

Needle felts for kiln dedusting, 10 good reasons to stay away from fabric based membranes.

When bag houses after the kiln started to become a technology trend in the cement industry it became a challenge for filter media manufacturers too.

Basically there were four major points of concern that had to be taken care of.

1. Relatively high operating temperatures between 140° - 260° C . An exhaust gas temperature after kiln and cyclones which is usually in the range of 300 -350° C has to be cooled down with as little energy and cost as possible.
2. Extraordinary high dust loads exceeding 700 gr in many cases, especially in compound operation with the raw mill.
3. Aggressive chemical conditions with high pH levels combined with the fact that many plants use all kinds of waste as secondary fuel, ranging from household to liquid chemical and industrial waste make it necessary to clean the flue gas from heavy metals, dioxines and furanes.
4. Extremely low targets for emission levels of < 10 mg / Nm³ which could not be met with the existing ESP's, had forced the industry to implement a bag house into the concept.

The country where it all started was Korea in 1995, when the government decided to lower the emission levels for cement producers below 50 mg / Nm³. Today we can say that it has become a worldwide trend wherever environmental pollution control is more than just talk.

What has been observed since then is described in this article taking into consideration the experiences from the Korean market.

The 10 points listed below may give you a guideline how to avoid expensive experiments when already existing solutions are available and approved by the industry.

1. Standard bag house conditions are in favor of needle felts.

Membranes are of an extremely fragile composition and has to be laminated to a fabric in order to give it mechanical stability and to be able to sew filter bags. With each pulsing cycle the quality of the lamination is under a severe mechanical test, as the pulsing air tries to blow off the membrane from the supporting fabric.

Actual experiences show that only low cleaning pressures < 3 bar result in acceptable bag life for membrane material, as well as air to cloth ratios which are recommended to be below 1,0 m /min.

Bags out of needle felts have a average life time of 4 – 6 years operating with 4-6 bar cleaning pressure and up to 1,4 m/min air to cloth ratios.

2. Needle felts (except PTFE) generate lower initial cost for the bag house in total (size, cages, bag material, cost per bag)

The formula is simple: lower a/c ratio = larger sized bag house = higher initial cost.

Because of the fragility of both, the glass based fabric and membrane, special support cages with double the wires compared to a standart cage are needed. On top of all, membrane bags are significantly more expensive than needlefelt bags.

3. Lower differential pressure saves energy and money.

A comparison of various high temperature resistant needle felts based on P 84 fibres and membrane materials result in differential pressures being between 30 – 40 mm / WC lower in case of needled material.

As a rule of thumb every 10 % of lower differential pressure **saves up to 200 kWh/m² filter area per year!** Needle felts out of P 84 material show a differential pressure of 80 – 110 mm WG which slowly increases towards the end of their cycle time to app. 140 – 150mm EG whereas membrane based materials already start at an initial differential pressure of 140 – 160 mm WG!

4. Lower operating & maintenance cost.

When it comes to bag replacement, the cost for needled material other than PTFE is significantly lower. An additional point in favor for needle felts is the fact that the bags can be taken out, washed and cleaned in case of unexpected operational problems. After cleaning and if necessary repairing, the bags can be installed again.

5. Needle felts are easy to handle and don't need special attention during storage and installation.

Due to the fragility and finess of membranes it is extremely important to take utmost care when installing the bags. Any sharp edge, even a finger nail is enough to damage the membrane and cause premature failure of the damaged bag. Once the membrane is damaged the dust starts creeping underneath and the so called chicken effect starts the delamination process of the membrane resulting in an dramatic increase in pressure drop.

It is estimated that app. 10% of all newly installed membrane bags are damaged before they come in contact with the flue gas.

6. Needle felts are by far superior with regards to mechanical stability, even more at elevated temperatures.

One of the weak points of PTFE based materials in general is the relatively low initial tenacity. When heated up to temperatures above 160° C the tenacity of PTFE is dramatically reduced.

This typical behavior of PTFE material has resulted in premature bag failure due to dust abrasion at elevated temperatures.

7. Glass fibre fabrics have low life cycles in pulse jet systems.

As the generic name suggests, glass is a pretty brittle fibre which easily breaks when subjected to mechanical stress such as pulsing at 4-6 bar and hitting the cage wires when snapping back after the pulse. Therefore glass fabrics have a limited and rather short life cycle in pulse jet systems. When the first generation of membranes came on the market, the base material was in most cases 100% glass fabric.

Due to numerous problems with these fabrics the material was finally upgraded to a glass PTFE blend in order to extend the life cycle.

Upgrading the fabric with PTFE has improved the bag life to a certain extent but still the glass fibre is the weak link in the chain the same problems arise only several months later.

8. A dust cake on filter bags not only increases filtration efficiency but most important of all, is responsible for effective neutralisation of acidic flue gases in the gas stream.

In case of membranes where little to no dust cake is formed, this effect is rather limited and the flue gas needs to be treated with additional amounts of additives.

9. Needle felts meet the toughest environmental standards.

Even in Europe where probably the most stringent emission requirements are in place, emission levels of < 5 mg are achieved over the complete bag life cycle.

10. Needle felts show excellent collection efficiency with high dust loads as well as with abrasive dust.

Conclusion

The first bag houses in Korea were initially equipped with glass / membrane filter bags. When these had failed within 6 – 8 months the fabric material was changed to Gore's " Superflex " which again resulted in premature failures after 12 – 14 months. From 1996 on the first set of conventional needle felt bags out of P 84 were installed and were only replaced after 5 years of operation without problems.

Today P 84 needle felts are covering more than 95% of the kiln dedusting applications in Korea, including one of the largest cement kilns worldwide at Sungshin Cement with a capacity of 9100 to/day.