Enhancement on Gaseous Fluoride and Sulfur Dioxide Emission Performance of the Outer Compartments at EGA Al Taweelah Smelter Gas Treatment Center (GTC)

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Abstract

Emirates Global Aluminium (EGA) Al Taweelah smelter lines 1 and 2 (also known as Phase 1) Gas Treatment Centers (GTC) have one of the longest primary alumina airslides in the industry. Each pot line has two GTCs and each GTC has both a dry scrubber and a wet scrubber. The GTCs have 32 compartments, 16 on either side of the primary alumina storage silo, all connected by a 120 m long primary airslide. Despite the industry-accepted low levels of hydrogen fluoride (HF) and sulfur dioxide (SO_2) emissions from the stacks, process gas testing on individual compartments revealed that the outer compartments emitted elevated HF and SO_2 compared to the rest of the plant with similar results found on all four GTCs. This paper describes the unique and innovative methods used by, identified the resolve the problem to further reduce HF and SO_2 emissions.

Keywords: DX Cell Technology, potline gas treatment center (GTC), gaseous fluoride emissions from GTC, alumina conveying airslide, alumina distribution to potlines.

1. Introduction

Emirates Global Aluminium (EGA) owns and operates two smelters, the older Jebel Ali smelter in Dubai. The newer Al Taweelah smelter, is located in the Khalifa Industrial Zone Abu Dhabi approximately 80 km east of Abu Dhabi city.

Al Taweelah Phase 1 has four GTCs divided between east and west GTCs. East GTCs (5311 and 5312) are identical whereas west GTCs (5312 and 5322) are slightly different. GTC 5322 has additional two ducts connected to Hot Butt Removal (HBR) for gaseous treatment of the fumes from the hot spent anode cover. This duct has an advantage of cooling the gas stream into GTC, which leads to a lower inlet gas temperature and lower HF gaseous emissions. Therefore compared with the other three GTCs, GTC 5322 has lower HF and SO_2 emissions. Therefore for the purposes of simplicity, this paper only references the plant with the highest emissions; however the air slide is same in all four GTCs.

In addition, Al Taweelah Phase 1 GTCs are divided into “dry side” and “wet side”. The “dry side” is the traditional dry alumina scrubbing technology that is common in one form or another at most aluminium smelters in the world. The “wet side” or “wet scrubber is a SO_2 removal system that uses a total of 26,000 tonnes per hour of fresh seawater in a single pass to reduce the SO_2 emissions by approximately 90%. The spent seawater is then mixed with the blow down from the seawater cooling system for the power station, additional fresh seawater, aerated and cooled and released back into the Arabian Gulf in line with the conditions set by the Environmental Department of the Abu Dhabi Government and EGA’s lenders.

Alumina is conveyed via an approximately 100 m long air slide connected to both halves of the GTC as shown in Figure 1. The primary alumina air slide feeds the plant via 32 alumina distribution slots with the aim to distribute equal amounts of alumina to each individual mini airlift and from there to individual compartments for adsorption of the gaseous HF. In each side of half GTC, the gas flow from certain

compartments tends to flow to specific fans due to the design of the outlet duct work. Physically there is no isolation between the compartments but due to the location we can say that there is.

Figure 1. GTC primary alumina airslide with sampling locations.

The emission data for the last 4 years will be presented in this report in order to give a clear picture of before and after scenario. This study and trial has been undertaken on GTC 5311 with the same innovative solution applied to the other two GTCs. The alumina quality and flow ability were studied to identify the reason of elevated emission of HF and SO_2 emission in outer compartments. During the first summer in 2011, EGA observed that the gaseous fluoride and sulfur dioxide emission on the outer compartments (Fan 1 and 6) are higher compared to inner compartments.

While the issue was being investigated the problem disappeared on its own during the cooler months, only to return the following summer in 2012 and again repeat itself into 2013. Further investigation looking at visual changes in the plant and using a water gauge identified the airlside itself was changing shape during the warmer months. The main cause was thermal expansion of the +100 m long airslide which is rigidly fixed to the plant with heavy duty 100 mm diameter drain piping at the end of the plant forcing the airsides to rise or move sideways, although the actual outcome varied from plant to plant and even end to end of each GTC. The visual and measured changes of the plant were then compared against actual process analysis to determine if these physical changes were causation or correlation.

2. Test Results

The average gaseous HF emission for GTC 5311 during the years 2014 - 2015 at sample positions Fan 1 and 6 is higher by 171 % than in sample locations in Fans 2 to 5 with similar performance in the other two GTCs. The gaseous fluoride emissions for the last 4 years are presented in Figure 2 for all Phase 1 GTCs.

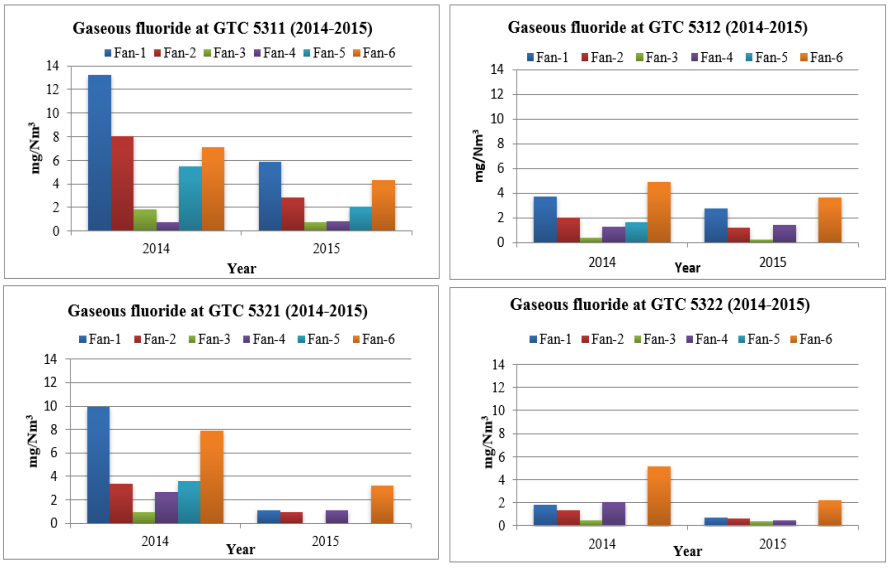

Figure 2. Gaseous fluoride (F_g) at GTC before modification.

Table 2. Theoretical AlF_3 consumption, before and after the modification per GTC.

Year	HF (mg/Nm^3)	HF (kg/t Al)	AlF_3 (kg/t Al)	AlF_3 cost (USD$/y)
2014 - 2015	7.6	0.58	0.93	213 211
2016 - 2017	0.5	0.04	0.06	15 533
Benefits	**7.1**	**0.55**	**0.87**	**197 678**

As the figures in Table 2 indicate, the cost savings are considerable: USD$ 200 000 y per GTC, which is USD$ 600 000 /y for all three GTCs in Phase1.

9. Conclusion

Using this innovative method and the human resources available on site, EGA Al Taweelah smelter has found environmental benefits as well as a cost effective solution to reduce AlF_3 consumption demonstrating that relatively small, low cost improvements on large plants can lead to significant benefits: A saving of 600 000 $ per year and a reduction of 93 % in gaseous fluoride emissions from the dry scrubber side and 63 % of SO_2 emission from the wet scrubber.

10. References

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