Optimized Cleaning Systems for Industrial Baghouse Filters

FILTECH 2011, Wiesbaden

March 24th 2011

P. Bai, T. Neuhaus, T. Schrooten, G.-M. Klein

Intensiv-Filter GmbH & Co. KG, Velbert-Langenberg, Germany
Optimized Cleaning Systems for Industrial Bag Filters

Agenda

1. Introduction

2. Test conditions

3. Analysis of pressure progression inside filter bag

4. Test results

5. Conclusion

6. ProExpertise
Optimized Cleaning Systems for Industrial Bag Filters

Introduction

Intensiv-Filter at Velbert-Langenberg, Germany

Deutsches Museum

1922

2011

Leadership in industrial dedusting technology for more than 85 years
Optimized Cleaning Systems for Industrial Bag Filters

Introduction

More than 50,000 references all over the world

Process filter, kiln and rawmeal mill dedusting - France

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume flow</strong></td>
<td>1,000,000</td>
<td>m³/h n.c.</td>
</tr>
<tr>
<td><strong>Raw gas conc.</strong></td>
<td>100</td>
<td>g/m³</td>
</tr>
<tr>
<td><strong>Clean gas conc.</strong></td>
<td>&lt; 10</td>
<td>mg/m³ n.c. dry</td>
</tr>
<tr>
<td><strong>Filter area</strong></td>
<td>13,700</td>
<td>m²</td>
</tr>
</tbody>
</table>
Optimized Cleaning Systems for Industrial Bag Filters

Introduction

ProJet mega® PJM 136/36-8000-D
Heidelberg Cement, Cementa Slite, Gotland Sweden
Cement kiln and rawmeal mill dedusting
Turnkey project, 1,225,000 m³/h a.c., $c_{RG} = 300 \ldots 900$ g/m³

During erection (July 2009)  

After hot commissioning (Nov. 2009)
Optimized Cleaning Systems for Industrial Bag Filters

Introduction

Minimizing of energy consumption of baghouse filters

Increased air flow to be dedusted: long bag technology

The jet-pulse cleaning system plays a key role

Direct impact in reducing the pressure drop of the baghouse filter caused by the periodically deposited filter cake on the filter bags

Influence on the fan power and compressed air consumption

The longer the filter bag, the more effectively the cleaning system will work to ensure an over-all dust cake release along the bag length.
A special pressure measurement system was used to determine the efficiency of the cleaning systems for bags up to 12m length.
Optimized Cleaning Systems for Industrial Bag Filters

Introduction

Comparison of different injector systems

a) Hole type nozzle with inlet nozzle
b) Ideal nozzle with inlet nozzle
c) Coanda Injector with inlet nozzle
Test with dust complicates the measurements and compromises the measuring technique.

Tests were performed with a special filter medium and without dust.

Several bags from practice analyzed and the air permeability (DIN EN ISO 9237) measured.

A special filter medium with 5 l/(dm²·min) was selected.

For validating the test, a filter medium with 30 l/(dm²·min) and a steel pipe with 0 l/(dm²·min) were added to the tests.
Optimized Cleaning Systems for Industrial Bag Filters

Test conditions

Test bench

Positioning of transmitter inside bag

Quick response pressure transmitters

Evaluation unit

Software
Optimized Cleaning Systems for Industrial Bag Filters

Analysis of pressure progression inside filter bag

Piezoresistive pressure sensors
Measurement range: -50/50 mbar
Test frequency: 1 ms

pressure profiles during cleaning (Coanda Injector, 0.5 MPa)

Optimized Cleaning Systems for Industrial Baghouse Filters
Optimized Cleaning Systems for Industrial Bag Filters
Analysis of pressure progression inside filter bag

Analysis of the impulse measurement

\[ p_{\text{max}} \text{ [Pa]}: \quad \text{Maximum bag cleaning pressure} \]

\[ p_D \text{ [Pa·s]}: \quad \text{Pressure impulse} \quad (F. Löffler: Staubabscheiden) \]

(Surface integral below the positive part of the bag pressure curve)

\[ p_D = \int_{t_1}^{t_2} p(t) \cdot dt \]
Test results

Maximum excess pressure inside the filter bags $P_{\text{max}}$ [Pa]

- Filter medium with 30 l/(dm$^2$·min)
- Filter medium with 5 l/(dm$^2$·min)
- Steel pipe

Test condition

- Electr. valve opening time: 50 ms
- Operating mode: offline
Optimized Cleaning Systems for Industrial Bag Filters

Test results

Minimum: about 300-400 Pa for limestone (Sievert)

Test condition

<table>
<thead>
<tr>
<th>Test condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electr. valve opening time</td>
<td>50 ms</td>
</tr>
<tr>
<td>Filter medium</td>
<td>5 l/(dm²·min)</td>
</tr>
<tr>
<td>Operating mode</td>
<td>offline</td>
</tr>
</tbody>
</table>
Optimized Cleaning Systems for Industrial Bag Filters

Test results

![Graph showing pressure impulse inside the filter bags $P_D$ [Pa s]]

- 0.1 MPa tank pressure
- 0.2 MPa tank pressure
- 0.3 MPa tank pressure
- 0.5 MPa tank pressure

<table>
<thead>
<tr>
<th>Test condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electr. valve opening time</td>
<td>50 ms</td>
</tr>
<tr>
<td>Filter medium</td>
<td>5 l/(m²·min)</td>
</tr>
<tr>
<td>Operating mode</td>
<td>offline</td>
</tr>
</tbody>
</table>
Optimized Cleaning Systems for Industrial Bag Filters

Test results

Minimum: about 900 - 1000 Pa for limestone (inclusive under pressure of 600 Pa)
Optimized Cleaning Systems for Industrial Bag Filters

Conclusion

• The minimum required tank pressure for an effective dust cake release.
• Bags up to 12 m can be regenerated with the optimized Intensiv-Filter cleaning system for online and offline operation.
• The optimal cleaning pressure must be adapted individually for each application to achieve minimum energy consumption.

Because of several parameters influencing the optimal operating point of a baghouse filter and the cleaning system respectively, a new calculation tool has been developed and introduced onto the market.

ProExpertise
Input of design and operating parameters, e.g. gas volume, raw gas concentration, temperature, cycle time, filter medium, bag length…

Calculation of pressure drop and the energy demand in € of the filter plant.

ProExpertise validated by several filter plants in practice.
Operating costs of a filter plant (without filter bag costs):

![Graph showing optimal operating point and energy saving](image-url)

- **Optimal operating point**
- **Energy saving:** about 70,000 €/a
- **Minimal operating costs**
Thank you for your attention.