A Robust Fume Treatment Centre of the Global Aluminium Industry

Peter Klut[1], Travis Turco[2], Jamal el Filali[3] and Edo Engel[4]
1. Senior Technology Manager – Environmental Solutions
2. Technical Specialist – Dry Scrubbing Technology
3. Senior Mechanical Engineer
4. Marketing Manager
Danieli Corus, IJmuiden, The Netherlands
Corresponding author: edo.engel@danieli-corus.com
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Abstract

Who does not remember the Toyota Landcruiser that the team of Top Gear mistreated in their show? Despite all the abuse, each time the Toyota was brought back to life with a few simple tools. The Fume Treatment Centre (FTC) of Danieli Corus has many similarities; it does not matter what you do to it; it will perform. The original Pleno design was developed by a former maintenance manager at a primary aluminium smelter in the eighties. At that time, this maintenance manager was not pleased with the equipment given to him, so he decided to manufacture his own gas cleaning equipment. Currently the fifth generation of the Pleno Design is on the market. Experience shows that hot temperatures, sparks, tar, dust will all be handled. Also, poor operation or lack of maintenance has little effect on the operation of the FTC. In the paper we will show examples of the performance of the FTC during extreme conditions and how any damage could be repaired easily.

Keywords: Fume treatment center, Equipment maintenance, Equipment reliability.

1. Introduction: Pleno V Fume Treatment Centres

The Fume Treatment Centre designed by Danieli Corus for the primary aluminium smelting sector has shown its robustness and reliability over decades. Now in its fifth generation the Pleno design has been updated and improved while retaining its tried and tested design. Pleno V relies on a design dating back to the 1980s that has proved itself over the years, while undergoing improvements in each successive generation. The Pleno V design as seen in Figure 1, provides additional platforms, easy access for inspection and maintenance, and isolation points.

Figure 1. Pleno V Fume Treatment Center.

A key component of the FTC is the conditioning tower, a component that must be strong, robust and built to withstand corrosive atmospheres and high temperatures. Conditioning tower design, operation and replacement were discussed in previous publications [1–3].

2. The Conditioning Tower

The conditioning tower's main purpose is to condense and remove volatile pollutants, Polyaromatic Hydrocarbons (PAH) and particulates. A constant temperature of approximately (105–110) °C at the outlet of the conditioning tower, but not above is key.

The robust conditioning tower conservatively designed by Danieli Corus, has been known worldwide as a reliable means of cooling the bake furnace fume for the past 25–30 years. To facilitate the complete evaporation of the water droplets inside the cooling tower, a special atomizing nozzle has been selected which uses water and compressed air to create a very fine mist of water droplets in the gas flow. This fine mist allows complete evaporation of the water in just a few seconds, well before the mist reaches the bottom of the tower. The cooling tower has been designed conservatively, using a residence time of 8 seconds at the design conditions, ensuring complete evaporation while sustaining a fume outlet temperature of 105 °C. This generous evaporation time in combination with the flexibility to use up to 7 spray nozzles will continue normal operation when a single lance is removed for maintenance. The Hastelloy spray nozzle and stainless-steel lance body is equipped with quick-disconnect coupling for easy maintenance. A set of 3 inlet and outlet temperature sensors on the conditioning tower will monitor the process. A false reading is automatically discarded by the control system to prevent unwanted bypass operation.

The conditioning tower cools flue gases to a constant temperature, irrespective of varying heat load, gas throughput, changes in raw material supply and disrupted operating conditions. It targets more than 99.5 % online availability which equates to less than 48 hours downtime per year.

2.1 “Dry Bottom” Operation

“Dry bottom” operation of the conditioning tower as seen in Figure 2, is the operating mode whereby pollutants are discharged at the bottom without containing any moisture. This reduces corrosion risk and makes for a service life of 30 years and more, against typical design life of 20 years.

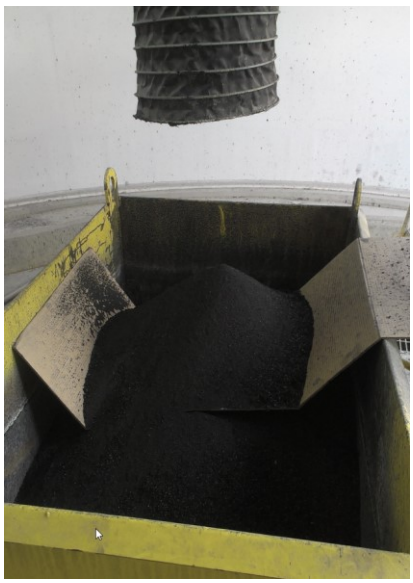

Figure 2. Separated pollutants with “dry bottom” operation.

contain tar/sticky matter. Changes in the sulphur content of the used pet coke have led to a rise in sulphuric emission (SO_2, SO_3, H_2SO_4) while capacity creep at potlines and the associated baking furnaces have stretch many fume treatment centers towards or beyond the limits of their design capacities.

The "Pleno" design for dry scrubbing of anode baking furnace fumes and potline gases was developed in the 1980s with the objectives of robustness and maintenance friendliness. All of the "Pleno" design FTCs and GTCs that have been decommissioned, were taken out of operation for business reasons rather than technical. These units have demonstrated their ability to remove pollutants and cope with the aforementioned temperature spikes and sparks.

One of the keys to a long lifetime is in the "dry bottom" operation of the conditioning tower, while the conditioning tower primarily serves to protect the baghouse modules, this operating mode also eliminates the risk of (acidic) corrosion downstream by preventing condensation and as such, acid-accelerated corrosion. "Dry bottom" operation is achieved by proper engineering of the conditioning tower and is maintained by effective maintenance of especially the spray lances. However, though lacking maintenance may jeopardize some equipment, operational experiences with "Pleno" design fume treatment centers have shown that even in those cases, the "Pleno" design FTC is robust will not fail.

References:

1. Stephan Broek, Ike Loukos, Smelters scrub up with Pleno IV, *Aluminium Today*, January/February issue (1999), 21–23.
2. Peter Klut, Wouter Ewalts, Travis Turco, Aluminerie de Bécancour Conditioning Tower Replacement, *Proceedings of the 145th TMS Annual Meeting*, Nashville – TN, USA, 14–18 February 2016, 479–483.
3. Erik Dupon, Edo Engel, Rick Oliana, Bas Admiraal, Peter Klut, Structured Approach to Modernization of Fume Treatment Centers, *Proceedings of the 143rd TMS Annual Meeting,* San Diego – CA, USA, 16–20 February 2014, 1181–1185.