Intensiv-Filter GmbH & Co. KG

Optimized Cleaning Systems for Industrial Baghouse Filters

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Optimized Cleaning Systems for Industrial Bag Filters

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2. Test conditions
3. Analysis of pressure progression inside filter bag
4. Test results
5. Conclusion
6. ProExpertise

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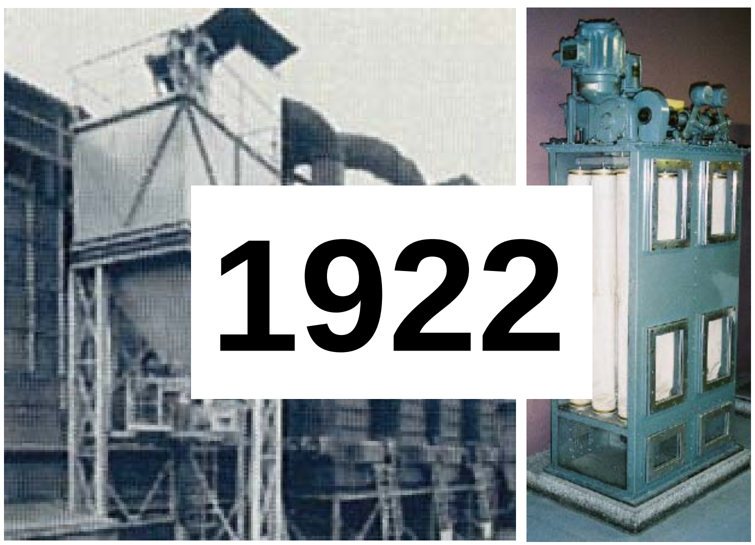
Introduction

Intensiv-Filter at Velbert-Langenberg, Germany

Deutsches Museum



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

Volume flow	1,000,000	m^3/h n.c.
Raw gas conc.	100	g/m^3
Clean gas conc.	< 10	mg/m^3 n.c. dry
Filter area	13,700	m^2

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 m^3/h a.c., c_{RG} = 300 … 900 g/m^3

During erection (July 2009)

After hot commissioning (Nov. 2009)

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Introduction

Minimizing of energy consumption of baghouse filters

Increased air flow to be de-dusted: 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.

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Introduction

Injector type

Inlet nozzle

Tank pressure

Adjustable automatically by the JetBus Controller® of Intensiv-Filter.

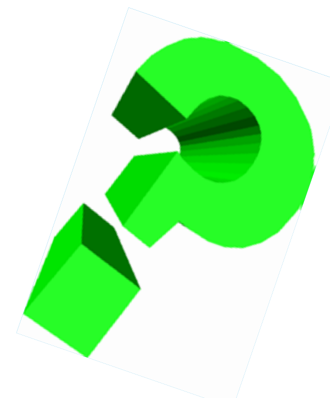
Optimized Cleaning System

Tank volume

Cycle time

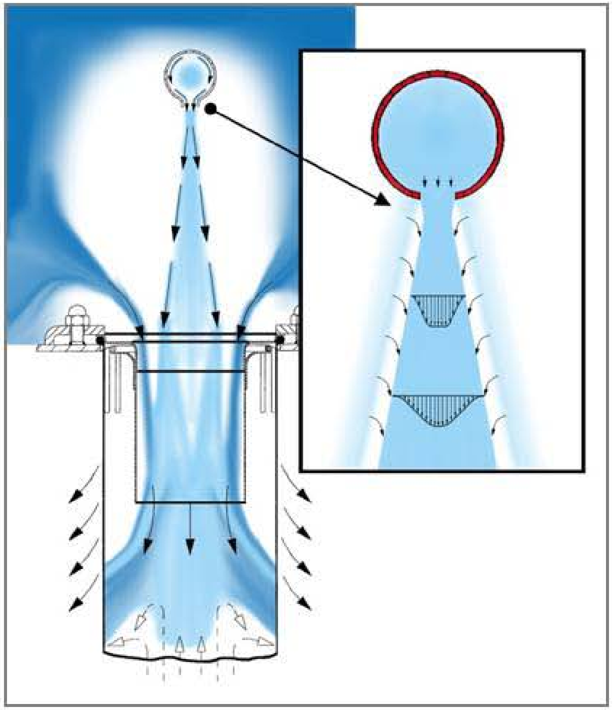
The optimum can be calculated by ProExpertise

Bag length

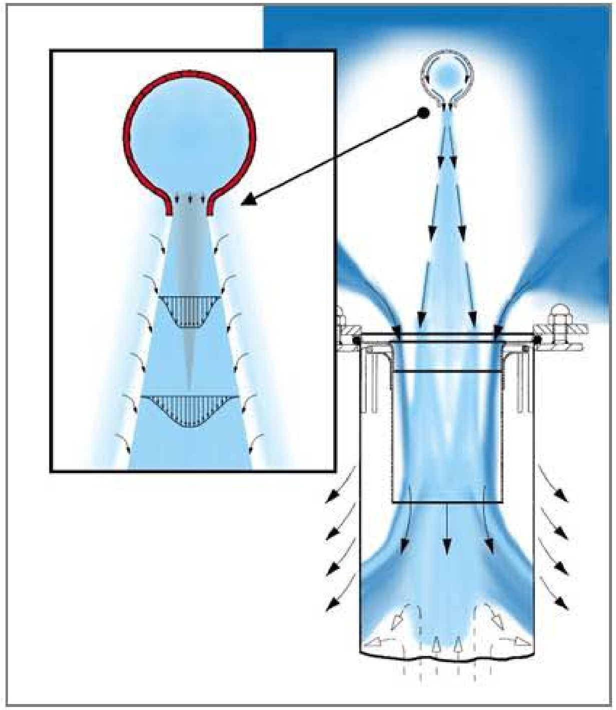


A special pressure measurement system was used to determine the efficiency of the cleaning systems for bags up to 12m length.

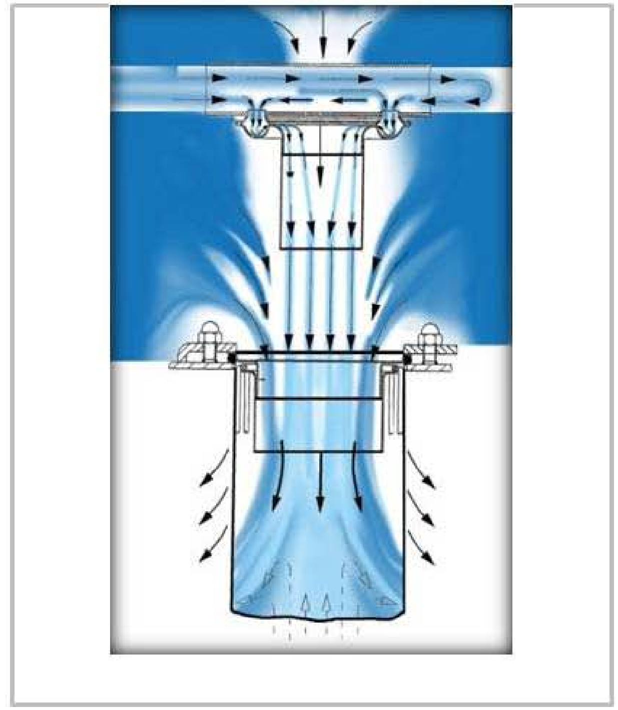
Comparison of different injector systems



a) Hole type nozzle with inlet nozzle



b) Ideal nozzle with inlet nozzle



c) Coanda Injector with inlet nozzle

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Test conditions

- 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

Air permeability [l/(dm²·min)] @ 200 Pa according to DIN EN ISO 9237	
Dust loaded bags before cleaning	**Bags after the jet-pulse cleaning**
4 - 6	10 - 50

➡ 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.

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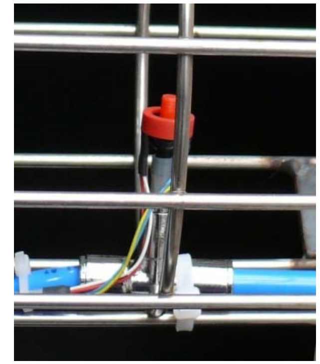
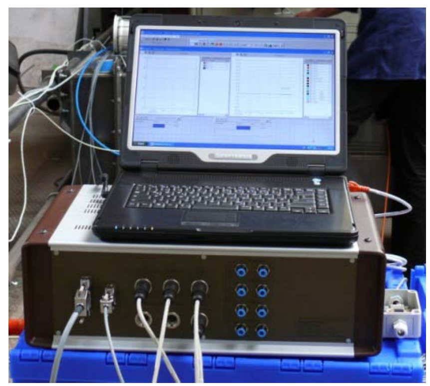
Test conditions

Test bench

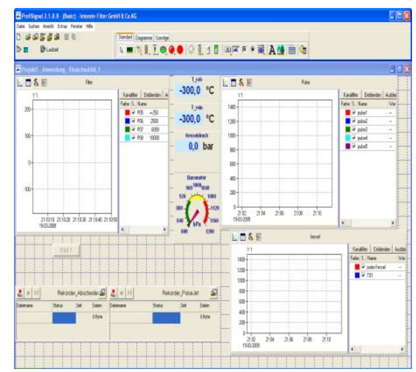
Positioning of transmitter inside bag



Quick response pressure transmitters



Evaluation unit



Software

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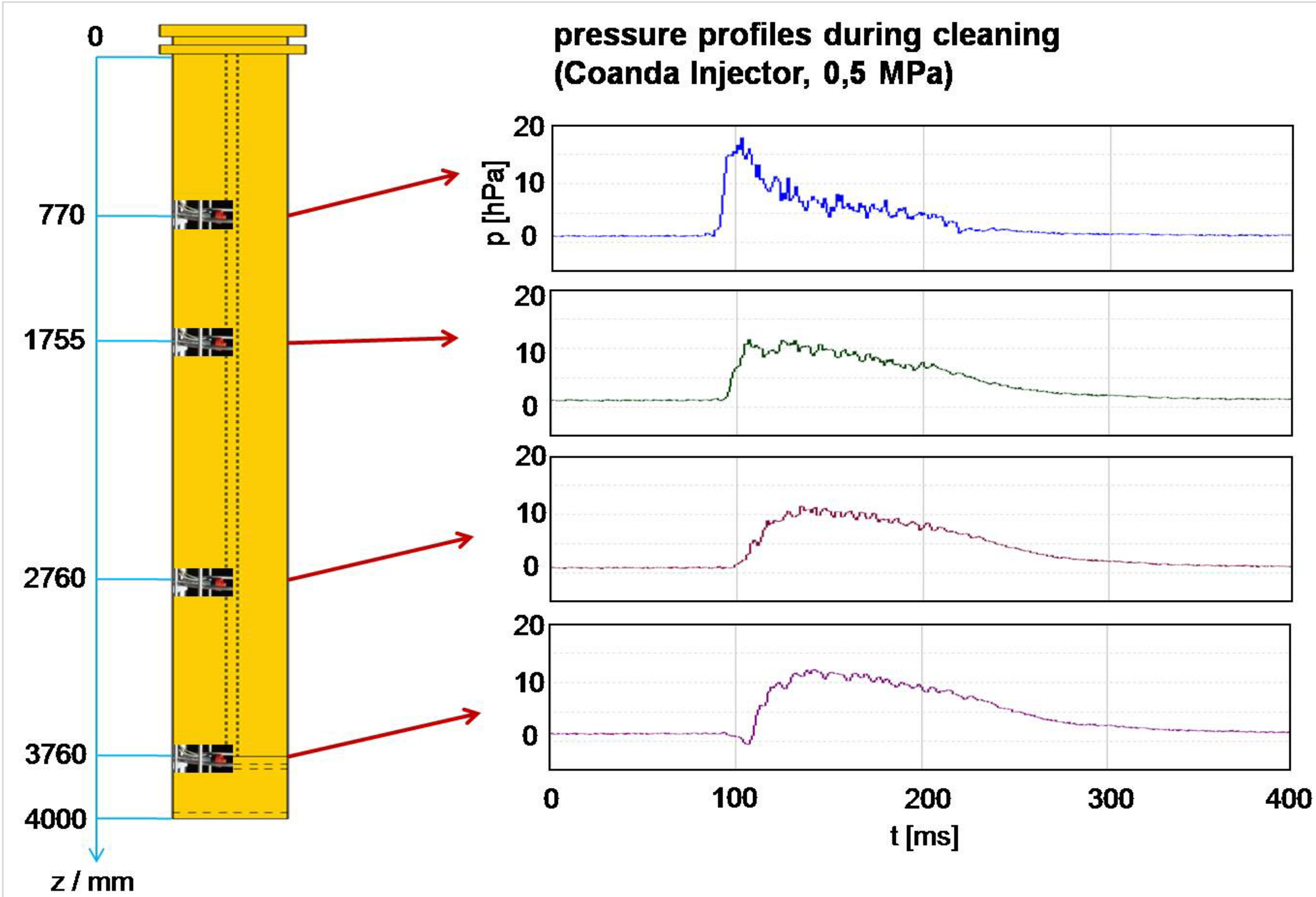
Analysis of pressure progression inside filter bag

Piezoresistive pressure sensors

Measurement range: -50/50 mbar

Test frequency: 1 ms



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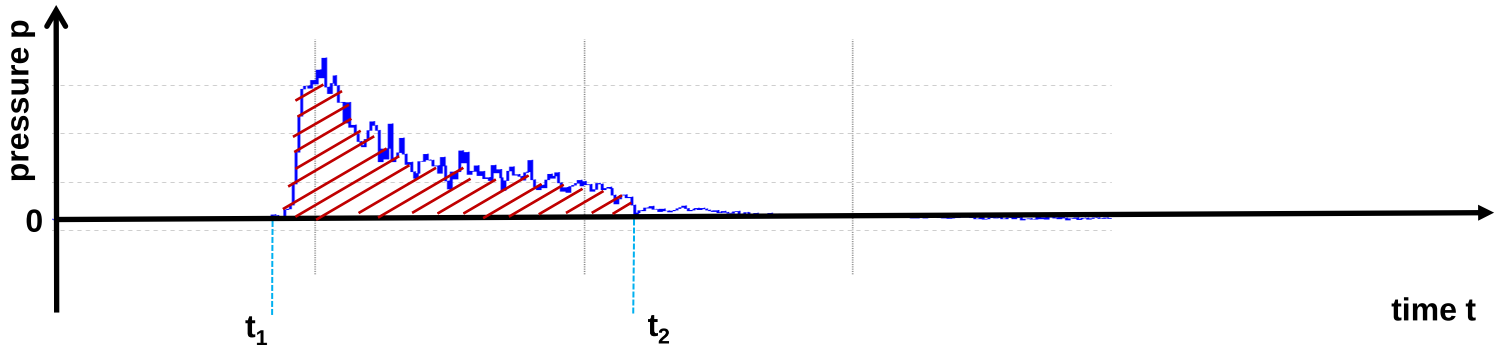
Analysis of pressure progression inside filter bag

Analysis of the impulse measurement



p_{max} [Pa]: **Maximum bag cleaning pressure**

p_D [Pa·s]: **Pressure impulse** (F. Löffler: Staubabscheiden)

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

$$p_D = \int_{t_1}^{t_2} p(t) \cdot dt$$

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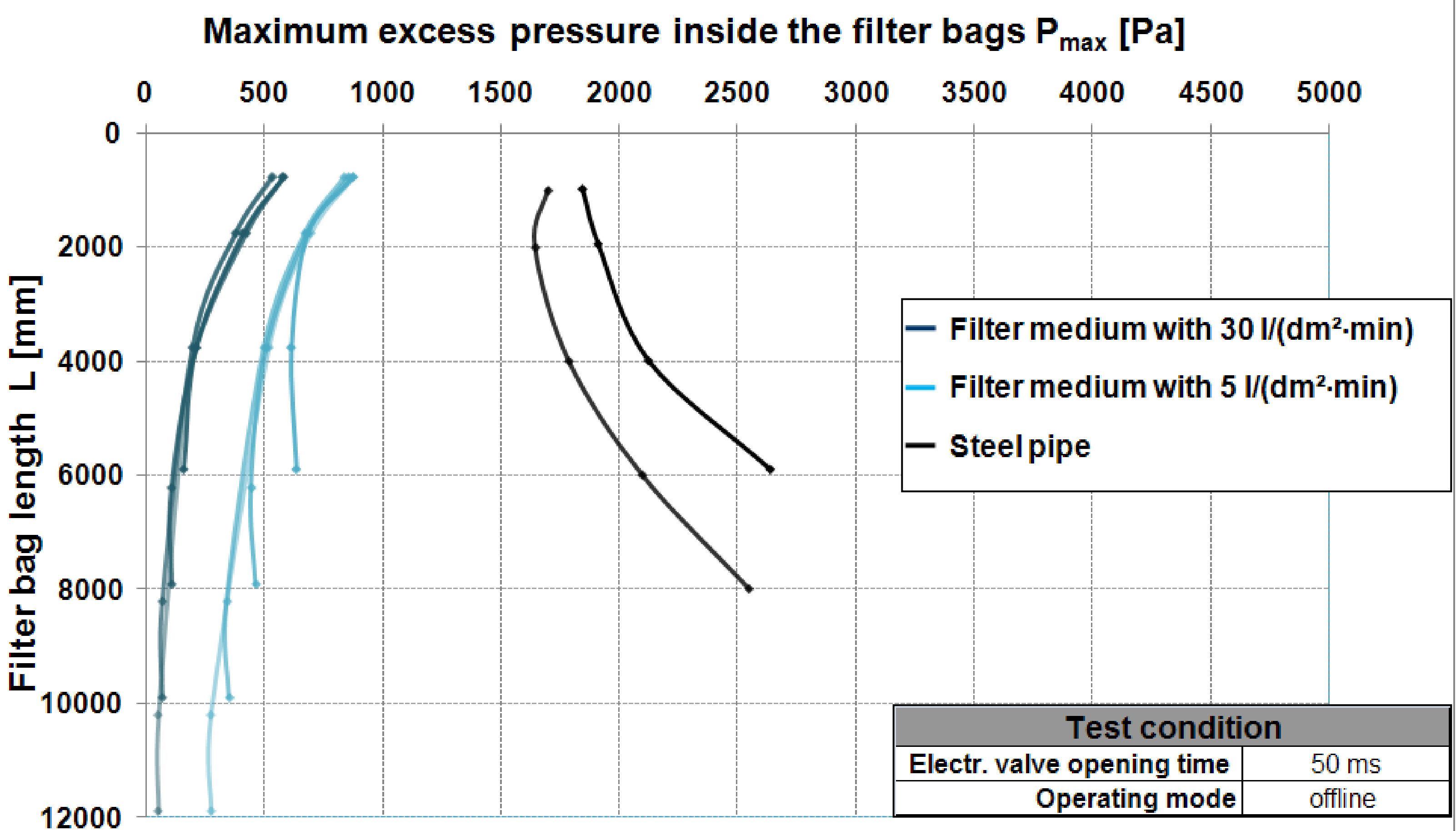
Test results



Test condition	
Electr. valve opening time	50 ms
Operating mode	offline

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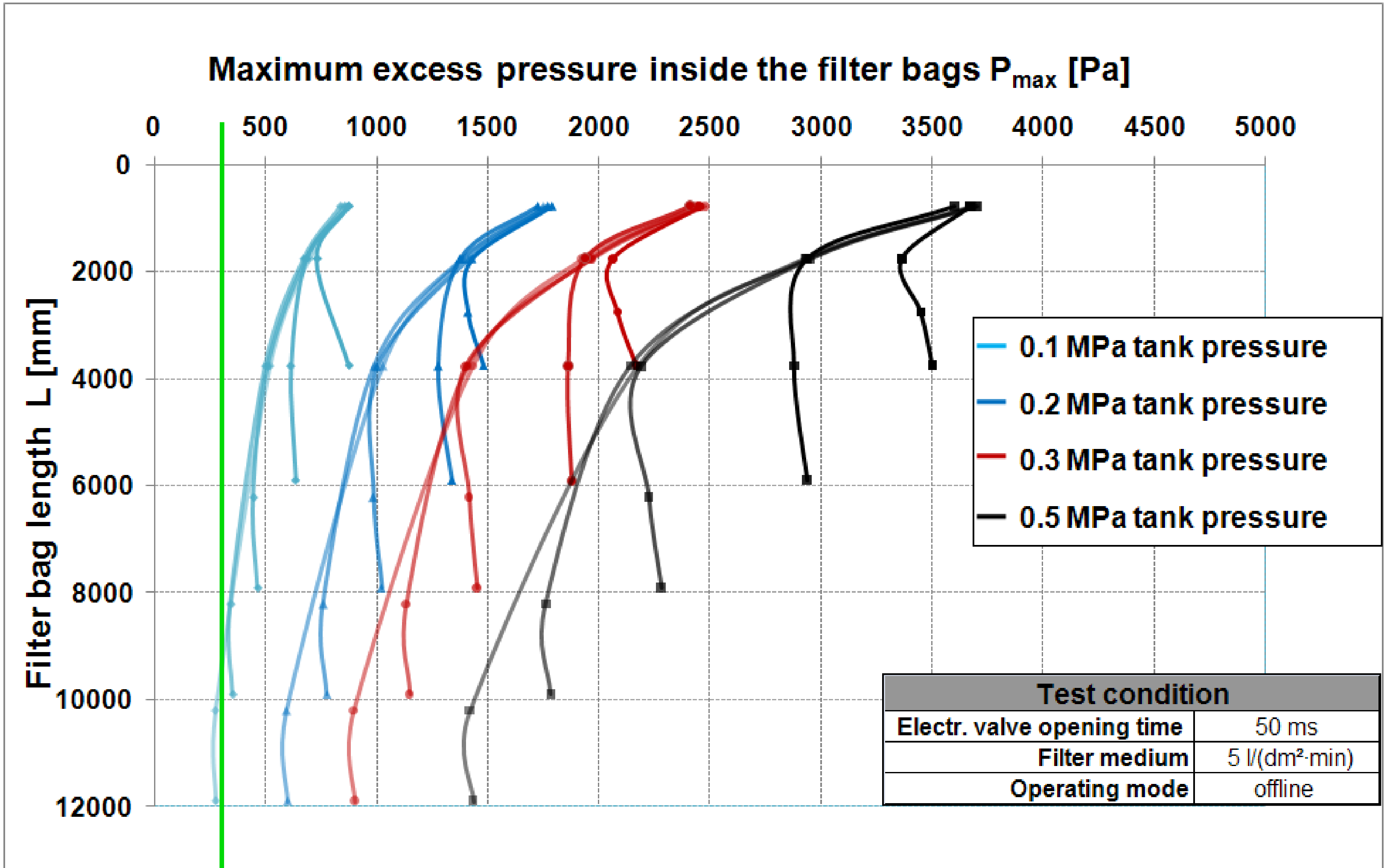
Test results



Test condition	
Electr. valve opening time	50 ms
Filter medium	5 l/(dm²·min)
Operating mode	offline

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

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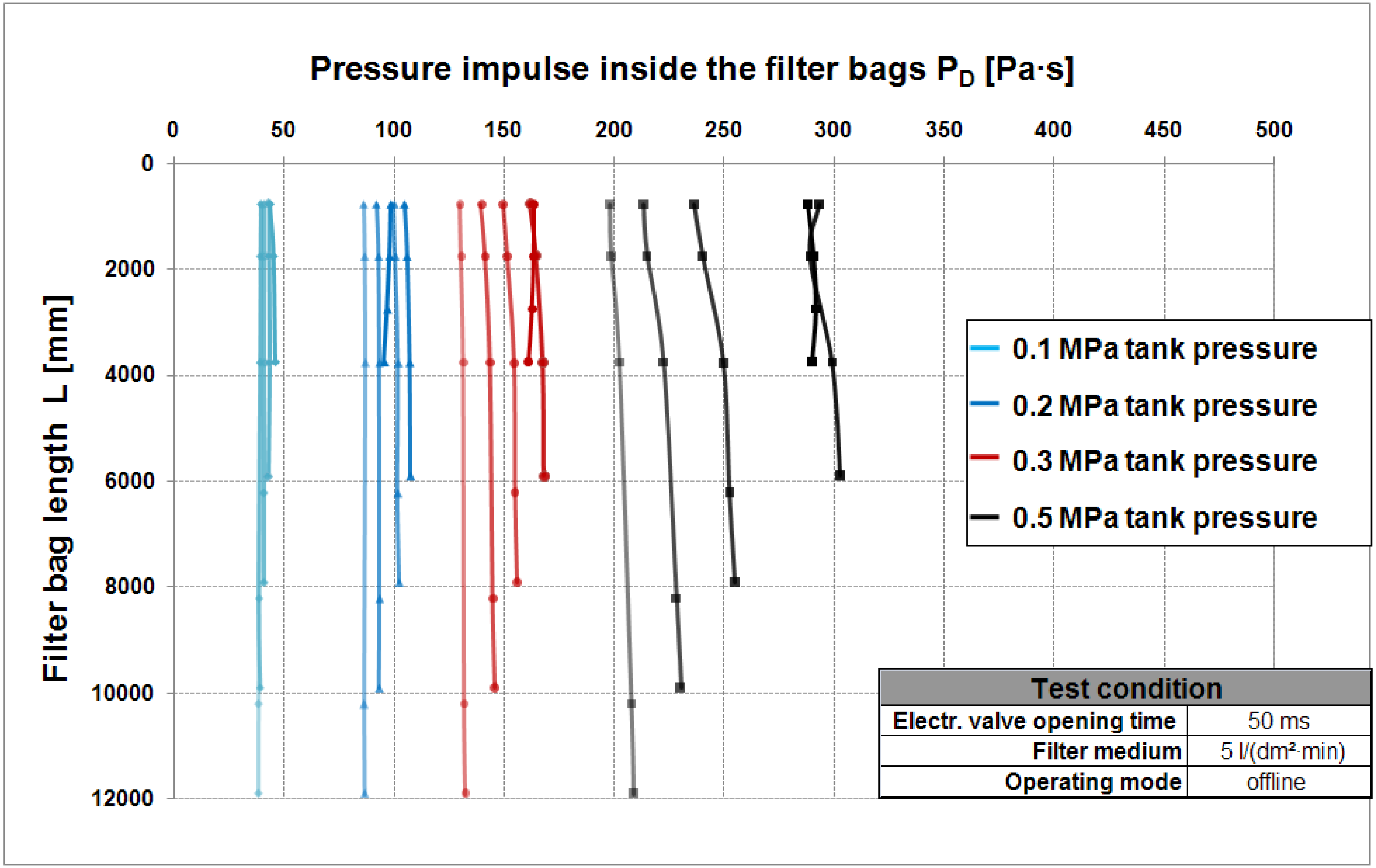
Test results



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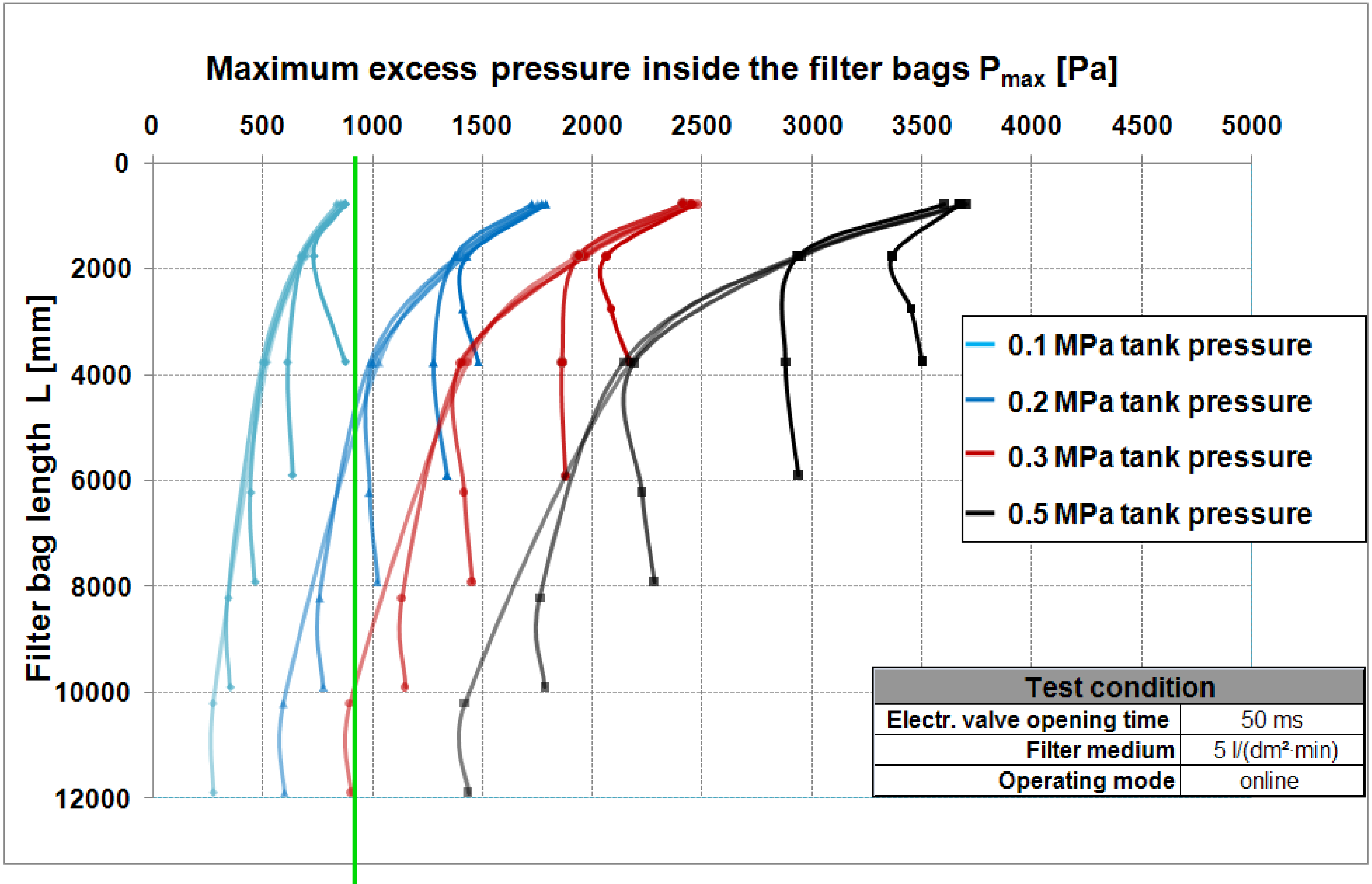
Test results



Minimum: about 900 - 1000 Pa for limestone (inclusive under pressure of 600 Pa)

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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

Optimized Cleaning Systems for Industrial Bag Filters

ProExpertise

ProExpertise

Der optimale Betriebspunkt einer Filteranlage*
The optimum operating point of a filtering installation*

Sprache/Language English Deutsch/ English

Default Values

Type of dust	Raw meal/kiln dust	
Dust concentration [g/m³]	535	
Operating temperature [°C]	125	Input
Volume flow [m³/h] a.c.	830.557	Gross / Calculated
Air-to-cloth ratio [m³/(m²·min)]	0,7	Net
Energy demand for 1 m³ (n.c.) compressed air [kWh/m³]	0,1	
Fan efficiency	0,8	
Annual operating hours [h/a]	8000	
Electricity rate [€/kWh]	0,05	
Filter type	PJM	Input: JC, JN or PJM
Number of bags per chamber	136	
Number of chambers	36	
Number of chambers during cleaning (offline)	2	Input: 0 for Online
Injector type	N	Input: C or N - C = Coanda and N = Nozzle
Filter medium	Membran	Input: Membran, ProTex m-Ar or ProTex PI
Operating mode	Offline	Input: Offline or Online
Bag diameter [m]	0,165	
Bag length [m]	8	
Temperature of compressed air [°C]	20	
Safety factor (leaks and losses)	10%	
Air tank volume [L]	48	
Filter area [m²] (gross)	20303,2	
Filter area [m²] (net)	19175,3	
Number of bags in total	4896	
Number of injectors per injection tube	17	
Number of injection tubes per chamber	8	

Calculation Results

Cycle time [s]	Cleaning pressure [MPa]				
	0,6	0,5	0,4	0,3	0,2
	Average pressure drop (filter bag + filter cake [Pa]				
194	763	769	774	780	809
	Pressure drop (miscellaneous**) [Pa]				
194	320	320	320	320	320
	Total average pressure drop [Pa]				
194	1183	1189	1194	1200	1229
	Compressed air consumption [m³/h n.c.]				
194	1000	868	706	586	377
	Annual energy demand (compressed air + fan) [kWh/a]				
194	3.530.525	3.436.913	3.318.953	3.237.414	3.138.321
	Annual operating costs (compressed air + fan) [€/a]				
194	176.526	171.846	165.948	161.871	156.916

* Estimated operating costs of a baghouse filter plant based on Intensiv-Filter baghouse data.

- 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.

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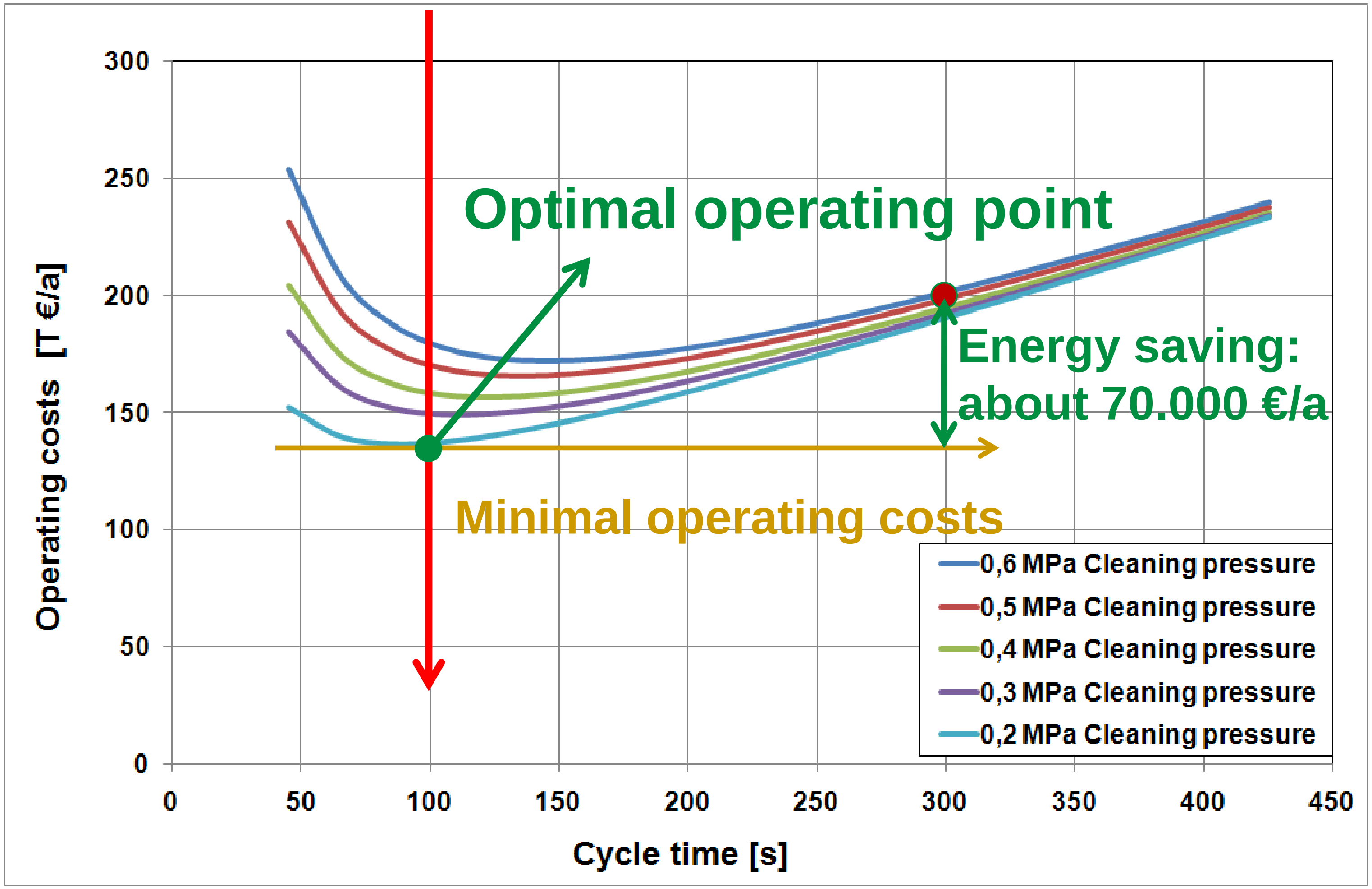
ProExpertise

Operating costs of a filter plant (without filter bag costs):



www.intensiv-filter.com

Thank you for your attention.