Pot Integrated ABART (PIA) Gas Treatment

Anders Sørhuus[1], Håvard Olsen[2], Eivind Holmefjord[3], Roger Theodoresen[4], Mikkel Sørum[5] and Guillaume Girault[6]
1. Product Technology Manager
2. Senior Process Engineer
3. Technical performance and Service Manager
4. Test & Commissioning Engineer
5. Process Engineer
REEL ECS, Oslo, Norway
6. Head of Technology & Engineering, REEL ECS, Aix En Provence, France
Corresponding author: anders.sorhuus@reel-norway.com

Abstract

A novel dedicated pot gas treatment unit, Pot Integrated ABART (PIA) concept is reviewed, and initial test results are shown.

In the Gas Treatment Centres (GTCs) the fluoride components contained in the pot gas are captured and returned to the electrolysis cell with the enriched alumina. This not only recovers the valuable fluoride back to the electrolysis process, but also minimizes the emissions of hazardous fluoride components to the atmosphere. The new PIA concept differs from conventional centralized GTCs in that each pot will have its dedicated mini gas treatment process. This ensures that the same amount of fluoride will be collected and recovered back to the same pot. Among other benefits, this is expected to result in improved pot stability due to less fluctuations in the electrolyte composition.

An early version of the PIA process has been tested in parallel with the central GTC at Alcoa Mosjøen with promising results that are presented in this paper. Currently, fabrication of a larger test unit to be installed on one pot is ongoing, and the paper will also discuss the challenges expected for individual pot operation, maintenance and modular fabrication. This new test unit will allow further investigation of the impact on the pot stability, as part of a joint R&D program between REEL, Alcoa and SINTEF.

Keywords: Gas treatment center, Pot Integrated ABART, Alumina, ABART.

1. Introduction

Particulate and gaseous fluorides are emitted from the pot with the pot gas, and the corresponding concentrations and fluoride mass flows will be quite different from one pot to another, due to different pot process settings and heterogeneous crust and cover qualities.

On individual pots, long-term temporal variations in gaseous fluoride evolutions (from a few hours to several weeks) can also be significant due, for instance, to changes in the same process parameters and crust integrity, as well as variations in ambient conditions (humidity) and alumina properties, to list only the most important parameters. But fluoride evolution will also vary over the short-term (a few minutes). Typically, high HF concentrations are observed during alumina feeding and a lower background level in between as also described in [3], [5], [7]. Overall, in high amperage pots the average gaseous HF concentration measured may be in the range of 200-300 mg/Nm^3 with peaks of 500-600 mg/Nm^3, corresponding to typically 15-30 kg F_g/t Al.

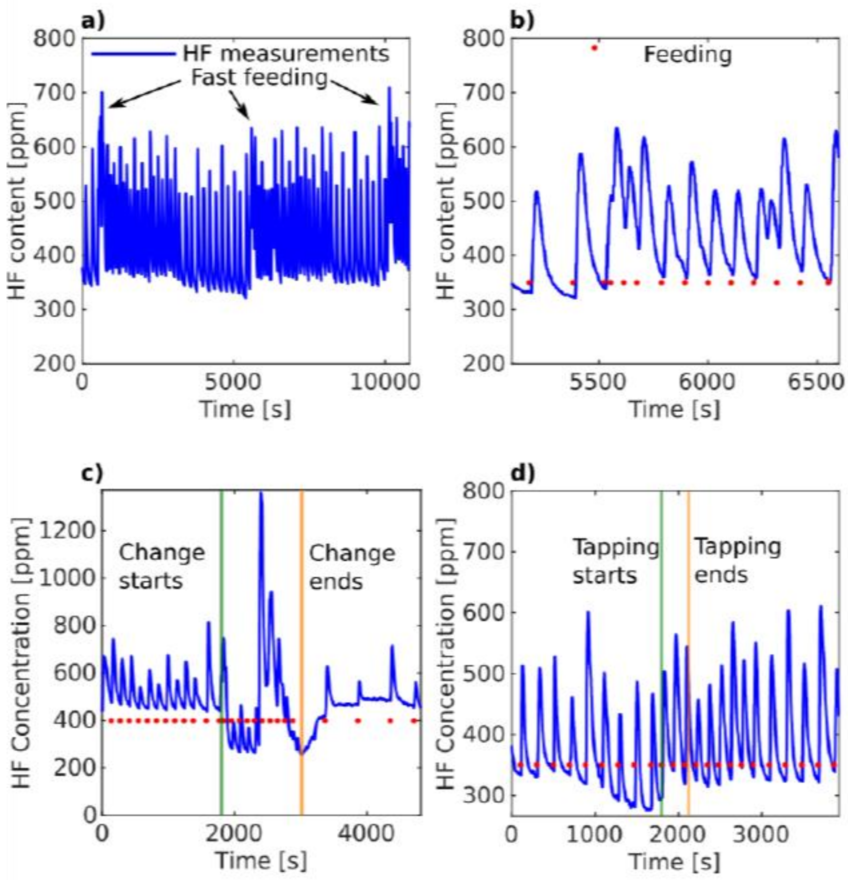

Figure 1. HF variations during pot feeding (a and b), anode change (c), and tapping (d) [3].

The temporal variations in particulate fluoride quantities are not so well documented but are expected to be influenced by the same parameters as gaseous fluoride, including the crust integrity. However, higher humidity will initially increase the fraction of particulate fluoride which further down the process can hydrolyze into HF, therefore increasing the ratio gaseous fluoride over particulate fluoride [6, 9].

Traditionally, pot gas is treated in large centralized GTCs consisting of several REEL ABART compartments. A description of this process can for instance be found in [4]. In this typical arrangement, GTCs treat the combined fumes from a group of pots, which can reach up to 200 in the largest installations.

As an alternative to the traditional GTC configuration, a dedicated Pot Integrated ABART (PIA) gas treatment module for one pot is proposed [1]. This novel concept enables a one-to-one fluoride recovery for each pot, and is illustrated in Figure 2.

6. References

1. Anders Sørhuus, Håvard Olsen, Eivind Holmefjord, Roger Theodorsen, Mikkel Sørum. Gas treatment in the GE Pot Integrated ABART modules (PIA), *Light Metals*, 2021, 485-490.
2. Anders Kenneth Sorhuus, Sivert Ose, Method for controlled alumina supply, *Patent* EP 3569301 A1, Date of filing 18.05.2018.
3. Sindre Engzelius Gylver, Åste Hegglid Follo, Vegard Aulie, Helene Marie Granlund, Anders Sørhuus, Espen Sandnes, Kristian Etienne Einarsrud, On gaseous emissions during alumina feeding, *Light Metals* 2021, 504-510.
4. Anders Sørhuus, Sivert Ose, Eivind Holmefjord, Update on the ABART gas treatment and alumina handling at the Karmøy Technology Pilot. *Light Metals* 2020, 785-790.
5. W. Haupin, H. Kvande, Mathematical modelling of fluoride evolution from Hall-Héroult cells, *Light Metals* 1993, 257-264.
6. K. S. Osen, T. A. Aarhaug, A. Solheim, E. Skybakmoen, and C. Sommerseth, HF measurements inside an aluminium electrolysis cell, *Light Metals* 2011 259–268.
7. N. Dando and R. Tang. Fluoride evolution and emissions from aluminium smelting pots - Impact of ore feeding and cover practices, *Light Metals* 2005 363–366.
8. Anders Sørhuus, Sivert Ose, Eivind Holmefjord, HF and SO_2 multipoint monitoring on large Gas Treatment Centers (GTCs) with prewarning abilities, *Light Metals* 2019, 873-878.
9. Thor Anders Aarhaug, Arne Petter Ratvik, Aluminium primary production off-gas composition and emissions: an overview, *JOM*, Vol. 71, No. 9, 2019, 2966-2977.