Energy-Efficient Bag Filter for Bypass Dedusting

مرشحات قماشية لإزالة غبار الممرات الجانبية مع توفير في الطاقة

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مع الاستخدام المتزايد للوقودات البديلة في عمليات الإسمنت يصبح فصل التدفق من الممر الجانبي عن تدفق غاز العادم الرئيسي ضرورياً لتخفيض المواد الضارة في أقسام المصنع الحاملة للغاز . لذلك يتم تجهيز مصانع الإسمنت الحديثة ، أو تطوير المصانع القائمة ، بمرشح قماشي إضافي للغبار . والمرشحات القماشية ذات كفاءة عالية وأداء آمن ، كما أنها تخفض من تكاليف العمليات في كل وحدة من وحدات المصنع أثناء عملية إنتاج الإسمنت .

Because of the increased use of secondary fuel in the cement process, a separation of a 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 plants get upgraded with 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 one of the further top goals for every operator. Thereof affected are also bypass bag filters.

Introduction

With 26 % of the gross value added, the 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 recourses. Alternatives of secondary fuels are for example used tires, waste oil, commercial and municipal waste (plastic, paper, textile waste, etc.), meat and bone meal or sewage sludge. In 2009, the German cement industry covered 58,4 % of the entire thermal energy requirements by secondary fuel [1].

Care and attention must be paid on non-polluting combustion and a stable and safe kiln operation without any malfunction using secondary fuels. Consequential, the bag filter needs a proper design and filter media and components must be careful selected.

Toxic cycle and reduction of the toxics by bypass-dedusting plant

Alkalis (potassium, sodium) and chlorides, in combination with also sulphur species (measured as masses of % SO_3) inserted into the process by the raw meal, lead to operational disturbances in the production process. Heat exchanger arrangements are concerned by it in particular. Caused by high temperatures in the rotary kiln the chlorides evaporate and condense again in the heat exchanger connected downstream. Therewith they form an internal circulation which leads to an enrichment in the kiln/ heat exchanger system. The volatile components Na_2O, K2O, sulphur and chlorine facilitate the creation of caking in the kiln inlet area and in the riser duct. Additionally, alkalis 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 in clinker. The high 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 down to the required bag filter entry temperature of 150 to 250°C. When cooling by air temperatures are usually adjusted from 220 to 250°C before bag filter. Compared to air cooling, the gas cooling can be carried out by minimum rise of the gas volume (a.c.) 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 Optimized ProJet mega®

The pressure loss of filter medium and attached filter cake has by far the highest part of energy costs that accumulate 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 of the filter cake. Membranes distinguish themselves by their low price, nevertheless, own 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 both filter medium kinds have proved themselves in practice.

The difference pressure is usually used as an input size for a control of the interval and the cleaning pulse. Intensiv-Filter sets, in addition, on a control of the pressure 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®) adjusted to the 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 prevented efficiently. In parallel cleaning in off-line operation can be carried out with a less intensive jet pulse. At this the pressure valve block (compressed air tank capacity) is from 0.1 to 0.4 MPa.

Summary

By carried 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 %. 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 8 hPa, is possible for operation with low pressure cleaning in semi off-line mode.

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

Fig 1. Holcim Lägerdorf – Eco filtering installation with evaporation cooler

Fig.2 Castle Cement, Ketton (HeidelbergCement

Fig.3 Castle Cement, Ketton (HeidelbergCement

Customer	Process	Filter bags	Cleaning System	Gas Volume m³/h a.c.	Gas Temperature °C
Lafarge Karsdorfer Zement, Germany	Kiln Bypass with Air Dilution	4.500 mm PTFE	online	2 x 65.000	200
Holcim Alsen Zement, Germany	Kiln Bypass with GCT	4.500 mm PTFE	online	150.000	200
Eastern Province Cement, Saudi Arabia	Kiln Bypass with Air Dilution	6.000 mm Glass / PTFE membrane	semi-offline	310.000	220
Holcim Lägerdorf, Germany	Kiln Bypass with GCT	5.000 mm PTFE	semi-offline	80.000	180
Yamama Cement, Saudi Arabia	Kiln Bypass with Air Dilution	6.000 mm Glass / PTFE membrane	semi-offline	460.000	240
Castle Cement,Ketton, UK (HeidelbergCement Group)	Kiln Bypass with GCT	5.625 mm Glass / PTFE membrane	online	107.000	220
Norcem, Norway (HeidelbergCement Group)	Kiln Bypass with Air Dilution	6.000mm PTFE	Online	95.000	220
National Cement / Yemen	Kiln Bypass with Air Dilution	6.000 mm Glass / PTFE membrane	semi-offline	111.500	200
Ahlia Cement Company, Zliten, Libya	Kiln Bypass with Air Dilution	6.000 mm PTFE / PI	semi-offline	82.500	200
National Cement, United Arab Emirates (ESP Retrofit)	Kiln Bypass with GCT	6.000 mm PTFE / PI	online	80.000	200