Material differences

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Social responsibility combined with stringent air pollution regulations are the main factors behind the selection of state-of-the-art off-gas emission control equipment for kiln baghouses in cement plants. At Cementirossi’s 1 MtA Piacenza cement plant in Italy, the kiln dedusting filter treats the exhaust gases from the kiln and three raw mills. The kiln outlet gases are pretreated with water to control the baghouse inlet temperature at 130°C. The filter is based on a Lurgi design with eight chambers containing 5500 bags. The bags are cleaned by low-pressure, high-volume pulse jets distributed into the bags via a rotating manifold.

However, the filter bags used presented the cement producer with some challenges which led to the replacement of the initial set of bags (based on a PTFE membrane laminated onto a woven glass substrate material) with a material based on PB4® multilobal fibres blended into the surface of a PPS substrate matrix.

**Initial filter material**
The kiln baghouse was commissioned in January 2008 as an upgrade from the old ESP. The original set of bags was constructed with a filter material based on 700g/m² woven glass with a surface PTFE membrane. Typical new and failed woven glass/PTFE membrane (G/M) materials are shown in Figure 2.

In September 2008, after about eight months of operation, the works started to have issues with dust emissions which were running very close to the emission limit, as well as with high baghouse pressure losses. The operating pressure difference (ΔP) was 20mbar instead of the desired 12mbar. It is important to note that G/M materials are potentially susceptible to blinding due to unburned hydrocarbons, very fine dust, salt condensates and acid dewpoint operating conditions. A key cause relates to the fact that with membrane-type materials the filtration dust cake is not stable. The membrane is a very fine, smooth layer and all dust slides away from the filter media surface during the bag cleaning phase, leaving the membrane exposed to the potentially harmful elements previously described.

**New PB4-based filter media**
To alleviate these issues, technical staff at the Piacenza works decided to select a different type of filter media. In March 2009 all bags were replaced with a needlefelt material based on PB4 multilobed fibres blended into the dust-sided surface of a PPS substrate. These

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**About the Piacenza plant**
- **Core components**
  - 2 x rotary raw material crushers
  - 3 x raw mills
  - ø3.75 x 57m kiln
  - 2 x coal mills
  - 7 x cement mills

- **Klin section**
  - five-stage preheater
  - precalciner
  - IKN static grate cooler
  - Fuller grate cooler (hot and cold)
  - clinker hammer crushe
cross-section fibres are used to produce felts with high filtration efficiency. Figures 3 and 4 show the new filter material used at the Piacenza plant.

Blending of different fibres can have a positive influence on the filtration behaviour by modifying the distribution of static charges on the felt surface, and leading to the formation of a porous and stable dust cake. The dust cake characteristics are crucial in dry filtration in terms of filter media protection, prevention of dust penetration and reduction of particulate emissions, all these benefits at low ΔP losses. The felt filtration side constructed with PB4 multilobal fibres has the highest surface area, thus, it is irregular and porous. During the filtration process, the dust separates in the low velocity zones of the multilobal fibres, forming a rich dust cake due to the PB4 fibre irregularity (see Figure 5).

A filtration surface based on round fibres will form a more compact and less stable dust cake. A membrane-based filter medium, like the G/M, forms an even more compact (less porous) dust cake and, during the bag’s cleaning phase almost all dust is being released, leaving the material (membrane) unprotected.

**Performance of the new filter material**

Since its first installation, the new set of bags based on a PB4-PPS/PPS scrim construction remains in operation with an optimal performance. The ΔP across the baghouse is stable, around 12mbar (see Figure 6), and the particulate emissions are lower than 1mg/Nm³.

The bags were analysed in specialised textile laboratories at regular intervals as part of the bag filter condition monitoring programme to determine the filter material condition regarding air permeability, tensile strength, chemical and temperature degradation and dust penetration. The test results revealed that after five years of operation the bags are in mint condition with no dust penetration and good mechanical and chemical properties. Figure 7 shows felt cross-sections from 2009 and 2014.

**Increased bag life, plus associated benefits**

By considering a PB4-based filter media Cementrossi was able to increase the bag life from less than a year to over five years in a cost-effective way. Apart from the savings related to the longer bag life, the plant has enjoyed low pressure losses given the dust cake structure and low particulate emissions due to the dust cake stability. Suction fan power consumption has also been saved due to the stable ΔPs and compressed air consumption has been reduced on account of the low cleaning/pulsing rates owing to the PB4 multilobal fibres’ high dust-charging capacity.
Unique Performance in Cement Plants

Filter bags out of P84® Polyimide Fibres offer Highest Filtration Efficiency.

The profile makes the difference:
The unique multilobal profile of P84® fibres creates an extremely high specific surface area. This is the guarantee for advanced filtration performance and the fulfillment of emission limits.

Flexibility for changing operating conditions:
When changing from direct operation at temperatures up to 240 °C to compound mode at 140 °C the dust load is increased 10 - 15 times! Even at dust loads above 500 g/Nm³ P84® material ensures maximum efficiency and keeps emission levels far below environmental standards.

Secondary fuels require chemical resistant filter material:
P84® material can be used within a wide pH range of 2 - 12 making it the preferred material when flue gas conditions vary due to different fuels.

In summary P84® material offers:
- good chemical and mechanical stability
- high temperature resistance up to 260 °C
- suitability for high a/c ratios up to 1,5 m/min
- superior filtration efficiency for fine dust
- stable and low Δp for savings on ID-fan power