Upgrade of Fume Treatment Plants 1 and 2 of D18+ Potline in EGA Jebel Ali Smelter

Budoor Ali[1] and Mohamad Hussein[2]
1. Senior Supervisor - FTP/GTC, Reduction
2. Senior Superintendent - FTP/GTC, Reduction
Emirates Global Aluminium (EGA), Jebel Ali, Dubai, United Arab Emirates
Corresponding author: buali@ega.ae

Abstract

Hydrogen fluoride (HF) emissions from potlines in 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. Many studies and continuous improvements to increase their efficiency have been made. It is very easy to have high efficiency of new FTP/GTCs but it is an entirely different story to upgrade a more than 35 years old FTP, which was designed for 5 000 Nm^3/h per pot at 163 kA. The aim of this paper is to describe the challenges encountered during the upgrade of FTPs for D18+ potlines in EGA Jebel Ali, which now have to provide 6 000 Nm^3/h per pot at 242 kA. The reasons of high HF emissions during the upgrade will be explored and actions taken to control them will be discussed. These include: designing auxiliary air entry in two locations, temporary mini airlift, optimizing the alumina strategy and optimizing alumina distribution in individual compartments. Recommendations for the control of HF emissions during the upgrade of the old FTPs are given.

Keywords: EGA D18+ potlines, Fume Treatment Plant (FTP), Gas Treatment Center (GTC), HF emissions.

1. Background

1.1. Introduction

In 2015, it was decided to upgrade Potline 1 (PL 1) and Potline 3 (PL 3) FTPs in EGA Jebel Ali to handle amperage increase from 180 to 225 kA. Unfortunately, FTP operation had to overcome several challenges during this upgrade project as follows:

1- High HF emission during upgrade and commissioning,
2- Continuous compartment build up,
3- Secondary system by-pass system (buffer silo and secondary silo filling),
4- Secondary silo filling,
5- Feeding system.

Many actions were taken to overcome the above challenges. However, this paper will focus on one of the main challenges during the upgrade which is the high HF emission.

1.2. Methodology

In this study, the measurement methodology used is Boreal online measurement system and NEO Monitors, Model LaserGas III Portable HF sniffer. Both systems work by sending a laser beam to a receiver on the other end of the device and compare the wave lengths of the sample collected with the reference cells. The difference between the two devices is that the Boreal online system is fixed at the stack and requires no pump while the NEO sniffer is portable and has a pump to pump the collected sample into the device and analyses it.

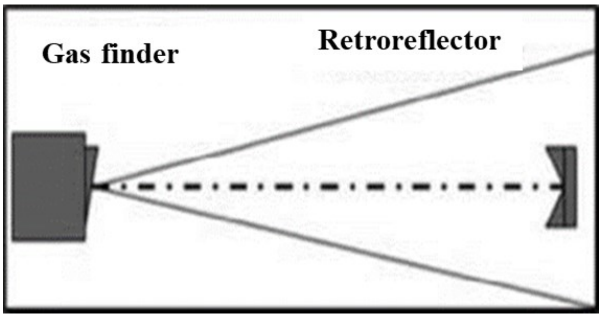

Figure 1. Boreal online measurment system.

2. Control of High HF Emissions during the Modification of the Plant,

To control the high HF emission to below the set target of 7 mg/Nm^3 during the modification of the plant, the following actions were taken:

- False (auxiliary) air entry in 2 locations,
- Temporary mini airlift,
- Optimizing alumina strategy,
- Optimizing the alumina distribution in the individual compartments.

2.1. Auxiliary Air Entry in 2 Locations

It was suggested to introduce auxiliary air entry to dilute the HF emissions by opening two false air flanges at the end of the section. Also, the manhole hatch on the main header was opened to allow more air to cool the gas temperature and therefore, reduce the HF emissions.

The advantage of introducing auxiliary air entry is that the HF emission was reduced by 13.6 % (from 4.19 mg/Nm^3 to 3.62 mg/Nm^3) as can be seen from Figure 2. The drawback of this solution is that the suction rate of the end pots is reduced below the requirement. Therefore, the decision was taken to abandon the auxiliary air entry.

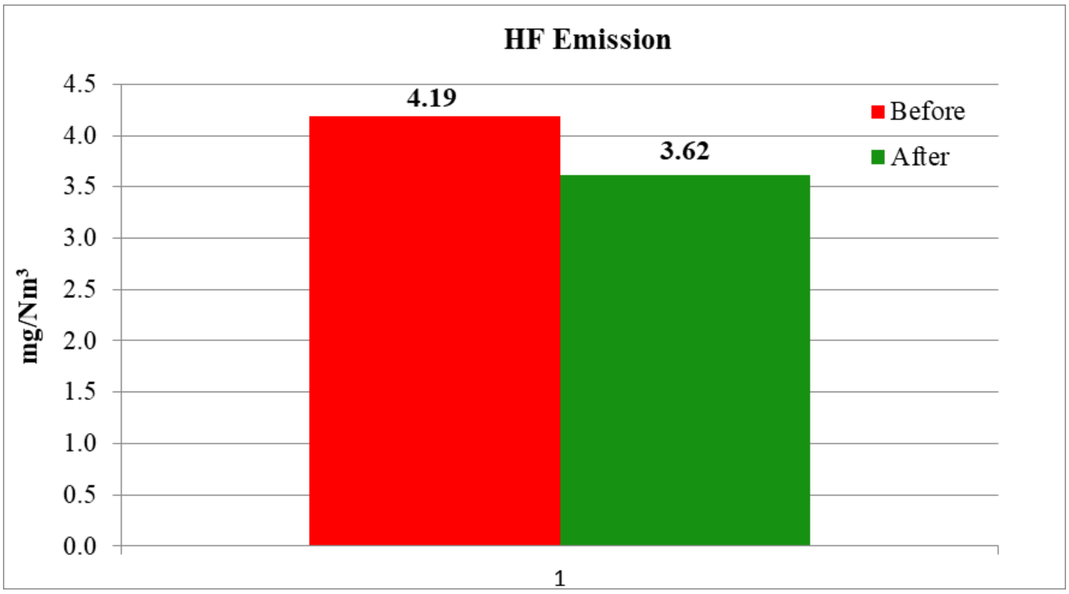

Figure 2. HF emission before and after auxiliary air entry.

2.2. Temporary Mini Airlift

After abandoning the false air entry due to the lower suction rate at the end pots, the HF emission in PL 1 and PL 3 increased because of the increasing summer temperatures and because the modification of FTP compartments was only 60 % complete at this stage. In another words, FTP lost 60 % of the reactors. At this stage HF increased from 4.19 to 9.73 mg/Nm^3. Therefore, a temporary mini airlift that recycled the material from the secondary airside to the main duct (acting like recirculation feeding system) was introduced by making a discharge pipe that connected the airside with FTP's main duct as can be seen from the photo below.

The advantage of the Temporary mini airlift was a reduction in the HF emission by 19.6 % (from 9.73 mg/Nm^3 to 7.82 mg/Nm^3 as shown in Figure 4. The drawback of this solution was that the recycled material could not be quantified nor controlled.

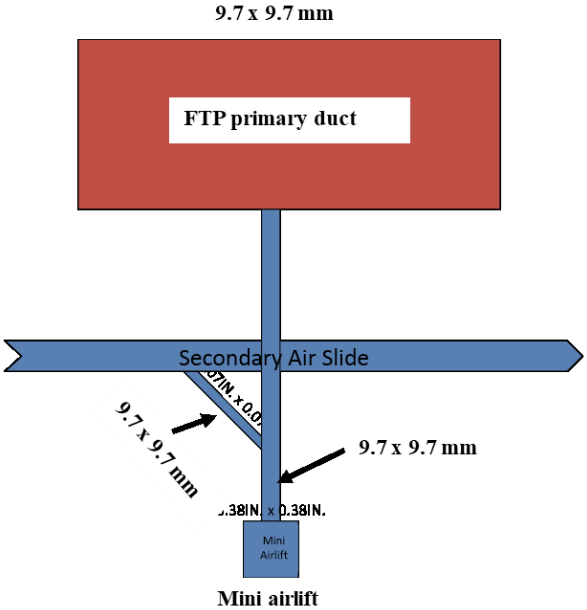

Figure 3. Temporary mini airlift.

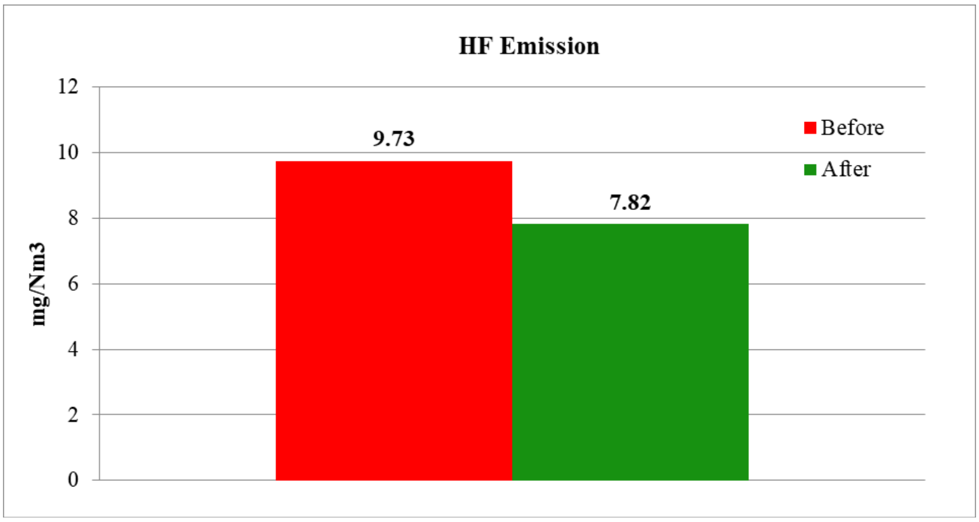

Figure 4. HF emission before and after introducing temporary mini-airlift.

2.3. Optimizing Alumina Strategy

Due to increased ongoing project activities and ambient temperature increase in summer, the HF emission increased again to an average of 7.9 mg/Nm^3. Therefore, another initiative had to be put in place. It was decided to inject fine alumina to the plant which helped reducing HF emission from the stack. This initiative was managed through the alumina strategy by diverting the fines supply to D18+ FTPs [6] [7].

The advantage of optimizing alumina strategy is the reduction of HF emission by 44 % as shown in Figure 5. The drawbacks are:

I. The reduction of HF is subject to the availability of fine materials
II. In case of superfine alumina, the alumina will not reach the FTP due to the high spillage from the unloading station, so the unloading belt conveyor rotation speed is adjusted to enable the belt to transfer the alumina to the targeted FTP. This will slow down the alumina tanker unloading per shift.

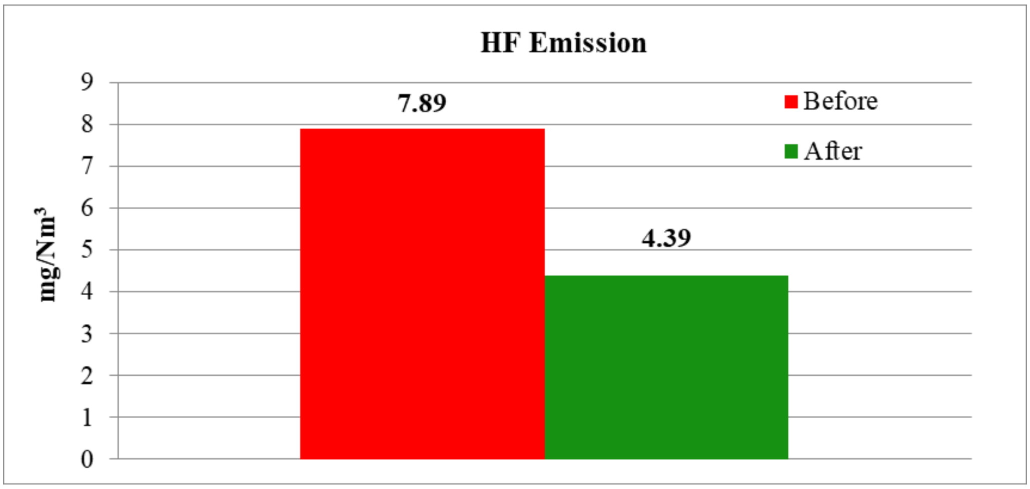

Figure 5. HF emission before and after optimizing alumina strategy.

2.4. Optimizing the Alumina Distribution in the Individual Compartments

After installing the inlet damper of the pre-reactor, the gas profile in the main duct was changed. This altered the alumina flow as the injection took place in the main duct. Hence, the scrubbing efficiency was reduced since there was disturbance due to gas profile changes at alumina injection point. As a consequence, the HF emission increased and it had to be investigated further to identify additional areas of improvement. Accordingly, the HF emissions from the individual compartments were measured using HF sniffer and below are the results from the test, which indicate that there was less alumina at the compartments close to the FTP inlet where a significant increase in HF was observed (see Figure 6). Therefore, it was decided to adjust the feed rate in induvial compartments/cells by changing the slot size.

After modification of the individual compartments, the fluorination became more uniform which resulted in HF emission per compartment as shown in figures 6 and 7.

The advantage of optimizing the alumina distribution in the individual compartments is that alumina is more evenly distributed among the compartments and the HF emission is reduced by 55.8 % as can be seen from figures 6 and 7. There are no drawbacks of this solution.

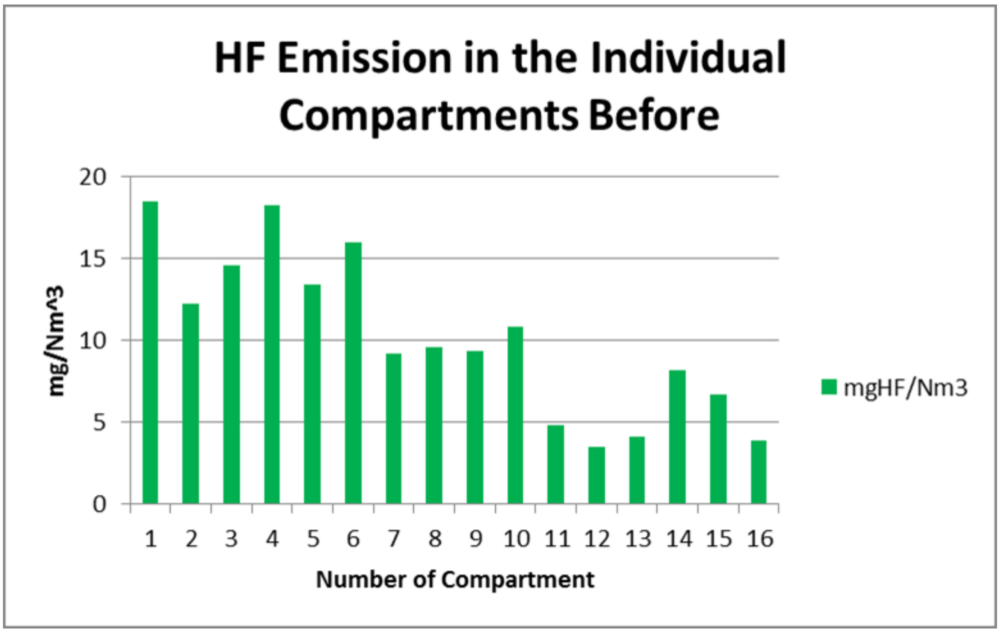

Figure 6. HF emission before optimizing alumina strategy.

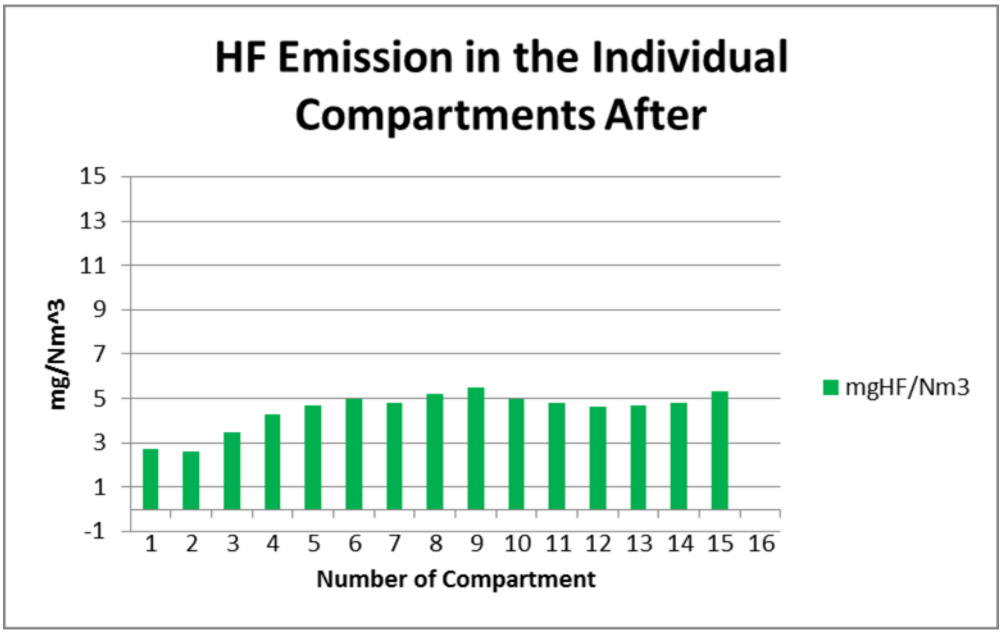

Figure 7. HF emission after optimizing alumina strategy.

3. Results

- The auxiliary air entry option is an acceptable solution if there is enough capacity in the MEF to create higher suction rate to compensate the additional draft coming from auxiliary air entries and to maintain the suction rate from the end pots.
- The temporary mini airlift showed a reduction in HF by 19.6 %; however, it was not consistent and was subject to many variables.
- Optimizing the alumina strategy and optimizing the alumina flow per compartment have put an end to the high HF emission and they were a permanent solution where HF was maintained small and constant as can be seen in Figure 8 since December 2017.

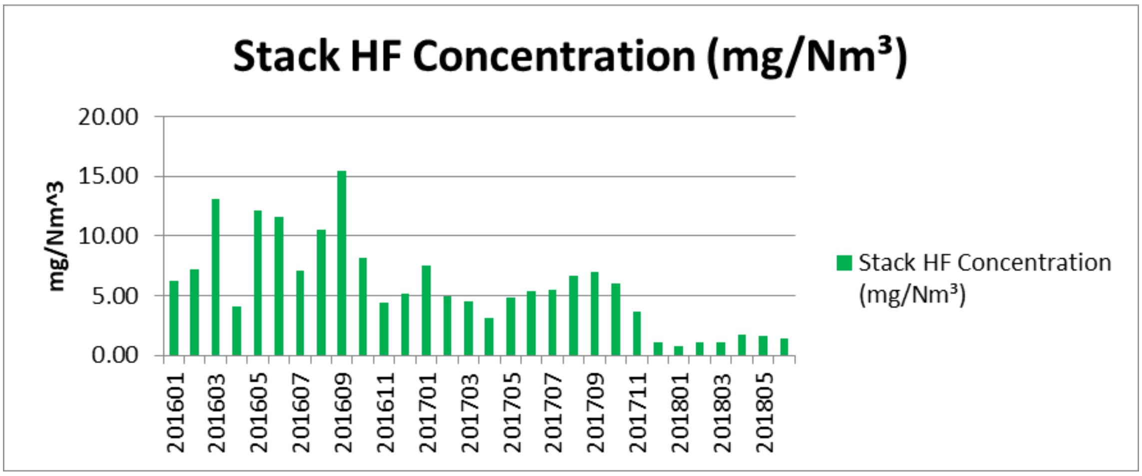

Figure 8. Stack HF emission in EGA- JA from 2016 to 2018.

4. Conclusion

When 50 % of the horizontal reactors in the plant are converted to act as part of the duct, the HF emission will rapidly increase due to the low capability of the plant to treat the gases. The best method to control the HF in the upgrade is to optimize alumina strategy and the alumina flow into the individual compartments.