Energy efficient bag filters

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As a result of the increased use of secondary fuels in the cement making process, a separation of bypass flow from main exhaust gas flow is necessary to reduce aggressive substances in the gas-bearing plant sections. Therefore, new cement plants are equipped and existing cement works usually need to upgrade with an additional dust filter. Bag filters are state-of-the-art, due to their high separation efficiency and safe operation. The reduction of operation costs of each plant unit in the cement process is another top target for every operator and bypass bag filters can play their part in helping to achieve this.

With 26 per cent of the gross value added, energy costs for cement production are one of the highest in all industry branches. Accordingly, cement producers have a vested interest in saving valuable and expensive raw material resources. In 2009, the German cement industry met 58.4 per cent of its entire thermal energy requirements with secondary fuels[1]. Alternative secondary fuels include tyres, waste oil, commercial and municipal waste (plastic, paper, textile waste, etc), meat and bone meal or sewage sludge.

Care and attention must be paid to non-polluting combustion and as well as stable and safe kiln operation without any malfunction, especially when using secondary fuels. Consequently, the bag filter needs a proper design and filter media and components must be carefully selected.

Toxic cycle and reduction of toxics by bypass-dedusting

Alkalis (potassium, sodium) and chlorides, in combination with sulphur species (measured as masses of percentage SO_3) inserted into the process by the raw meal, lead to operational disturbances in the production process. Heat exchanger arrangements are particularly affected. This is caused by high temperatures in the rotary kiln. The chlorides evaporate and condense again in the heat exchanger connected downstream. There they form an internal circulation, which leads to an enrichment in the kiln/heat exchanger system. The volatile components Na_2O, K_2O, sulphur and chlorine facilitate the creation of caking in the kiln inlet area and in the riser duct. Additionally, alkalis

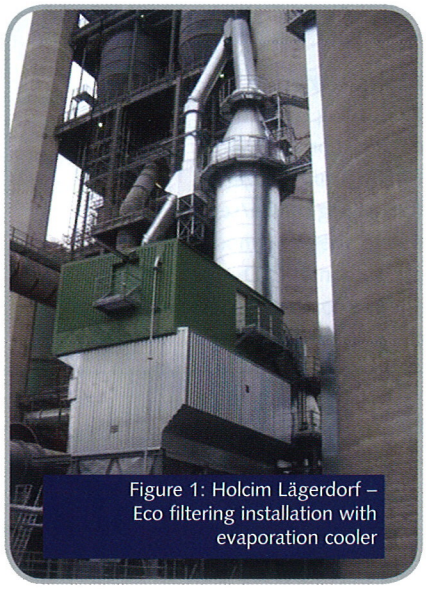


Figure 1: Holcim Lägerdorf – Eco filtering installation with evaporation cooler

significantly affect the quality of cement. In Germany the 'alkali directive' of the German committee for ferro-concrete (DAfStb) regulates the measures to the avoidance of damaging alkali silicic acid reaction in concrete.

By establishing a partial gas deduction in the area of the kiln inlet (the so-called bypass) it is possible to reduce the toxic cycle and, therefore, the contaminant content held in the clinker. The highly-contaminated kiln dust, drawn off by the bypass, cannot be taken back into the kiln.

The exhaust gases coming from the kiln are cooled in a mixing chamber by supply of air on temperatures of about 400°C, so that the gaseous toxic components located in the exhaust gas already condense or sublimate.

In the second cooling stage, either by air or water, the bypass exhaust gas is cooled to the required bag filter entry temperature of 150 to 250°C. When cooling by air temperatures are usually adjusted from 220-250°C before entering the bag filter. Compared to air cooling, gas cooling can be carried out by a minimum rise in gas volume before the bag filter when establishing a evaporation cooler.

Dual fluid nozzles as well as return nozzles are used for water injection into the evaporation cooler.

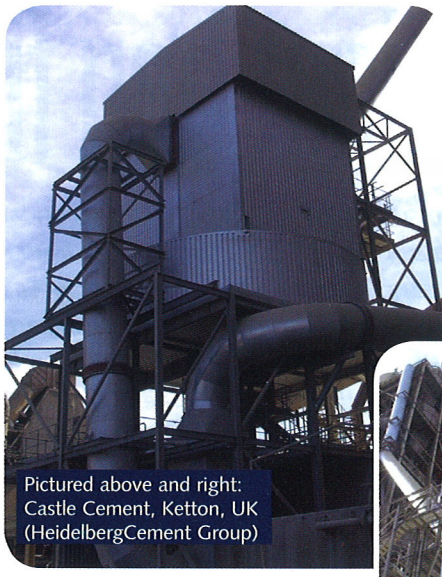
Energy optimised ProJet mega®

The pressure loss of filter medium and the attached filter cake has by far the highest part of accumulated energy costs for running the filtering installation. Intensiv-Filter uses for bypass dedusting PTFE needle felts, mixing felts made of Polyimid (P84®) and PTFE or glass-needle felts with laminated PTFE membrane. Needle felts with microfibers and special needling, as they are also offered by Intensiv-Filter under the name of ProTex, feature an optimised surface filtration and show an especially good behaviour concerning air permeability and regeneration. The filter pressure loss can be held consistently low with high separation efficiencies. Only a diminished pressure respectively compressed air consumption is necessary for cleaning the filter cake. Membranes distinguish themselves by their low price, nevertheless, but they own some disadvantages with regard to their surface delicacy as well as low air permeability, caused by very fine pored membrane and the raised filter pressure loss walking along with it[2].

Concerning the chemical permanence and the life span, in practice, both filter medium kinds have proved themselves more than satisfactory.

The pressure difference is usually used as an input size for a control of the interval and the cleaning pulse. In addition, Intensiv-Filter sets a pressure control in the compressed air tank (variation, pressure regulator). The pressure loss of the filter plant as well as the compressed air consumption is reduced by this fully variable control of the Jet-Pulse-cleaning (Intensiv-Filter JetBus Controller®) which can be adjusted to customer needs.

For a further increase of energy efficiency, filter modules of the filter plant are set while cleaning into a nearly non-flowing state by shut-off devices (flaps, valves, gates). This operating mode is called offline or semi-offline (only clean gas sided separation) operation. Through this, the potential re-agglomeration of redispersible dust (fine dust shares) is efficiently prevented. Parallel cleaning can be carried out when the operation is off-line with a less intensive jet pulse. At this the pressure valve block (compressed air tank capacity) is from 0.1 to 0.4MPa.



Pictured above and right: Castle Cement, Ketton, UK (HeidelbergCement Group)

Summary

By carrying out optimisation measures for the ProJet mega®, concerning offline/semi offline operating mode, the application of CFD-optimised components and the combination with efficient cleaning systems, as for example to the patented Coanda injector and the JetBus Controller®, the specific energy demand of a filtering installation can be decreased around up to 30 per cent. Today filters of this design are operated with filter pressure losses around and less than 1000 Pa. Long time experiences in a North German bypass installation have shown that – in combination with PTFE needle felt bags – the differential pressure, which is under 8hPa, is possible for operation with low pressure cleaning in semi off-line mode._

References

1. BDZ – Bundesverband der deutschen Zementindustrie e.V., http://www.bdzement.de/
2. Neuhaus, T, Bai, P, Schrooten, T, Klein, GM: Steigerung der Energieeffizienz in der industriellen Gasreinigung durch optimierte Oberflächenfiltration, Gefahrstoffe – Reinhaltung der Luft 70 (2010), No. 6, pp. 231-236

Table 1: Intensiv-Filter installations

Customer	*Process*	*Filter bags*	*Cleaning System*	*Gas Volume m³/h a.c.*	*Gas Temperature °C*
Lafarge Karsdorfer Zement (Germany)	Kiln bypass with air dilution	4500mm PTFE	online	2 x 65,000	200
Holcim Alsen Zement (Germany)	Kiln bypass with GCT	450mm PTFE	online	150,000	200
Eastern Province Cement (Saudi Arabia)	Kiln bypass	6000mm Glass PTFE membrane	semi-offline	310,000	220
Holcim Lägerdorf, (Germany)	Kiln bypass with GCT	5000mm PTFE	semi-offline	80,000	180
Yamama Cement, Saudi Arabia	Kiln bypass with air dilution	6000mm Glass /PTFE membrane	semi-offline	460,000	240
Castle Cement,Ketton UK (HeidelbergCement)	Kiln bypass with GCT	5625 mm Glass /PTFE membrane	online	107,000	220
Norcem, Norway (HeidelbergCement)	Kiln bypass with air dilution	6000mm PTFE	online	95,000	220
National Cement (Yemen)	Kiln bypass with air dilution	6000mm Glass /PTFE membrane	semi-offline	111,500	200
Ahlia Cement Company, Zliten (Libya)	Kiln bypass with air dilution	6000mm PTFE/PI	semi-offline	82,500	200
National Cement (UAE) – ESP retrofit	Kiln bypass with GCT	6.000mm PTFE/PI	online	80,000	200