Energy Optimization and Emissions Improvement in Fume Treatment in EGA Jebel Ali Smelter

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1. Abstract

The Hydrogen fluoride (HF) gas emissions from potlines of aluminium smelters are treated in Fume Treatment Plants (FTPs) or Gas Treatment Centers (GTCs). In EGA, these installations are called FTPs in Jebel Ali and GTCs in Al Taweelah. Most smelters strive to creep aluminium production, which eventually increases the load on FTP scrubbing efficiency and increases emissions. Many improvements to increase the pot gas flow and improvement on emissions have been implemented in the past by increasing the total number of filter bags in the compartment, adding more compartments, or using filter bags constructed with high permeability fabric. However, the outcome was very limited and had many drawbacks including high cost. The aim of this paper is to share the experience of installing Extended Surface Bags (ESB) in EGA Jebel Ali FTP. There are many papers, explaining the fundamentals of using the ESB [1 – 3], but in this paper, the focus is on the challenges encountered during implementation and how each challenge was solved. In addition, this paper will explain the realised benefits of ESB.

Keywords: Fume Treatment Plant (FTP), Gas Treatment Center (GTC), hydrogen fluoride (HF), Extended Surface Bag (ESB), Emirates Global Aluminium (EGA).

2. Introduction

FTP-6A was built using EGA's CD20 technology at the DUBAL smelter complex (now EGA Jebel Ali) in 1999. This dry scrubber system was built with a total of 10 filter compartments containing 540 standard polyester needle felt filter bags of diameter 127 mm and 6066 mm length per compartment. It was designed to achieve a total gas volume of 720 000 Nm^3/h at a gas temperature of 125 °C, treating flue gas from 120 reduction cells at an average draft rate of 6000 Nm^3/h per cell. The plant was designed for nominal temperature of 125 °C and maximum of 140 °C at the FTP inlet to treat flue gas containing total fluoride of 160 mg/Nm^3 and total particulate of 500 mg/Nm^3.

The gradual increase in potline amperage to increase aluminium production eventually caught up with the limitation in the FTP design. This led to the upgrading of the FTP in 2002. An additional 60 filter bags per compartment were added by installing new bags holding tube sheets. This modification helped to increase the filtration area but increased the CAN velocity (velocity between the bags) in the compartment. This has resulted in only a negligible increase in gas flow.

Further enhancement of cell technology and continued amperage increase of the reduction line took place in the following years. This put additional load on FTP and the performance was not adequate even after the completion of the upgrade. Total fluoride at FTP inlet increased to 250 - 300 mg/Nm^3 and inlet gas temperature at FTP increased to an average of 130 - 140 °C (and even above 145 °C during the summer months). This impacted the filter bag life and treatment performance, resulting in higher emissions. High pressure drop across filter compartments eventually reduced gas draft in the reduction cells; this affected the thermal balance and contributed to loss of productivity.

In 2017, EGA Jebel Ali, with close co-ordination with filter bag suppliers, introduced standard bags made of high permeability fabric. These bags enabled a 10 % increase in gas flow with particulate emissions within the target. Increased gas flow and low pressure drop helped to reduce the temperature of inlet gas at FTP. This initiative was implemented with very little cost and allowed EGA Jebel Ali to overcome this very critical operational issue in the plant.

At the same time EGA also looked for other options available technically to improve the existing plant operating condition such as upgrading the plant, ambient air duct systems, impulse duct systems and cooling the inlet gas with water spray, etc. High cost ruled out upgrading the plant and installation of impulse duct and a trial of water spray system were not found to be sufficiently effective. Even though a previous trial of extended filter bags was a failure, EGA was still convinced that extended surface bags are the future of FTP operation with minimum investments. In addition, EGA is committed to reduce fluoride emissions and ESB technology is one of the tools, which enabled EGA to achieve the continuous improvement in emissions.

3. Constraints

Replacing the standard filter bags with extended surface bags and cages was not a direct one-to-one bag replacement in the plant due to some of the constraints highlighted below:

3.1 Additional weight of ESB bag and cage,
3.2 Less gap between existing bags in each row,
3.3 Maintaining velocity in the hopper and between the bags,
3.4 Developing a procedure to handle new bags and cages.

3.1 The concern was whether the old tube sheet would be able to sustain the total additional load on the existing tube sheet after installing the extended surface bag and cage and for a longer period without deforming or buckling. Table 1 gives the comparison which shows that the load would increase by almost 50 % with ESB. Therefore, it was necessary to replace the tube sheet along with additional stiffener plates to keep the new plate from buckling before installing ESB. The task was more complicated since it was done in an operational plant without affecting the normal operation, and it required specialised scaffolding structures to access the bottom part of the tube sheet for welding stiffener plates. Furthermore, the task was planned during the peak summer with ambient temperature reaching as high as 45 to 50 °C with humidity between 60 and 90 %. Employee safety was the main concern.

Table 1. Comparison of weights (kg) between standard and ESB bags.

	Standard	ESB
Bag	2	4
Cage	8	12
Dust in the bags	1.5	3.5
Total	11.5	17.5

3.2 In the previous modification in 2002, where 120 bags were added in each compartment, four rows were added within existing tube sheet plate. By doing so it narrowed the gap between the bags. During the trial installation of extended surface bags on one of these tube sheets, adjacent bags were found touching each other and this was expected to cause

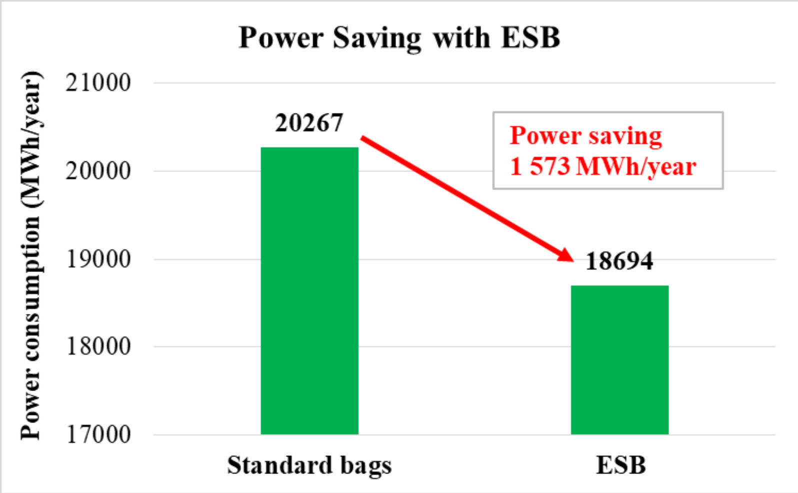

Figure 3. Energy consumption saving by ESB.

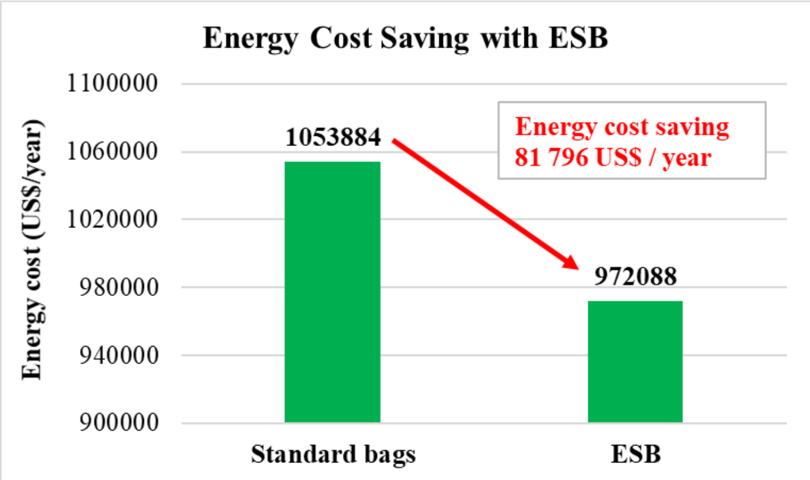

Figure 4. Energy cost saving by ESB.

7. Conclusions

EGA Jebel Ali smelter has successfully installed Extended Surface Bags (ESB) in order to keep HF and particulate emissions below emission standards in spite of amperage increase in the potline. In spite of many constraints that had to be taken into account, the installation was made during FTP in normal operation. During the analysis period of 6 months after ESB installation, the operating cost was reduced by 81 796 US$ due to lower fan amperage.

8. References

1. Stephan Broek and Julie Dontigny, The application of extended surface filtration bags in Gas Treatment Centres, *Proceedings of 35th International ICSOBA Conference*, Hamburg, Germany, 2 – 5 October, 2017, *Travaux* 47, Paper AL23, 1005-1018.
2. Petra Mühlen, Bernard Cloutier and Valérie Paquet, Extended surface filter bags in reverse air cleaning filters, *Proceedings of 35th International ICSOBA Conference*, Hamburg, Germany, 2 – 5 October, 2017, *Travaux* 47, Paper AL24, 1019-1036.
3. Petra Mühlen, Extended surface filter bags – applications and benefits, *Proceedings of 33rd International ICSOBA Conference*, Dubai, UAE, 29 November – 1 December 2015, *Travaux No. 44,* Paper AL07, 561-565.