

C R A D A facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY

FILTRATION
PROJECT

PARTICLE DEPOSITION CONTROL TEST RIG

CONTACT POINTS

TECHNICAL:

Paul C. Yue**
Physicist

Office: (304) 285-4062
E-Mail: pyue@fetc.doe.gov

William A. Rogers**
Senior Engineer

Office: (304) 285-4272
E-Mail: wroger@fetc.doe.gov

ADMINISTRATIVE:

R. Diane Manilla**
Technology Transfer
Program Manager

Office: (304) 285-4086
E-Mail: rmanil@fetc.doe.gov

Janice Murphy*
Physical Scientist

Office: (412) 892-4512
E-Mail: murphy@fetc.doe.gov

Lisa Jarr**
Patent Counsel

Office: (304) 285-4555
E-Mail: ljarr@fetc.doe.gov

MAIL ADDRESS:

* U.S. Department of Energy
P.O. Box 10940
626 Cochran's Mill Road
Pittsburgh, PA 15236-0940

** U.S. Department of Energy
P.O. Box 880
3610 Collins Ferry Rd.
Morgantown, WV 26507-0880

Capabilities

FETC is currently conducting a proof-of-concept study to verify a novel way of controlling dust-cake thickness or formation on a candle-filter surface. The concept is being developed to support hot-gas particulate removal. The goal of this study is to explore an alternate method to remove particles from a hot-gas stream, based on centrifugal separation and filtration in support of integrated gasification combined-cycle (IGCC) systems development. The concept provides a means to eliminate or reduce the need for backpulse cleaning of candle filters, currently the method used for filter cleaning.

The test rig consists of a cyclonic cylinder with a candle filter replacing the vortex finder typically used in cylindrical cyclone separators. The cyclonic cylinder is made from 10 cm (4 in.) Carbon-steel pipe for test conditions of 2.17 MPa (300 psig) and 510 °C (950 °F). A particle-loaded gas stream is directed tangentially into the cylinder, where the curvature of the inner wall of the cylinder creates a swirl flow. The centrifugal force of this swirl flow directs larger particles towards the cylinder wall. The filter porosity allows gas to flow through the filter, thereby removing the fines. The fines residing on the candle-filter surface in the form of a filter cake experience a drag force, created by the swirling flow parallel to the filter surface. This drag force is being used to remove particles that do not strongly adhere to the surface. The current setup has an acrylic section that allows visual access. This section can be easily replaced with the carbon-steel section for high-pressure test conditions.

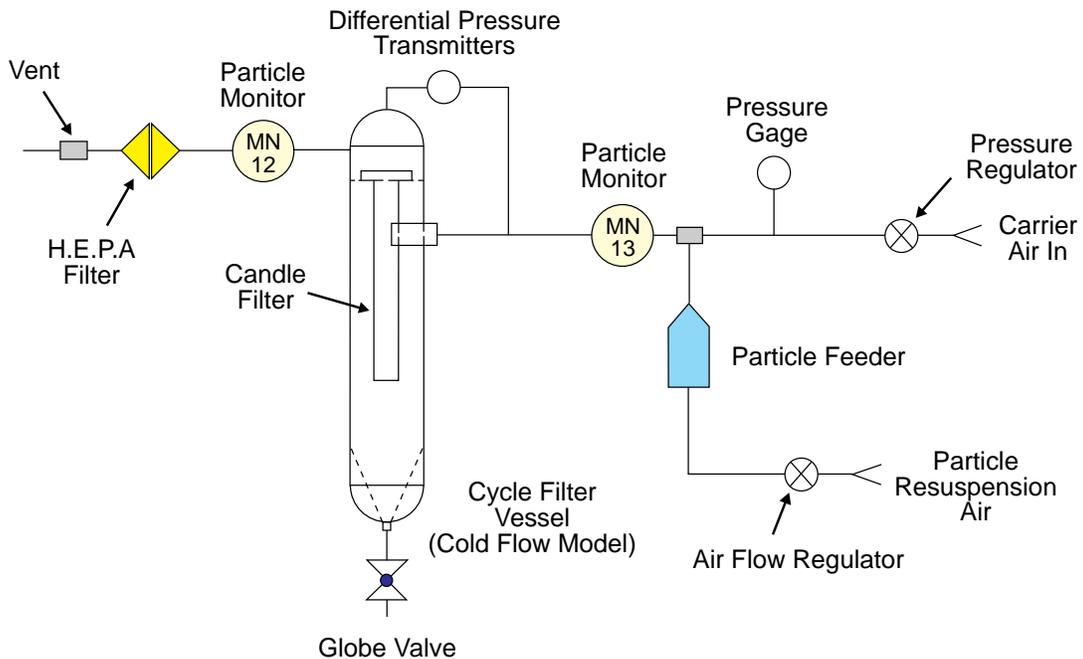
The FLUENT™ commercial Computational Fluid Dynamics (CFD) code (Fluent, Inc., Lebanon, NH) is being used to assist in analyzing fluid and particle flows in the Test Rig. Two- and three-dimensional simulations have been performed to study the interaction of the swirling flow and the candle filter. Flyash particles have been injected into the predicted flow to study trajectories and the coupling of gas and particulate flows. The CFD is being used to assist the design process by simulating various designs for evaluation as candidates for experimental study.

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Opportunities

- Test the effect of particle properties on dust-cake formation.
- Test the effectiveness of backpulse cleaning efficiency.
- Study the re-entrainment effect after each pulse cleaning.
- Assist experimental studies using CFD support, by helping to understand experimental observation and reduce experimental costs.

Particle Deposition Control Test Rig



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