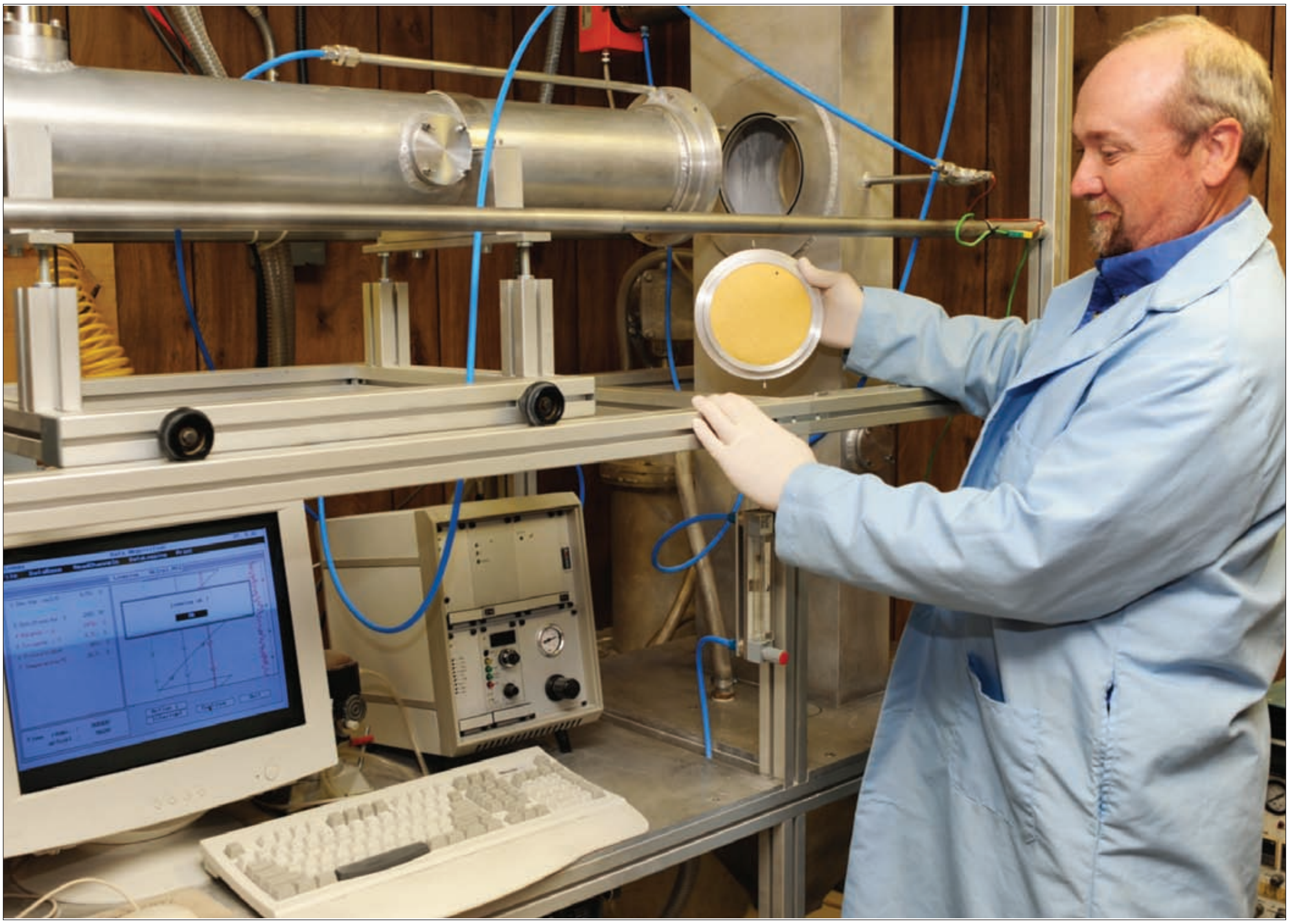
The Impact of PM Legislation on Baghouse Technology

By John D. McKenna, PhD, Christina Clark, and Terry Williamson, ETS, Inc.



ETS Laboratory Manager utilizing the filtration performance test apparatus to measure filter media performance under defined conditions to simulate actual baghouse conditions.

In 2006 the U.S. Environmental Protection Agency (EPA) promulgated a revised PM2.5 particulate standard (see Table 1).[1] In 2011 EPA will again consider revising particulate matter standards on the basis of the most current assessment of the scientific information. In the USA the Clean Air Interstate Replacement (CAIR) Rule (SO_2 and NOx), Regional Haze (SO_2, NOx, PM), and National Ambient Air Quality Standard (NAAQS) Revisions (PM2.5, Ozone, SO_2, NO_2) will probably act to drive total particulate emissions limits to near detection levels. Fabric filters will be one of the more important technologies utilized to achieve the reductions in primary fine particulate emissions. Filter Media testing of filtration performance has shown that "non-detect" particulate emission levels are achievable.

Fabric filter baghouses have been utilized for more than a century to control particulate emissions, and typically the current selection criteria have focused on first cost, operating cost and bag life. The key criteria may well change. The emission control performance, especially fine particle control at very high levels, may become a dominant consideration.

In the early 1990s EPA was persuaded that PM2.5 particles posed sufficient harm to humans and the environment and that more in depth research & development and health studies were needed. Goals and objectives were formulated for obtaining the information and using it to show effects and trends of PM2.5. A significant nationwide reduction in direct PM2.5 from manmade sources was made between 1993 and 2002 (17 percent). This reduction does not account for secondary particles, which typically account for a large percentage of total ambient PM2.5. The secondary particles are principally sulfates, nitrates, and organic carbon.

Table 1

	1997 Standards		2006 Standards	
	Annual	24-hour	Annual	24-hour
$PM_{2.5}$ (Fine)	15 µg/m^3 Annual arithmetic mean, averaged over 3 years	65 µg/m^3 98th percentile, averaged over 3 years	15 µg/m^3 Annual arithmetic mean, averaged over 3 years	35 µg/m^3 98th percentile, averaged over 3 years
PM_{10} (Coarse)	50 µg/m^3 Annual arithmetic mean, averaged over 3 years	150 µg/m^3 Not to be exceeded more than once per year on average over a 3-year period	Revoked	150 µg/m^3 Not to be exceeded more than once per year on average over a 3-year period

EVOLUTION OF TEST METHODS

Environmental Technology Verification (ETV): EPA's ETV program, which was initiated in October 1995, develops testing protocols and verifies the performance of innovative technologies that have the potential to improve protection of human health and the environment. ETV was created to accelerate the entrance of new environmental technologies into the domestic and international marketplace. ETV achieves this goal by generating independent and credible data on the performance of innovative technologies that have the potential to improve protection of public health and the environment.

Air Pollution Control Technology (APCT): The air pollution control area is a focus of the ETV program because it assists vendors and users in demonstrating technologies for air pollution control. Baghouse Filtration Products was proposed as a verification technical area of emphasis within the APCT Center and verifications were initiated in 2000. New fabrics have been developed that offer the combination of highly effective particle removal and low operational pressure drop. Selecting the best fabric for each application requires having reliable and credible performance data.

Baghouse Filtration Products (BFP): The BFP program effort is intended to verify the performance of industrial air filtration control technologies. The ETV APCT Center, operated by RTI International under a cooperative agreement with EPA's National Risk Management Research Laboratory, has, as of April 2010, verified the performance of 24 technologies for reducing emissions of fine particulate matter

Table 2

	EPA/ETV	ASTM	ISO
YEAR	2000	2002	2011
I.D.	BFP	D6830	"11057"
GOAL	Verification of BFP Vendor Claims 2.5 Efficiency P	Product Development End User Suitability 2.5 Efficiency P	Comparison of Operational Performance & Particle Emission
PROTOCOL	EPA	EPA/Modified	ISO
SAMPLE	Vertical Round Disc	Vertical Round Disc	Vertical Round Disc
FILTER FACE VELOCITY	120 m/h	120 m/h[1]	2 m/min.(120 m/h)
DUST (Concentration)	Pural NF 18.4 g/dscm	Pural NF[1] 18.4 g/dscm	Pural NF 5.0 g/m^3
CLEANING	Pulse Jet	Pulse Jet[1]	Pulse Jet

Notes:
1 – ETS, Inc. can modify test conditions such as filter face velocity, user-supplied dust, dust feed rate, reverse air cleaning, etc. to suit the end user's requirements.

(PM2.5). All of the verified products are commercial fabrics used in baghouse emission control devices.[2]

California Rule 1156: California has adopted a rule (Rule 1156) that provides incentives for cement-manufacturing facilities to use the ETV-verified baghouse fabrics to control particulate emissions. By reducing the required compliance testing frequency from annually to every five years, this rule can provide a significant cost savings to users of the verified technologies.[3]

ASTM: ASTM International has adopted the ETV baghouse filtration testing protocol as its standard (ASTM D6830-02 Methods for Characterizing the Pressure Drop and Filtration Performance of Cleanable Filters), promoting standardization and consistency in performance evaluation of these technologies. Since 2002 there have been approximately 350 runs performed at ETS, Inc.

International Standards Organization (ISO): The ISO, a worldwide voluntary standards organization, has also proposed the ETV testing protocol as their standard and it is progressing through the ISO adoption and approval process.

A summary of the evolution of the standard test methods may be found in Table 2. The goal of the ETV BFP project, which started in 2000, was to produce, for the public, credible test reports and verification statements regarding PM2.5 removal by tested baghouse filtration media based on a modified VDI Method 3926, Part 2,

Table 3

Bag Quality Control Program	
◆ **Fabric**	◆ **Bags**
- Construction	- Inspect for general quality of workmanship
- Tensile	- Length as fabricated
- Permeability	- Length under tension
- Mullen Burst	- Cuff to thimble & cap mate
- MIT Flex Endurance	- Cage Fit
- Finish	
- Fabric Thermal Stability (% Shrinkage)	
- Organic Matter (LOI)	
- **Filtration Performance**	
◆ **Thread**	◆ **Hardware**
- Material	- Caps
- Strength	- Rings
	- Bands

"Testing of Filter Media for Cleanable Filters Under Operational Conditions." The idea here was to accelerate market entry of commercial ready filter media by verifying product developer's filtration performance claims. The ETV protocol was then used as a basis for the development of the ASTM Method D6830 in 2002. ASTM D6830 quickly took hold for two reasons. Firstly, it is used as a 2.5 performance test prior to submitting for an EPA ETV verification to assure that the ETV test submission has a high probability of success. Secondly, ASTM D6830 has been widely applied as a performance test for screening and guidance of new filter media development. Since 2002 ISO has been working on a similar method with a possible publication date of March 2011.

The three test methods are very similar in that the filter samples are all vertically mounted round discs with an exposed diameter of 140 mm located at the entrance to a horizontal duct (clean-gas channel), the filtration velocities (G/C) are set at 120 m/h, the test dust is specified as aluminum oxide (calcined alumina) dust (Pural NF or equivalent), and they all specify pulse-jet cleaning mechanisms. One notable difference in the methods is the specification for the inlet dust concentrations. Both the ETV and ASTM methods specify a value of 18.4 g/dscm and are measured continuously with a dust load cell and mass flow controller and can be adjusted throughout the runs. The ISO method, however, specifies a dust concentration presented to the filter of 5 g/m3 and is to be determined gravimetrically prior to each test.

QA/QC PROGRAMS

It is ironic that for decades QA/QC Programs for air pollution control (APC) filter media have not included a filtration performance test. Typically, earlier programs have included permeability and strength tests such as ASTM D737 Permeability[4], ASTM D3786 Mullen Burst[5] and ASTM D5035 Tensile Strength.[6] Today as a consequence of the higher particulate removal and size specific legislation, it is becoming more common to have a much more rigorous QA/QC program, including filtration performance testing as shown in Table 3.

BAG MONITORING

Once the bag set is installed and operating, a bag monitoring program is undertaken. Bag monitoring has as its purpose: 1) To determine the retention of strength and flow characteristics of a bag set with on-stream time, 2) Aid in determining the useful life and scheduling the replacement of a bag set and 3) Provide a tool in assisting the client or his agent in troubleshooting a baghouse.

The monitoring program normally includes permeability and strength. Early on, the MIT Flex Test (ASTM D2176)[7] proved to be the leading indicator of bag failure for woven glass bags; more recently it has also proven to be a valuable early warning tool for P-84 and PPS felts as well. Each program is custom designed in terms of tests conducted as well as frequency and location of bag "pulls." The Bag Monitoring Program is a crucial element and cost saver when it comes to bag replacement timing.

CONCLUSION

ETV/ASTM/ISO Filtration performance testing is a new tool, which provides a major step forward in assuring the ability to achieve fine particle emission control. The ISO test should provide filter/fabric suppliers with a level international playing field. A comprehensive fabric and bag QA/QC program, including filtration performance, can greatly reduce the risk of premature emissions, failure to meet emission performance guarantees as well as code compliance issues and fines. A well planned and executed Bag Monitoring Program can identify when the bag set is approaching "end of life" and exposure to high risk of bag failure. It may not predict the exact timing of the bag set end of life, but it can provide the time frame between premature costly bag replacement and even more costly catastrophic bag set failure.

REFERENCES

1) U.S. Environmental Protection Agency. Integrated Review Plan for the National Ambient Air Quality Standards for Particulate Matter. EPA 452/R-08-004; U.S. Environmental Protection Agency: Research Triangle Park, NC, 2008.
2) U.S. Environmental Protection Agency. Environmental Technology Verification Program, ETV website: www.epa.gov./nrmrl/std/etv/vtapc.html#bfp.
3) Available at South Coast Air Quality Management District, AQMD website: http://aqmd.gov/rules/reg/reg11/r1156.pdf
4) ASTM Method D737: Standard Test Method for Air Permeability of Textile Fabrics. Visit www.astm.org for more information.
5) ASTM Method D3786: Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method. Visit www.astm.org for more information.
6) ASTM Method D5035: Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method). Visit www.astm.org for more information.
7) ASTM Method D2176: Standard Test Method for Folding Endurance of Paper by the M.I.T. Tester. Visit www.astm.org for more information.

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Also included are a comprehensive Technical Manual, Filtration Glossary, and Chemical Resistance Guide.

The catalog is available by calling 1-734-665-8201, or by going to Rosedale's home page, www.rosedaleproducts.com, and clicking the Flash Drive link.