Do COST SAVINGS AND ENVIRONMENTAL PROTECTION OPPOSE?

Dr. Georg Rathwallner, Evonik Fibres GmbH, Austria, reports on experience with needle felts from P84 and P84 blends in cement applications.

The operation of a bag house results in expenses for fan power, pressurised air and bag material as well as cost for manpower and the loss of production during maintenance. The choice of the bag material influences all of the other above listed costs. Nevertheless typically just the cost for bags and maybe the expected bag life are considered for the purchase decision.

What will future developments bring? The emission levels will continue to decrease, for sure. Questions how to reduce the operating costs will arise. Is it possible to reduce emissions and operating costs? Yes, at least in many cases, subsequent examples should give an idea of the performance of common filter media.

In pulse jet filters for kiln/raw mill dedusting just 2 bag materials are commonly used: woven glass with PTFE-membrane and P84® (polyimide) needle felts. Both are suitable up to peak temperatures of 260°C. The membrane material typically shows an increase of emissions when facing mechanical wear over the bag life whereas P84® bags operate at less than 10 mg/Nm3 typically until the end of life.

P84® bags are easy to handle and do not demand special care during installation. The app. 2-3 mm thick needle felt is quite abrasion resistant in comparison to membrane filter media – during installation and during operation. Spare bags can be stored over years without significant influence on the quality of the needle felt.

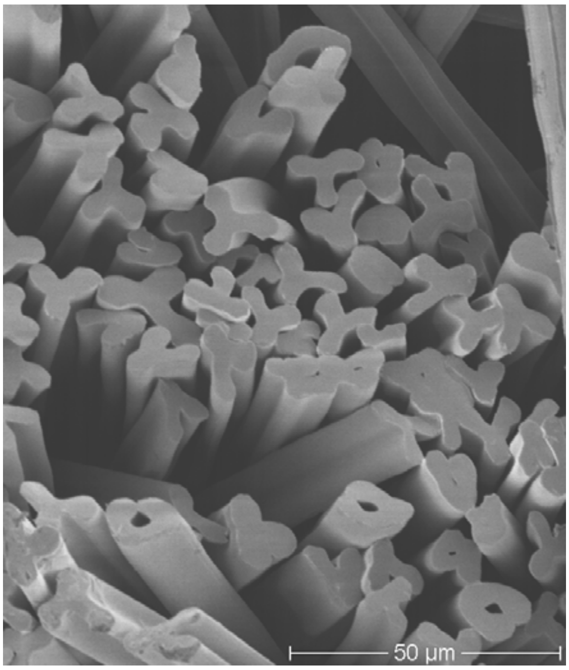

Fig. 1: Multilobal fibre cross section of P84®

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Comparative tests of kiln filter media

To get a direct comparison between P84® bags and glass/membrane bags we have placed both materials in a cement mill filter for 29 months. Then both materials have been evaluated on a test rig according to VDI 3926 regarding filtration efficiency and pressure drop. To get realistic conditions the test was done with cement dust, sampled from the hopper.

Fig. 3: cross section of filter media after 29 months operation; from left: glass with e-PTFE-membrane; cracks on the membrane surface; dust-free cross section of P84®

The membrane media exhibited damage along the supporting cage wires and dust could be found in the cross section of the supporting glass fabric. On the contrary the cross section of the P84® needle felt is free of dust. This resulted in 50% higher emission of the membrane media during evaluation. 29 months can be considered to represent just app. half of the life of the materials. Also the pressure drop of the P84® needle felt is app. 10-20 % lower than that of the membrane media, depending on the set point. This figure can be directly transferred to ID-fan power savings. The pressure drop development of the tested materials during a filtration cycle (which means between two cleaning pulses) is shown in fig. 4.

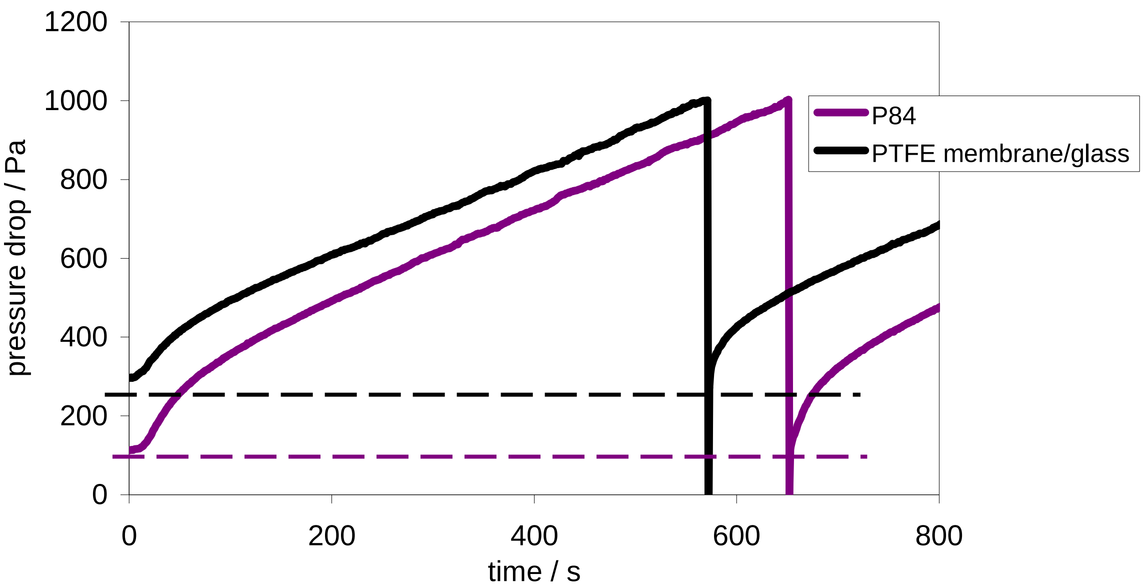

Fig. 4: Pressure drop development of kiln filter media after 29 months operation, evaluated on a test rig according to VDI 3926

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Ambuja Rauri – The first kiln/raw mill filter with P84® in India

The 10.000 TPD kiln of Ambuja near Darlaghat is the first big cement kiln / raw mill dedusting filter with P84® filter bags in India. It went in operation 1.5 years back and operates at a pressure drop of 4.5-11 mbar with emissions below 10 mg/Nm^3. This confirms the suitability in Indian kilns which has always been in question. A lab analysis of a used bag is due to be executed in the laboratory of Evonik Fibres and will allow a prediction of the remaining life.
An emission of 10 mg/Nm^3 corresponds to a loss of cement dust of app. 80 tons per year in a 8.000-10.000 ton per day kiln. Worth to consider a filter media that ensures emissions below legislative limits, especially if also energy can be saved because of a lower operational pressure drop.

Fig. 2: Ambuja Rauri plant

Other applications for P84® fibres

P84® has proven to be the fibre with high filtration efficiency because of its irregular cross section and the resulting high specific surface. This advantage can also be utilised in low temperature applications by blending P84® into the dust side of various base materials like polyacrylic, polyester, PPS and PTFE. These blends can solve pressure drop and emission problems as they allow stable operation at higher dust load and a/c-ratio than the base material without P84®.

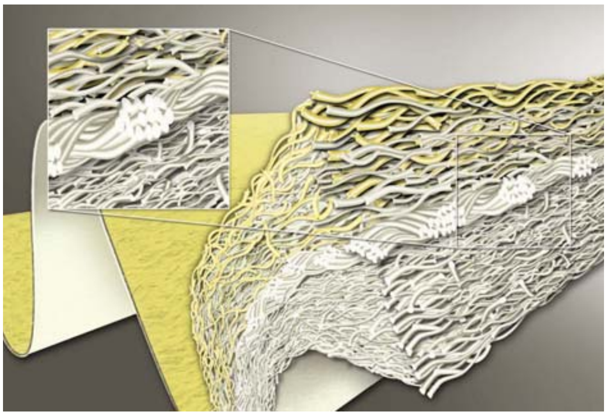

Fig. 5: Illustration of an asymmetric P84®-blend

Comparative test of cement mill filter media

In fig 6 a comparison of a polyester fine fibre felt and a polyester felt with P84® fibres blended into the filtration side is displayed. Details of felt construction and operating conditions are given in table 2. Both filter materials were used in similar clinker grinding lines under challenging conditions:
The blend with the multilobal polyimide fibres exhibits good filtration behaviour for 4-5 years, ensuring a low and stable pressure drop of app. 1500 Pa during the entire period. On the other hand the polyester fine fibre felt shows penetration of dust through the entire cross section after only 7 months operation. Operated at a comparable differential pressure it suffered from more frequent cleaning which lead to dust penetration. Besides emissions as a result of penetration through the felt, cracks occur as a result of increased mechanical burden (abrasion caused by incorporated dust and more frequent pulsing).
Even considering the higher investment for the P84® blended bags, this resulted in much lower annual costs for bag material and the additional benefit of higher process stability and less down times.

Tab 2 Specification of a polyester felt and a P84®/polyester blend and operating conditions of the cement clinker mill

		Polyester Fine Fibre	P84®/Polyester
Felt construction	Filtration side	PET fine fibre	40% P84® / 60% PET
	scrim	PET	PET
	Clean gas side	PET	PET
Felt weight		600 g/m2	600 g/m2
Air permeability (new) @ 200 Pa		40-50 l/dm2.min	40-50 l/dm2.min
Bag price		app. double the price of standard polyester	app. 60% more than polyester fine fibre
Performance		bag change after **7 months**	differential pressure flange-flange: 1500 Pa, stable for **60 months**
Operating conditions: A/C ratio: 1,2-1,3 m/min; dust load: 500 g/m³; temperature: 85 °C			

Fig.6:Finishing mill: Polyester fine fibre felt after 7 months (left, total blinding – the bags had to be changed) in comparison with a P84®/Polyester blend after 60 months in operation (right, constant pressure drop of app. 1500 Pa). See tab.2 for details

Summary

For a comparison of the total costs related to filter media more than just bag costs and estimated or warranted life has to be evaluated. Especially the operational pressure drop, which determines the ID-fan power consumption, can have even more effect than the costs for bags.
Needle felts, especially P84® and P84® blends can outperform membrane materials under realistic conditions, which might be opposite to results from short term tests on lab scale test rigs.
At the end of their life P84® bags and also P84® blends with polyester, acrylic or poly phenylene sulphide (commonly known as 'Ryton') do not need to be land filled. They represent an alternative fuel with reasonable heating value and do not produce significant amounts of gaseous pollutants and do not influence the cement quality because of a negligible content of inorganic material.