Self Cleaning HEPA Filtration In Arduous Environments

ISNATT June 2012

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HEPA Filtration

• Established for many decades as a reliable means of controlling environmental release to a known degree
• Limited in application by chemistry, temperature, solids load and radioactivity
• Results in expensive to dispose of secondary or tertiary waste streams
• A small amount of dust results in a large volume for disposal
HEPA Filtration in Arduous Environments

• Arduous Environments are here defined as
  • High Temperature (400 Celsius max [750 Fahrenheit] in oxidising flows)
  • High solids loads
  • High activity situations
  • Aggressive chemical streams
• 316L stainless filtration media meets all these needs (dependent upon chemical resistance)
• Removes need to dispose of secondary or tertiary waste stream
• Returns to the user the small amount of dust which would otherwise result in a large volume for disposal
Self Cleaning HEPA Filtration

- Pulsed Jet Filter Cleaning will return the collected solids to the user for removal and disposal
- Safe and reliable cleaning mechanism
- Industrially proven
- Systems can be adapted to provide remote maintenance
Self Cleaning HEPA Filtration

- Limited to 400 Celsius [750 Fahrenheit] in Oxidising Environments (up to 500 Celsius [930 Fahrenheit] in reducing atmospheres)
- Substantial DP penalty (possibly as high as 25 mbar [10” W.G] depending on solids load and cleaning cycle time)
- Equipment size and cost can be substantial
- Limited to atmospheres which are 316L compatible.
Pulsed Jet HEPA Filtration

- Will maintain 99.97% + at 0.3 micron release levels in the long term
- Increases the range of applications within reach of direct HEPA filtration (removing the need for scrubbers etc.)
- Can simplify process design
- Dust return mechanism can be designed to meet the specific needs of the user for disposal in a controlled fashion
Pulsed Jet Filter Cleaning

- Cleaning pulse can be 0.25 second or less
- Cleans In-situ
- Doesn’t Interrupt Process flow
- Returns Dust To the User
- Minimising Pressure Loss
- Operates at a stable DP Plateau
- Proven
- Reliable
Pulsed Jet HEPA Filtration Filter Medium (Sintered Metal Fibre)

- Random Laid (Non Woven) Matrix
- Metal Fibres range 1-30um
- Sinter-bonded - No Binders
- Pleatable
- High Porosity 60-80%
Pulsed Jet HEPA Filtration Filter Medium (Sintered Metal Fibre)

Fine Fibre Structure - Surface Filtration

Course Fibre Support Structure

Flow
Pulsed Jet Filtration

Dust Load Test
To Stable ΔP

ΔP / mbar

Time / Seconds

00:00.0 00:43.2 01:26.4 02:09.6 02:52.8 03:36.0 04:19.2 05:02.4 05:45.6 06:28.8

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Δp mbar
Flow m³/hr
Pulse Pressure barg
HEPA Filtration

![Graph showing Dust Load, Pulse, and Blowdown over time and pressure change.](image-url)
Self Cleaning HEPA Filtration Proof of Concept Testing

- Porvair Filtration, building upon its long term experience of Pulsed Jet self cleaning filters in the Nuclear Industry, developed the technology to provide reliable HEPA grade separation in gas streams
- The following is an abstract of some of that work, on test bed Pulsed Jet HEPA filter system at our UK research facility using high dust loading at ~ ambient T&P
- The results noted are at the pilot scale, but we know from our corporate experience that scale up is both possible and reliable
Self Cleaning HEPA Filtration Proof of Concept Test Conditions

- Filter element filtration area - 0.3 m² (3.4 ft²)
- Target efficiency 99.97% @ 0.3 microns (actual DOP tested efficiency 99.992% @ 0.3 microns)
- Test simulant used was Iron Oxide in the range 0 to 5 microns
- Air flow 32.4 m³/hr (19.2 cfm)
- Dust rate 108.5 g/hr
- Clean DP 6.2 mbar [2.5” W.G]
- Initial DP set point to start cleaning cycle 12.1 mbar [4.8” W.G]
- Adjusted DP set point to start cleaning cycle 18.1 mbar [7.3” W.G] (raised to see if increased DP would affect cleanability
- MPPS also measured (see certificates on last slide)
The Test Programme

The rig consisted of:

- Air Flow (Fan and Ducting)
- The Filter Vessel
- The Pulsed Jet Cleaning System
- The Dust Injection System
- Dust Recovery and Measurement
- Instrumentation
- Data Logging
The Results

The Test Programme Proved That Reliable Pulsed Jet, Self Cleaning HEPA Filtration Could Be Achieved Under High Dust load Conditions Using a Fine Test Dust
Evolution of the Stable Regime
Recovery Regime at Higher Initiation Pressure
Conclusions

• Efficiency Tests prove HEPA Efficiency Before and After the Test Programme
• DP data Proves That Stable Long Term Operation is Possible
• Subsequent Work On MPPS Shows Actual Efficiency at MPPS for the Filter Medium is better than 99.98% @ 0.14/0.16 microns
• Work is on-going
• Concept is proven
• Self Cleaning metallic filtration for arduous environments is an industrial reality.
# MPPS

## TEST REPORT

**Performed by:** MicroFilterx  
**Location:** Crawley  
**Date:** 2020-03-04

**Test Method:** EN1822-5 (2005) HEPA filter efficiency with MPPS

**Flow Rate:** 300 L/min

**Conditions:** Temperature: 21.5°C, RH: 35-45%, Barometric Pressure: 973mbar

**Tested Samples:**
- Double-thickness metallic filter discs 30mm diameter
- Tested in a 100mm diameter test chamber

**Data:**

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**Note:** These data relate only to the samples tested. This report may be copied only in its entirety.

**Reference:**
- **Performed by:** CP  
- **Data Location:** CP-01

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