

Electrolytic Cell Fume Cooling Technology: Case Study in Ma'aden Aluminium

Rahul Kumar Pandey¹, Abdulaziz Al-Taisan² and Ahmed Y. Al Taher³

1. Sr. Process Engineer

2. Manager-Reduction Technical

3. Director-Reduction Technical

Ma'aden Aluminium, Ras-Al-Khair Industrial City,

Corresponding author: pandeyr@maaden.com.sa

Abstract

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The temperature of fumes entering Gas Treatment Centers (GTCs), play a significant role in determining the scrubbing efficiency of GTCs. As pot gas temperature exceeds 115 °C, fluoride emissions increase in GTC stacks. This has always been a major challenge for the smelters located in hot climatic conditions especially in Middle East regions. Ma'aden has four (4) GTCs supplied by Fives serving 180 pots each, running at an amperage as high as 389 kA. In Ma'aden Aluminium, apart from traditional dilution dampers, Fives have provided hairpin type duct work for each pot to cool down the fume temperatures before entering the GTC. Being the first smelter to have such a unique kind of fume cooling system in temperate zone like Eastern Province of Saudi Arabia, we will share the performance of this system during five years of operation with potline amperage increase from 370 to 390 kA.

Keywords: Gas Treatment Center, scrubbing efficiency, fume cooling technology, fluoride emission, hairpin ducts.

1. Introduction

Ma'aden Aluminium is the first vertically integrated primary aluminum smelter in Gulf Cooperation Council (GCC) countries with its own bauxite mining, alumina refinery, smelter, cast house and rolling mill. It is the first aluminium smelter in Saudi Arabia located in Eastern Province's, Ras Al-Khair industrial city. The pot technology is AP37. The first hot metal was tapped in December 2012 and the two potlines attained its full capacity operation in July 2014 with 720 pots. Since then the amperage has increased from 370 to 389 kA.

The smelter is provided with 4 GTCs supplied by Fives (Solios), each GTC designed to handle 2 450 000 Nm³/h gas suction from 180 pots [1]. Each GTC is composed of eighteen (18) TGT-RI alumina dry scrubber modules and six (6) induced draft fans (ID fans) that are designed to maintain at all times a 2.6 Nm³/s flowrate at each pot outlet. Furthermore, each GTC is provided with a boosted suction system to double from 2.6 to 5.2 Nm³/s the gas flow extracted at pots during anode change or metal siphoning in order to reduce roof emissions in the potroom. Considering the high summer ambient temperature (up to 55 °C) and maximum pot gas temperature (190 °C), pot gas cooling is required to ensure the GTC inlet temperature never exceeds 135 °C. In Ma'aden, this is achieved by combining hairpin ducts (one at each pot) with dilution air.

The high temperature of pot gases at GTC inlet is a common problem in all aluminium smelters located in hot climatic zones like GCC. In general, the higher the temperature, the higher is the concentration of gaseous fluoride in the treated gas. With all the smelters looking forward to increase potline current in order to achieve maximum production, GTCs also have to prepare themselves competitively in order to meet the environmental norms which are becoming more stringent day by day.

Figures 1 and 2 show long established correlations between gaseous emissions from GTC stack with respect to inlet gas temperatures and humidity in various studies done earlier in this respect. Going forward we will study how Ma'aden GTC correlates to these hypothetical studies and performance of gas cooling system in Ma'aden GTCs.

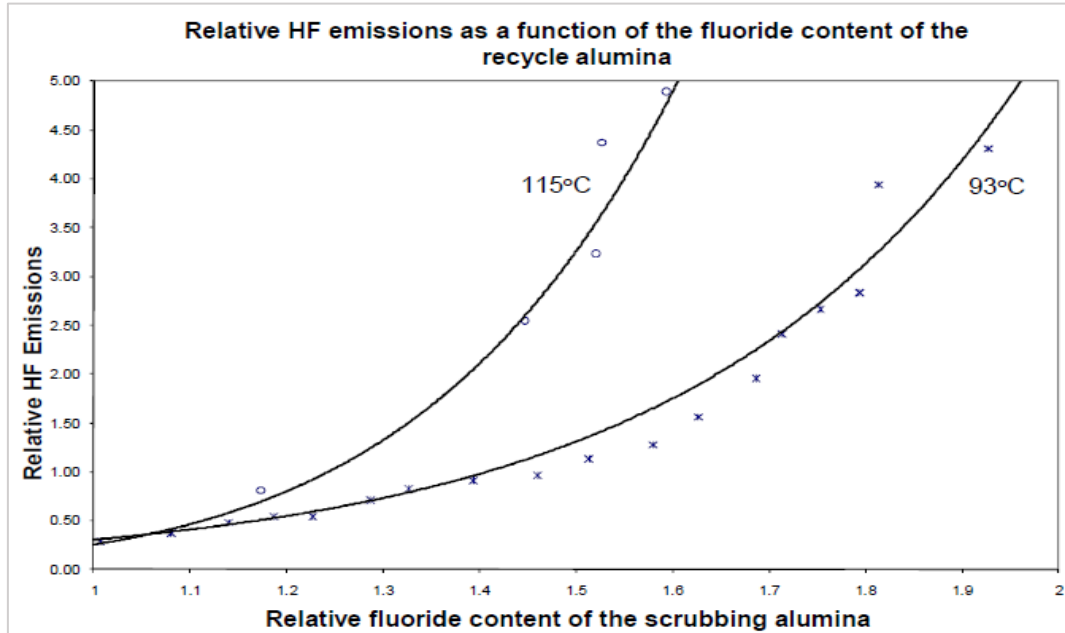


Figure 1. Relationship between HF emission and gas temperature [2].

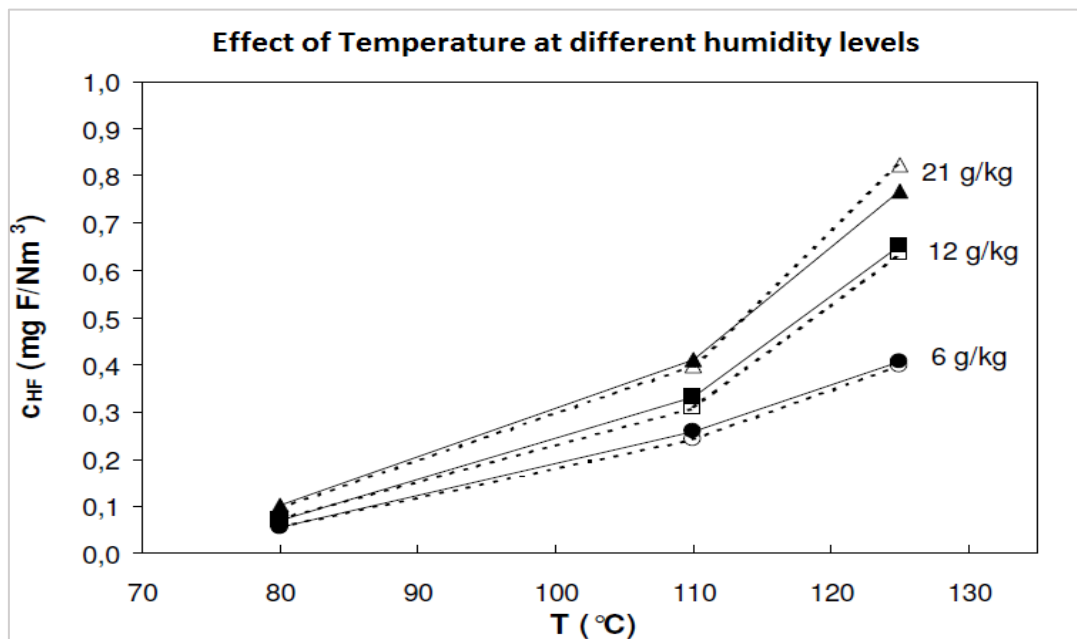


Figure 2. Relationship between HF emission and gas temperature at different humidity [3].

The temperature of exhaust gases generated from pots in Ma'aden were found to be varying between 120 - 160 °C with few pots up to 170 °C (Figure 3) and the fluoride composition at GTC inlet varying from 200 - 250 mg/Nm³. In Figure 3, the pots located towards the south of A-Room and B-Room tend to be inclined towards higher range of temperature because of high temperature during start-up of pots in GTC-2.

efficiency of gas cooling system and if the significance of air dilution dampers will increase at higher amperage when Ma'aden smelter amperage will increase to 410 kA.

5. References

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