Extended Surface Filter Bags in Reverse Air Cleaning Filters

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Abstract

The use of Extended Surface Filter Bags (ESB) is nowadays widely practiced in the aluminum industry for Gas and Fume Treatment Centers. The benefit in reduction in differential pressure to allow for more draft from the potline and reduced cleaning cycles or even reduction in electricity consumption is proven around the globe. There is a significant amount of reverse air cleaning filtration technology in the market – commonly known as Vibrair filters. These filters do not have a pressurized pulse cleaning system, but clean the filter media solely by reverse air, which is a more gentle cleaning process and allows for longer bags life. Vibrair users face the same challenge as other aluminum smelters with ever increasing amperage or more stringent environmental regulations. Consequently they seek an increase in filtration area. One way to achieve that increase is by converting the Vibrair filters from the pocket bag system to Extended Surface Filter Bag system whilst keeping the reverse air cleaning approach. The paper will show case studies that demonstrate successful trials and now full conversions of reverse air filters with the help of extended surface bags.

Keywords: Extended Surface Bags, ESB, Reverse Air Filter, Vibrair, GTC, conversion.

1. Introduction

Aluminum smelters are facing ever growing economic and environmental pressures: increasing efficiency and output whilst maintaining, or even better, reducing emissions. To battle the increasing HF and dust emissions (roof and stack), Extended Surface Filter Bags (ESBs) are nowadays commonly used by many plants around the world, successfully allowing for increased airflow from the potline and consequently reducing emissions at the stack as well as roof ([1], [2]).

All major groups use ESBs in their smelters today – yet the use is limited to the Gas or Fume Treatment Centers (GTCs or also referred to as FTCs) using a pulse cleaning system. There is an alternative established technology in the market for gas cleaning systems that does not rely on pulse cleaning systems, but works based on reverse air: the Vibrair Technology. The paper focuses on the introduction and implementation of the ESBs into the Vibrair GTCs.

1.1. Vibrair Technology

The Vibrair filter technology (see Figure 1) was developed by Fives Solios (Procedair) in the late 1960s and has been installed in more than twenty aluminum smelters worldwide from 1972 to 2012 to treat potline gas and capture fluorides. Many of the Gas Treatment Centers using that technology are still in service today.

The Vibrair unit features a compact filter module of 5, 8 or 10 cells that each house a filter block (see Figure 2) that has 12 multi-channels pocket bags. The Vibrair pocket bags are cleaned by Reverse Air. However, the air flow through the bags and the filtering velocity of 2 cm/s are typical of pulse jet filters. Each cell is cleaned on demand, one at a time in off-line mode: a poppet damper travels between two orifices to isolate the outlet plenum during cell cleaning mode or to isolate the reverse air manifold during cell filtering mode.

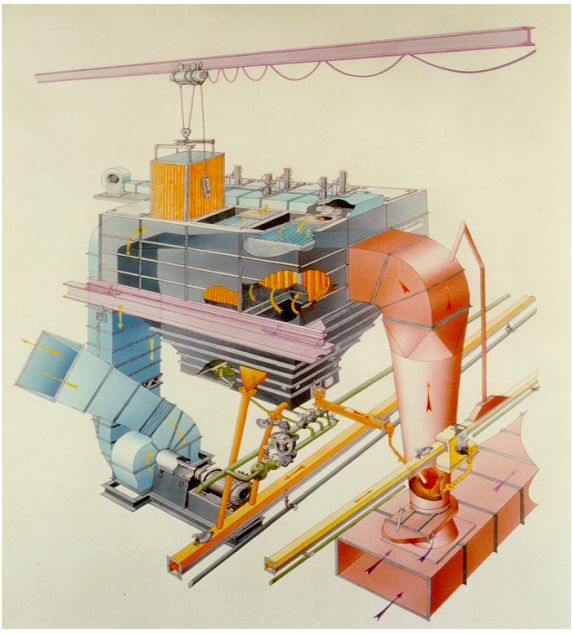

Figure 1. 8-cell VIBRAIR module.

Figure 2. Filter block with 12 pocket bags.

Each pocket bag is divided into 29 or 32 independent filtering channels. The total filtering area of one cell (12 pocket bags) is 185 m^2 when provided with 29-channels bags or 198 m^2 when provided with 32-channels bags. The assembly /disassembly of a filter block is typically done in specially designed maintenance room that is part of each Gas Treatment Centre. If there is a bag leak (1 filtering channel leaking), the usual procedure is to plug the channel with a pad of rock wool or polyurethane foam while the remaining channels can be maintained in filtration mode.

The soft cleaning system with reverse air ensures a long pocket bag life (5 – 6 years typical) but is not as effective as a pulse jet cleaning system to control a low pressure drop. Hence it is typical for those units to operate with a bag pressure drop of 320 to 350 mm WG.

1.2. Extended Surface Filter Bags

Extended Surface Bags get their name from the increased surface of the filter bags whilst maintaining the same physical dimensions as standard filter bags. The surface increase is balanced to allow for maximum increase in surface whilst maintaining an optimal cleaning capacity in high dust environments. Pleated filter elements were used for some time but they are not as suitable with high dust loads.

The current state-of-the-art design includes 12 pleats and has, in case of round filter elements, a surface increase of 120 % (more than double the surface) compared to the same length standard bags (Figure 3):

The start-up of the filter was done by plant personnel as well. After an initial three-month observation period the airflow to the compartment was increased by 14 % and is running stable ever since.

TRIMET Essen is continuing the roll-out of the ESBs and is testing different types of filtration fabrics. They plan a full conversion to ESBs if the concept is proven in the next steps, and will evaluate the need for additional measures to achieve the anticipated airflow increase.

5. Conclusions

The current installations show that the Extended Surface Bags perform very well in reverse air cleaning systems, like the Vibrair filter. The longest installation to date is now 3.5 years and still in operation.

With the ESB technology, the filtering area of a Vibrair filter that was equipped with 29-channels pocket bags can be increased by up to 29 %. If the GTC fans were operating at their limit prior to the conversion, the full conversion of a GTC to ESB technology can allow an increase of approximately 7.5 % in gas flow. On the contrary, if the GTC ID fans have excess capacity, the conversion can allow an increase in flow of up to 15 %. Increasing the flow beyond will have to be tested and could likely be limited by problems of abrasion and increase scale formation.

Long term durability of the ESBs, especially with the increased airflow and consequently higher incoming air velocity remains to be validated. The pocket filters have proven an average of 5 to 6 years life, under standard operating conditions.

The users give a very positive feedback: the handling, installation and if needed replacement of the bags have proven to be very simple and easy.

6. References

1. Stephan Broek and Julie Dontigny, The application of extended surface filtration bags in gas treatment centres, *Proceedings of 35th International Conference ICSOBA, Travaux No.*46, *Hamburg, 2 – 5 October 2017,* Paper ALxx.
2. Petra Mühlen, Extended surface filter bags – applications and benefits, *Proceedings of 33rd International ICSOBA Conference*, *Travaux No. 44,* Dubai, UAE, 29 November – 1 December 2015, Paper AL07, 561-565.
3. N. Depree et al., The 'Virtual Battery': Operating an Aluminum Smelter with Flexible Energy Input," *Light Metals* 2016, 571-576.