
Clean gas temperature	°C	40	40

** availability index: 98%; ** average of 2004*

3.2 Improvement/ Application Introduced in the New System

In the new gas cleaning system the following improvement was introduced:

- replacement of the annular gap element (AGE) 1001 by AGE 1601, which permitted lower gas speed in the smaller section of the annular gap element, reducing noise, wear and improvement in the control of the blast furnace “A” pressure;
- replacement of the dust catcher for a cyclone.

3.3 Project Targets

The main reasons for replacing the gas cleaning system were:

- eliminating the bottleneck of blast furnace “A”, preparing for the production level of 1,200,000 THM/year;
- reducing the noise, equipment wear and improving blast furnace “A” top pressure control;
- using the cyclone which yield is higher than the dust catcher, eliminating the quantity of mud to be treated;
- assuring the quality of BFG within the required standards.

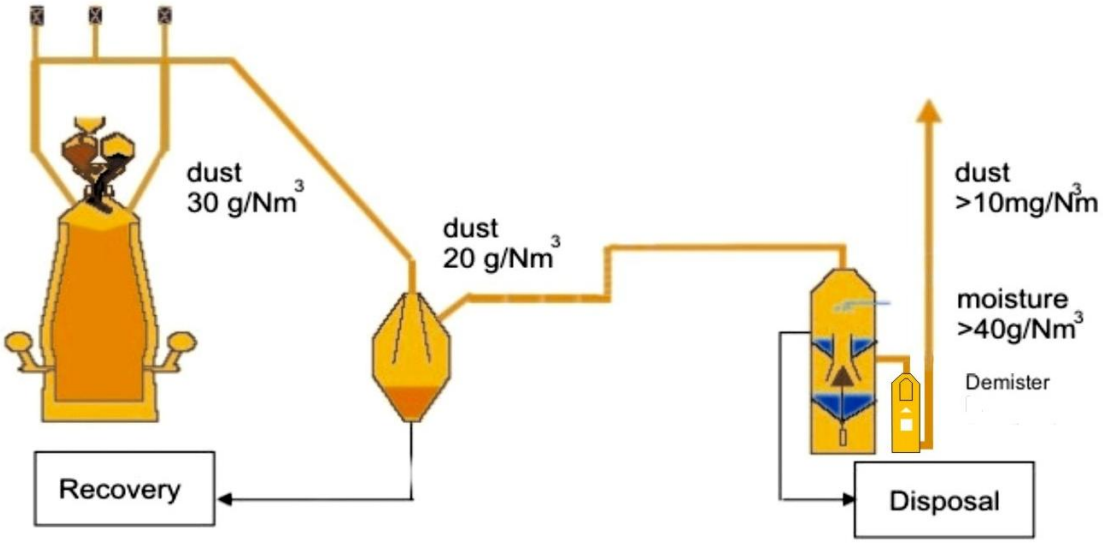

Figure 2 – BF-A previous gas cleaning system

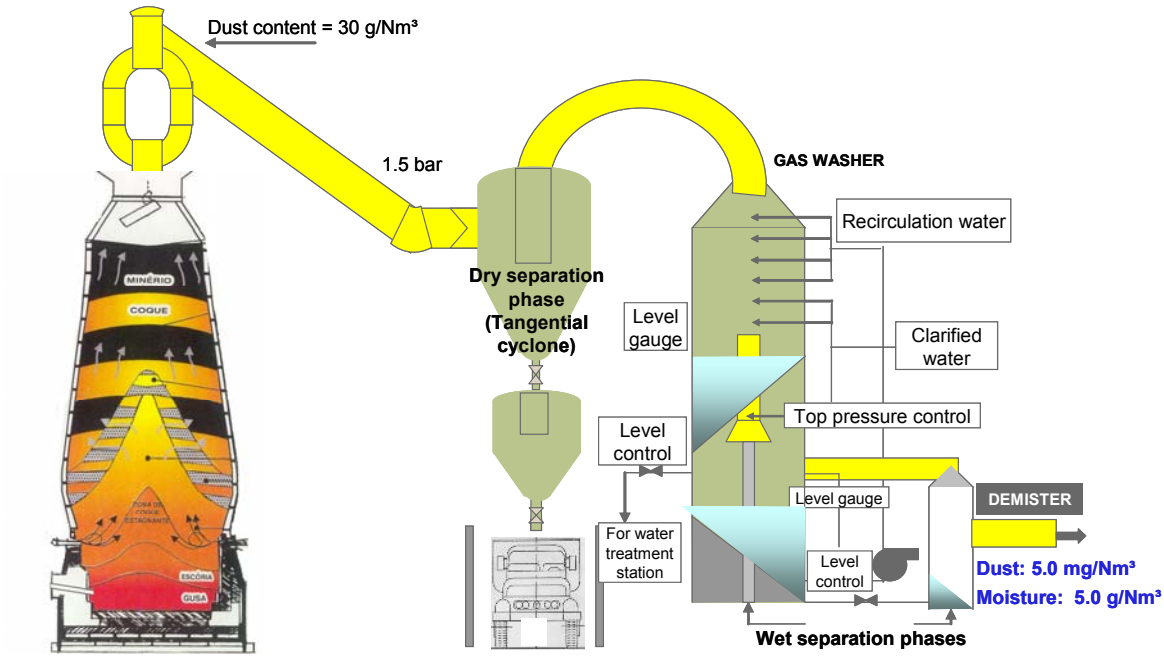

Figure 3 – BF-A new gas cleaning system

3.4 Project: Partners Companies

The project was developed in a “turn-key” basis by Paul Wurth Do Brasil. Other companies were subcontracted, as follows:

- MONTPLAM: mechanical assembly;
- DEGRAUS Engenharia: civil works;
- TECNOSOLO: pilling.

The PLC programming and the supervisory was under responsibility of ArcelorMittal automation area.

4 BLAST FURNACE “A” DUST REMOVAL AND HANDLING AT THE NEW GAS CLEANING SYSTEM

ArcelorMittal Monlevade Works started up the operation of the new gas cleaning system in June 2007. In the new gas cleaning system, the collected dust is stored in a 100 m³ capacity cyclone bin. From this bin the dust is discharged into a transfer bin with 8m³ capacity. The dust collected in this bin passes through a pug mill where it is wet and discharged into a closed bucket. This system has caused so much dirt in the discharge site due to the leakage of pasty material through the discharge valve of the pug mill. For this reason, a study was requested to the Maintenance Engineering area in order to find a solution for discharging the material of the new gas cleaning system in a clean and safe way. The battery limit begins at the discharge of the pug mill and finishes at the bucket of the truck that transports the dust to the recycling residues yard. A device was developed for the own truck, making possible the collection of dust sample to analysis with total safety to the operator.

Figure 4 – Discharge area before the new BF-A gas cleaning system start-up

After analysing different options the solution was using a telescopic loading bellows. The discharge of dust to the truck is done as following: the silo-truck parks moving backwards direction under the telescopic loading bellows that starts extending at the presence detection of the truck by optical sensor and adjusts on the inlet nozzle of the silo-truck. After that the dedusting system is switched on. The discharge valve is opened and begins the truck loading. Reaching the minimum weight of the vase, the discharge valve closes, the pug mill switches off, the telescopic loading bellows retracts and the dedusting system is switched off. The truck is allowed to transport the collected dust to residue yard. The parking place of the truck under the telescopic loading bellows has a sensor for detecting the truck-presence, lateral guides for the wheels and dead stop for the rear wheels to help the alignment of the inlet nozzle of the truck with the discharge telescopic loading bellows. The control room of the blast furnace “A” carries out the operation of dust discharge monitored by a camera installed in the discharge site. There is no need for an operator attendance during the system discharge.

4.2 Assembly of the New System

The erection started in March 2007 under ArcelorMittal team supervision, as well as cold and hot commissioning, being accomplished in June 2007 during the shutdown for the interconnection of the new gas cleaning system of the blast furnace “A”.
Some views of the new gas cleaning system are shown in the Figures 5, 6 and 7.

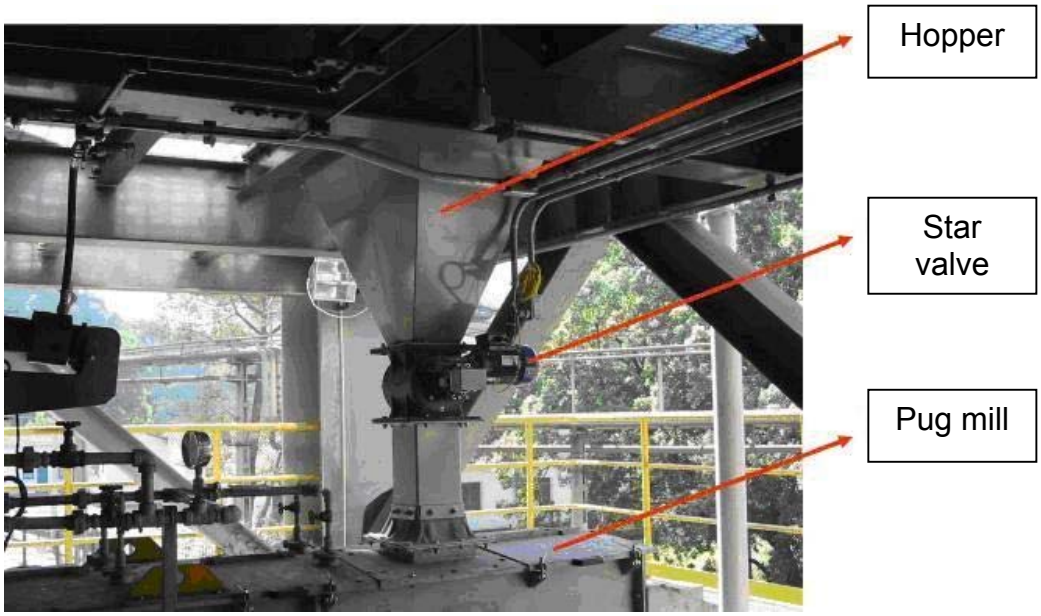

Figure 5 – Detail of the dust recirculation area

(a) (b)

Figure 6 – Telescopic loading bellows of the dust handling system; (a) the telescopic loading bellows starting the descent procedure; (b) the telescopic loading bellows in the discharging position.

Figure 7 – Discharge area after the new BF-A gas cleaning system start-up

5 RESULTS

The results of the performance guarantee tests were:

- dust content after demister (average values):1.7 mg/Nm³;
- free droplets content after demister (average values): 3.7 g/Nm³.

The Figure 8 shows the dust and mud generation from January/2007 to March/2008. The new BF-A gas cleaning system started up in June 2007. The dust collected by the system increased; it means a higher performance of the cyclone in comparison to the dust catcher. The mud generation decreased due to the better dust segregation in the cyclone.

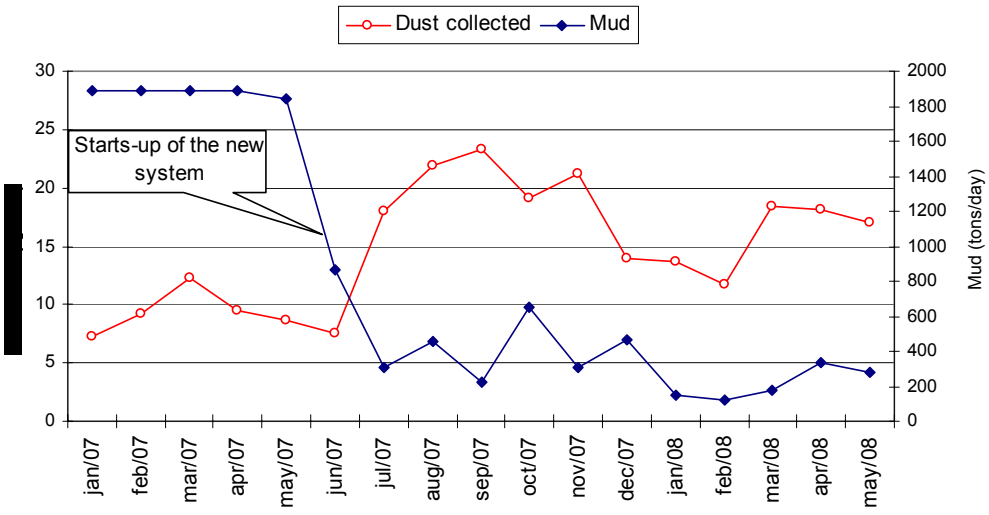

Figure 8 – Evolution of dust generation and mud of the blast furnace “A”

5 CONCLUSION

The new gas cleaning system eliminated a BF-A bottleneck and it is a condition for achieving a production of 1,200,000 THM/year.

This new system has guaranteed the blast furnace gas quality in accordance with the international standards, as follows:

- maximum dust level of 5.0 mg/Nm³;
- maximum gas free droplets of 5.0 g/Nm³.