Efficiency and Loading Evaluation of High Efficiency Mist Eliminators (HEME) - 12003

Paxton K. Giffin, Michael S. Parsons, and Charles A. Waggoner
Institute for Clean Energy Technology, Mississippi State University
205 Research Blvd Starkville, MS 39759

ABSTRACT

High efficiency mist eliminators (HEME) are filters primarily used to remove moisture and/or liquid aerosols from an airstream. HEME elements are designed to reduce aerosol and particulate load on primary High Efficiency Particulate Air (HEPA) filters and to have a liquid particle removal efficiency of approximately 99.5% for aerosols down to sub-micron size particulates. The investigation presented here evaluates the loading capacity of the element in the absence of a water spray cleaning system. The theory is that without the cleaning system, the HEME element will suffer rapid buildup of solid aerosols, greatly reducing the particle loading capacity. Evaluation consists of challenging the element with a waste surrogate dry aerosol and di-octyl phthalate (DOP) at varying intervals of differential pressure to examine the filtering efficiency of three different element designs at three different media velocities. Also, the elements are challenged with a liquid waste surrogate using Laskin nozzles and large dispersion nozzles. These tests allow the loading capacity of the unit to be determined and the effectiveness of washing down the interior of the elements to be evaluated.

INTRODUCTION

High efficiency mist eliminators (HEME) are filters primarily used to remove moisture and/or liquid aerosols from an airstream. HEME elements are designed to have a liquid particle removal efficiency of approximately 99.5% for aerosols down to sub-micron size particulates [1]. These elements are used to remove liquid and solid aerosols in an off-gas system. The HEME elements are predicted to have a very high solid particle loading capacity because the units are continuously misted and intermittently flushed with a water spray that reduces particle deposits. The theory is that without the water spray, the HEME filters will suffer rapid buildup of solid aerosols, greatly reducing the particle loading capacity and increasing secondary waste. The following tests are intended to provide data that can be used to evaluate the lifespan of HEME elements as well as the effectiveness of washing down the interior of the elements.

Previous Testing

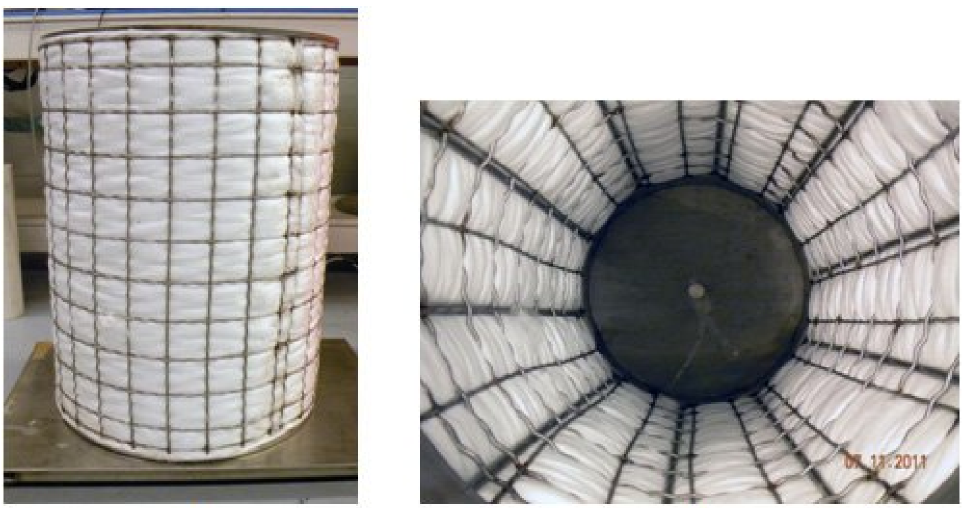
Filtration research at the Institute for Clean Energy Technology (ICET) at Mississippi State University (MSU) began in 2001 with its Department of Energy (DOE) sponsored HEPA Filter Monitoring Project. ICET was established at MSU in 1979 to support DOE's Magnetohydrodynamic (MHD) power program. From its inception, the mission of ICET has been to develop advanced instrumentation and use that instrumentation to characterize processes and equipment. ICET's testing capability, and its ability to rapidly deploy very sophisticated instrumentation in the field, has been an integral component of its success with MHD studies and HEPA filter studies.

The studies with square 0.3 m by 0.3 m by 0.29 m (12 in. by 12 in.by 11.5 in.) HEPA filters based on American Society of Mechanical Engineers (ASME) Code on Nuclear Air and Gas Treatment (AG-1) [2] Section FC have investigated moisture failure, source term loading, seal and pinhole leak tests, and media velocity. Details related to design, construction, and operation of the test stand utilized in these research efforts have been published [3]. Discussions of the experimental design related to these research efforts have been presented at several conferences [4, 5, 6] and published [7]. These discussions include aerosol generation, types of filters tested, and aerosol measurement instrumentation utilized.

Further studies conducted by ICET include lifecycle testing of HEPA filters under ambient and elevated conditions. These tests were conducted on ASME AG-1 Section FK radial flow representative filters with both safe and remote change filter designs. Ambient condition testing was performed at 21.1 to 26.7º C (70 to 80ºF) and 40-60% RH while the elevated condition testing occurred at 54.4º C (130ºF) and 50% RH or greater [8].

Test Stand Capabilities

The two main components of this study include determining the particle loading capacity and filtering efficiency of the HEME elements in the absence of a cleaning system and evaluating the effectiveness of using a water spray to wash-down the interior face of the HEME elements. ICET's small-scale HEPA test stand was retrofitted to facilitate these tests. The HEME design is 0.6 m (24 in.) in length and 0.46 m (18 in.) in outer diameter, with approximately 0.05 m (2 in.) of media thickness. There are three different HEME manufacturers tested at three different media velocities. Figure 1 presents images of the HEME elements while clean, prior to testing.



A B

Fig. 1. Exterior (A), interior (B), and design schematic (C) for the HEME elements.

Testing Deliverables

The study evaluated three different media velocities from three manufacturers for a total of nine elements. The elements underwent testing to determine loading times, filtering efficiency, and total mass loaded for each element. In addition, the effectiveness of the wash-down procedure on the HEME element was monitored at different stages of testing and the final mass was obtained.

TEST STAND

Components

Figure 2 (A) features a photograph of the test stand designed and constructed by ICET for the evaluation of the HEME elements. Design criteria for the test stand include the capabilities to evaluate a single HEME element at media velocities from 3.05 to 7.62 m/min (10 to 25 ft/min) corresponding to a standard flow of 1.67 to 4.16 m^3/min (59 to 147 scfm), to a maximum differential pressure (dP) of 3.73 kPa (15 in. w.c.), and up to 100% relative humidity (RH). The major components of the HEME test stand are identified in Figure 2.

The housing for the HEME elements was constructed in-house by ICET using 0.6m (24in.) stainless steel pipe. The upper and lower sections of the HEME housing are joined by 0.6m (24in.) flanges with a tube sheet secured between them. The HEME element is secured to the tube sheet by the use of all-thread stainless steel rods connecting a steel top plate on the element to the tube sheet. The inset of Figure 2 (B) features a drawing of the tube sheet and top plate without (left) and with (right) a HEME element.

The downstream aerosol measurement section of the test stand, fabricated from 0.15 m (6 in.) PVC pipe, is equipped with three 0.076 m (3 in.) ports for downstream sampling. A 0.3 m by 0.3 m by 0.29 m (12 in. by 12 in. by 11.5 in.) HEPA filter was placed downstream of the HEME element to protect the venturi used for controlling test stand flow rate. A Spencer induced draft fan, an air operated control valve, and a PFS venturi were used to produce test stand flow.

The test plan called for injection of water spray at a rate of 0.45 kg (1 lb) per minute per 28.3 m^3/min (1000 cfm) into the air flow upstream of the HEME element to ensure the relative humidity downstream was approximately 100%. Injection of water spray at these rates was accomplished using an ATI PSL generator (ATI Model TDA-J5) filled with distilled-deionized (DI) water. The PSL generator uses compressed air to produce an aerosol spray and is equipped with a pressure regulator and needle valve to control output. The pressure regulator, output valve, a stopwatch, and a top-loading balance (Mettler-Toledo Model SB32001) were used to adjust the water output to the desired rate. The output was periodically monitored to ensure output equaled desired rate specified in the test plan

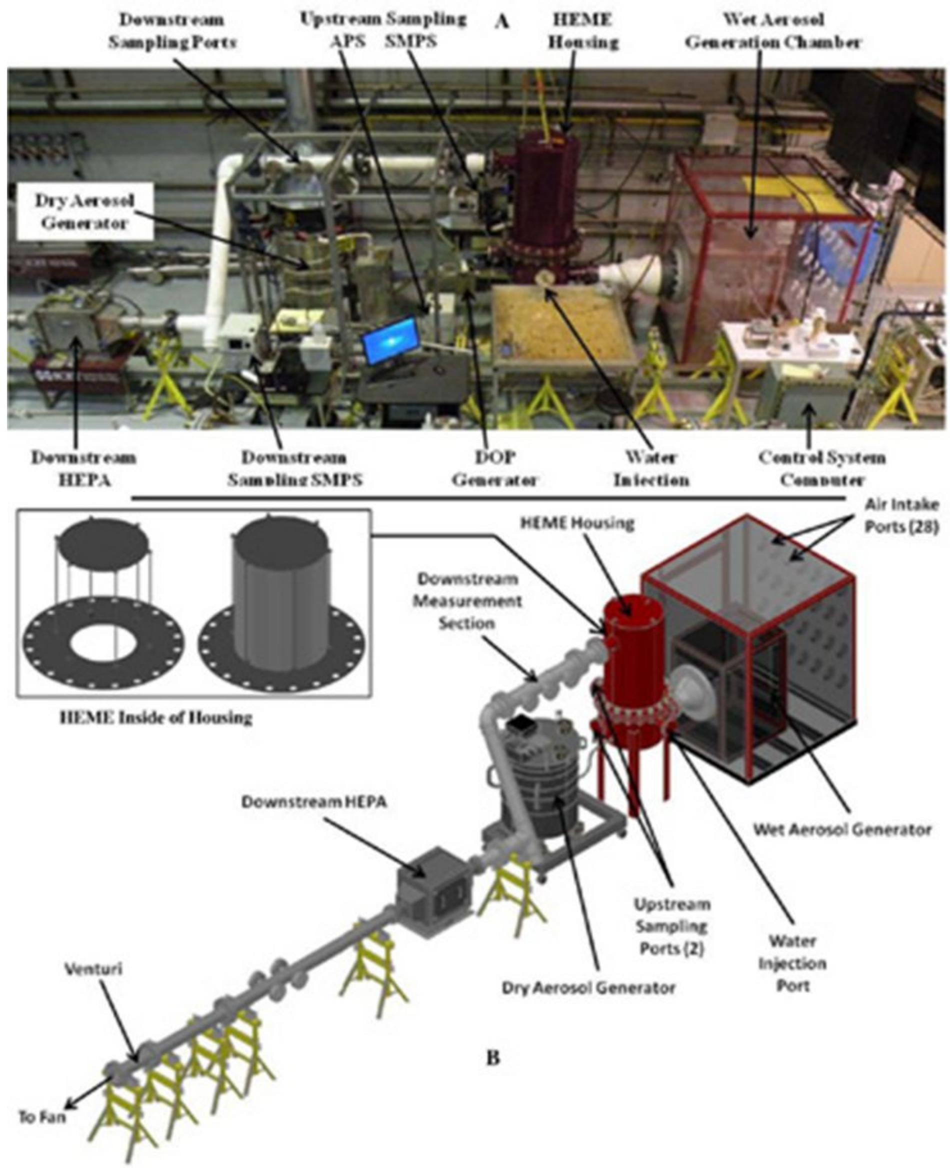


Fig. 2. (A) Picture of the test stand indicating the components, and (B) CAD drawing of the test stand indicating components; part B also includes an inset of a CAD drawing of the HEME inside the housing attached to the tube sheet.

Instrumentation

To determine the filtering efficiency of a HEME element, the element was first challenged with both DOP and a dry aerosol of the representative waste surrogate. Table I lists the particle measurement equipment used to determine the filtering efficiency. scanning mobility particle sizers (SMPS) were used upstream and downstream of the element. An aerodynamic particle sizer (APS) was also used upstream to measure particles greater than 1µm.

Table I. Particle Measurement Instrumentation and Specifications.

Instruments and Methodology	#/cc (min)	#/cc (max)	Particle Size Distribution (µm)
TSI SMPS composed of:	1	$1x10^7$	0.01 - 0.675
TSI Model 3775 CPC			
TSI Model 3080 EC			
TSI Model 3081 DMA			
TSI SMPS composed of:	1	$1x10^7$	0.01 - 0.523
TSI Model 3772 CPC			
TSI Model 3080 EC			
Custom 95cm DMA			
TSI Model 3321 APS	1	$1x10^3$	0.5 – 20

Due to the caustic and humid nature of the waste surrogate, the electrical instrumentation could not be used during loading to determine a mass loading rate. Therefore, two methods were devised by the research team to determine mass loading rate during wet aerosol loading. Sampling was conducted during loading of HEME elements to determine both wet and dry mass loading rates. Two types of miniature sampling train were utilized, inserting probes in the one of the upstream sampling ports.. The first method utilized an EPA Reference Method-5i filter assembly with a glass fiber filter with a standard midget impinger sampling train, while the second method did not include a filter before the sampling train.

Moisture sampling was conducted concurrently with aerosol measurements with the use of three midget impingers in an ice bath for both types of sampling trains. An SKC personal air sampling pump was used to pull the air sample as isokineticly as possible. The pump was calibrated before and after each sample. When yielding different flow rates, a linear change in volumetric flow rate was assumed.

The ICET HEME test stand is fully instrumented with sensors and controls, including upstream and downstream temperature, differential temperature across the HEME, static and differential pressure, and downstream relative humidity. Data from all sensors and controls are continuously logged by a central test stand control computer.

Challenge Aerosol

The test plan called for challenging the HEME elements with aerosols of known particle size distribution representative of those generated during waste tank sparging, particularly with respect to the suspended and dissolved solids content. The working group decided on the surrogate recipe presented in Table II. The surrogate was prepared in a stainless steel 208 L (55 gallon) drum with constant stirring throughout the duration of the HEME testing.

Table II. Composition of the ICET HEME Surrogate.

Component	Chemical Formula	Concentration (g/L)	Amount (g) Required to Make 200 Liters	Total (g)
Sodium Oxalate	$Na_2C_2O_4$	1.9	380	380.0
Aluminum nitrate (60% solution)	$Al(NO_3)_3\text{-}9H_20$	78	15600	15600.0
Sodium Phosphate	$Na_3PO_4\text{-}12H_20$	25	5000	5500.0
Sodum Sulfate	Na_2SO_4	25	5000	5000.0
Sodium Nitrate	$NaNO_3$	104	20800	20800.0
Sodium hydroxide (50% solution)	NaOH	127	25400	25400.0
Sodium Nitrite	$NaNO_2$	35	7000	7000.0
Sodium Carbonate	Na_2CO_3	58.57	11714	11214.0
Alumina				29000.0
Fe (III)				9600.0
Anti-Foaming Agent				80.0

Aerosol Generation Systems

The liquid aerosols used to challenge the HEME elements were created using a wet aerosol generator fabricated by ICET personnel. The generator,displayed in Figure 2, features an outer chamber which serves as a humidification chamber where hot water is produced from an on-demand hot water heater. A series of seven quad-nozzle misting heads spray the hot water as a mist into the chamber. This mist is sprayed onto a plexiglass shield to minimize the quantitiy of water droplets drawn into the inner chamber of the wet aerosol generator. Excess water is removed by a drain in the floor of the outer chamber.

Production of fine aerosol particles was accomplished through the use of Laskin nozzles fabricated by ICET. A total of 24 Laskin nozzles, four sets of six, were utilized. A nozzle set was created by connecting six nozzles to one manifold through which compressed air was supplied. Each nozzle set was placed into a 7.6 L (2 gallon) plastic bucket containing approximately four liters of surrogate. An outlet tube attached to the lid of each bucket directed aerosol output into the inlet of the test stand. Each bucket was equipped with a silicon tube on the outside to serve as a sight glass for monitoring levels of surrogate. When needed, additional surrogate was added to each bucket using variable speed peristaltic pumps. Four buckets were placed in the inner chamber of the wet aerosol generator. Air was supplied to the Laskin nozzles at 275.8 kPa (40 psi).

Large aerosol particles were produced by spraying surrogate directly into the inner chamber of the wet aerosol generator using a nozzle from Spraying Systems Inc. The nozzle was composed of a 1/4J-SS spray nozzle body, PF 1650DF-SS fluid cap, and PA64-SS Air Cap.

As described above, determination of mass loading rates during wet aerosol loading of a HEME element was not possible due to limitations of particle sampling instrumentation. Thus, two filtering efficiencies were measured at each specific differential pressure intervals during the testing. One filtering efficiency measurement was determined using di-octyl phthalate (DOP) as the challenge agent. DOP was generated using an ATI (Air Techniques International) Model

TDA-6C DOP generator. A second measurement was determined by producing a dry aerosol from the HEME surrogate. Details related to the design and operation of the dry aerosol generator have been demonstrated with the previous work on the small scale HEPA test stand [4,5,6,7, and 8].

TESTING PROCEDURE AND MATRIX

The test plan developed by the working group called for testing of nine elements, 3 each from three different manufacturers. Each manufacturer's three elements were evaluated at a different volumetric flow rate. The testing matrix determined by the working group is displayed in Table III.

Table III. HEME Evaluation Test Matrix

Run Number	HEME Element ID	Element Manufacturer	Media Velocity (m/min)	Flow rate (m^3/min)
HEME-AMCO-01	AMCO-01	AMISTCO	4.57	2.49
HEME-CECO-01	CECO-01	CECO Environmental	4.57	2.49
HEME-MECS-01	MECS-01	Monsanto	4.57	2.49
HEME-AMCO-02	AMCO-02	AMISTCO	7.62	4.16
HEME-CECO-02	CECO-02	CECO Environmental	7.62	4.16
HEME-MECS-02	MECS-02	Monsanto	7.62	4.16
HEME-AMCO-03	AMCO-03	AMISTCO	3.05	1.67
HEME-CECO-03	CECO-03	CECO Environmental	3.05	1.67
HEME-MECS-03	MECS-03	Monsanto	4.57	2.49 (Washdown)

RESULTS

Representative for each Element

A large number of data were collected from both the particle measurement instrumentation and the test stand control system during the process of testing each filter. These data include:

Entire Test:

- Intermittent Mass Loading Information
- Test Flow Rate
- Test Relative Humidity
- Test Temperature
- HEME Differential Pressure
- HEME Differential Temperature

During FE Measurement Intervals:

- Upstream Particle Size Distribution and Concentration
- Downstream Particle Size Distribution and Concentration

The representative results below are from a test on the HEME element manufactured by AMISTCO, Inc. tested at 2.49 m^3/min (88 cfm), represented in this study as AMCO-1.

Testing Summary for HEME AMCO-1

The HEME element AMCO-1 was challenged at a media velocity of 4.57 m/min (15 ft/min) which equates to 2.49 m^3/min (88 cfm). The testing took place from July 11, 2011 to July 12, 2011. The intervals to examine the filtering efficiency were taken at 1.25, 2.25, 3, and 3.75 kPa (5, 9, 12, and 15 in. w.c.) of differential pressure across the HEME element. Figure 3 (A) examines the differential pressure and temperature across the HEME element as a function of time.

Figure 3 (B) illustrates the testing condiditons as the element was tested. This figure also displays a relatively stable volumetric flow rate of 2.49 m3/min (88 cfm) mark and relative humidity staying within 90 to 100%. The drops in the RH and temperature in Figure 3 (B) correspond to the times at which the intermittent FE is collected and are due to the discontinued water spray during those times.

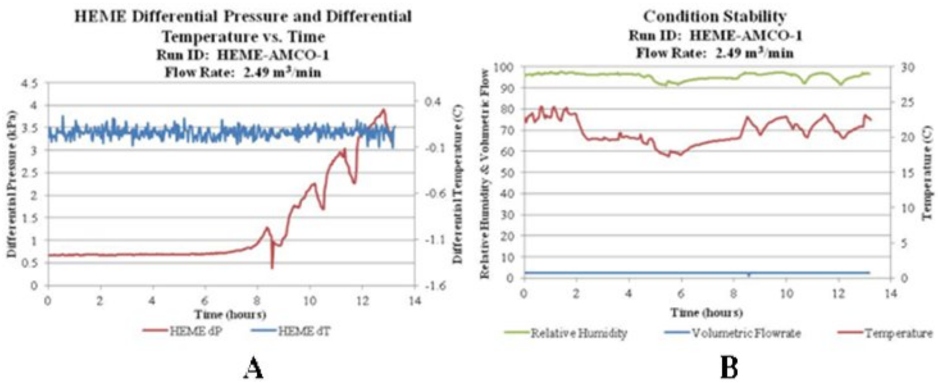


Fig. 3. (A) HEME differential pressure and differential temperature versus time, (B) condition stability versus time

FE Measurements

Particle measurements were made to determine the HEME filtering efficiency using a dry aerosol challenge at different intervals of differential pressure during the loading process. In order to make these measurements, the water spray had to be discontinued,causing the RH to begin dropping. To prevent excessive water evaporation, the efficiency measurements were made as quickly as possible, usually on the order of 15 minutes or less.

Figure 4 (A) depicts the upstream and downstream particle size distribution (PSD) as well as filtering efficiency versus particle diameter, commonly referred to as the penetration curve, for the DOP challenge. These parameters are plotted at different intervals of loading. The initial two points are for the pre-loaded HEME, one clean and dry, the other clean but wetted. The HEME is said to be wetted when the relative humidity reaches either 99% or is 95% and experiences zero change for a significant period of time. The penetration curve displayed in Figure 4 (A) shows 99% or greater efficiency for particle with a diameter more than 100 nm.

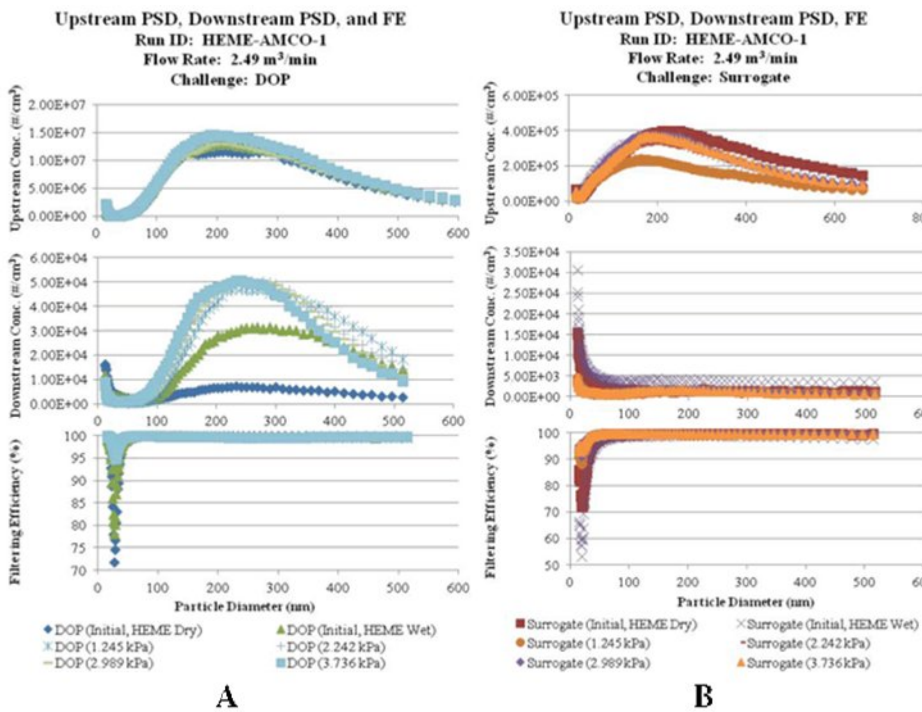


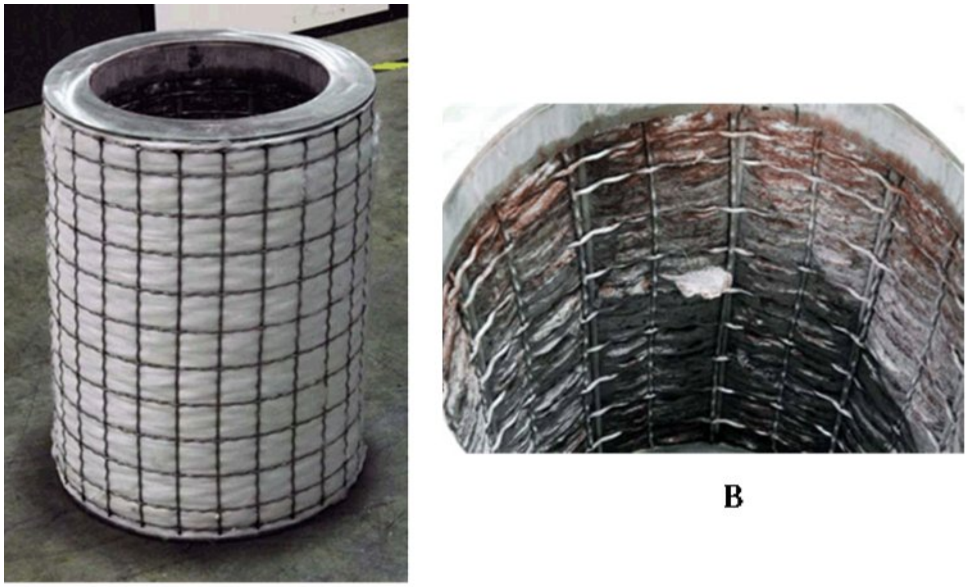
Fig. 4. Upstream PSD, downstream PSD, and filtering efficiency for HEME-AMCO-1 while challenging with (A) DOP and (B) Dry Surrogate

The count median diameter (CMD) and geometric standard deviation (GSD) should be considered when examining an aerosol stream. The downstream GSD is a strong indicator of a filter media leak. The upstream CMD was approximately 200 nm and the upstream GSD was 1.8, the downstream CMD was 225 nm and the downstream GSD was 2.

The second challenge aerosol used to determine filtering efficiency is a dry version of the wet waste surrogate mixture. Figure 6 (B) illustrates the upstream and downstream particle size distribution (PSD) as well as the filtering efficiency versus particle diameter for the surrogate challenge. The upstream CMD for the surrogate was approximately 175 nm and the upstream GSD was around 2.2. The downstream CMD for the Surrogate was 60 nm and the downstream GSD was 3.3.

Images

Figure 5 displays images of the HEME element, exterior (A) and interior (B), after testing. The interior image has a reddish hue caused by the iron content in the undisolved solids portion of the waste surrogate.



B

A

Fig. 5. (A) Exterior and (B) interior of a loaded HEME element

Results Comparison

Filtering Efficiencies

As previously stated, HEME elements must have a filtering efficiency of at least 99.5% for particles larger than 1 μm. The majority of filtering efficiency results from this study present the filtering efficiency for all measured particle diameters, and also for those particle diameters greater than 50 nm.There was a significant drop in downstream particle concentration for diameters greater than 50 nm, as illustrated in Figure 4. Table IV displays the filtering efficiencies for all elements tested.

Table IV. Filtering Efficiencies for All Elements Tested.

		Filtering Efficiency (%)			
		DOP		Surrogate	
Filter ID :	Flow Rate	All Diameters	Diameters > 50 nm	All Diameters	Diameters > 50 nm
AMCO-1	2.49 m^3/min	98.7	99.8	96.4	99.31
AMCO-2	2.49 m^3/min	93	96.8	90.3	95.6
AMCO-3	2.49 m^3/min	96.4	99.8	92	98.4
CECO-1	4.16 m^3/min	98.3	99.8	96.9	99.2
CECO-2	4.16 m^3/min	97.4	98.8	93	97.8
CECO-3	4.16 m^3/min	98.9	99.3	98.1	99.1
MECS-1	1.67 m^3/min	98.8	99.8	95.7	99.1
MECS-2	1.67 m^3/min	92.8	99.5	81	92.3

Loading Capacities

Figure 6 indicates the differential pressure versus time for all HEME elements tested. For each element, the loading process was stopped at predetermined intervals of differential pressure.

These intervals were evenly spaced based on manufacturer and flow rate. Representative drops in differential pressure at points in the loading process are illustrated in Figure 6. These drops are indicative of a halt in loading to perform filtering efficiency evaluations. Figure 6 (A-C) presents the differential pressure versus time curves for the elements grouped according to their test flow rates. These figures indicate that the AMCO elements typically take longer to load, generally have a flatter slope, and can be operated in a system longer before requiring change out. Figure 6 (D-F) displays the differential pressure versus time curves for all the elements tested grouped according to their manufacturer. It is evident from Figure 6 (D-F) that, typically, the lower the flow rate, the longer it takes the filter to rise in differential pressure. Despite this, it is important to note that when the rise in differential pressure begins, the slopes of the rise for each element are similar.

Table V displays the loading times for all the HEME elements. The table confirms that lower flow rates usually take the HEME element longer to reach a differential pressure of 3.736 kPa (15 in. w.c.). Table V examines only the time for when the system was loading.

Table V. HEME Loading Times.

	Loading Times (hr)		
Filter Manufacturer:	1.67 m^3/min	2.49 m^3/min	4.16 m^3/min
AMCO	6.88	6.06	4.81
CECO	8.08	6.68	5.47
MECS	N/A	2.23	2.56

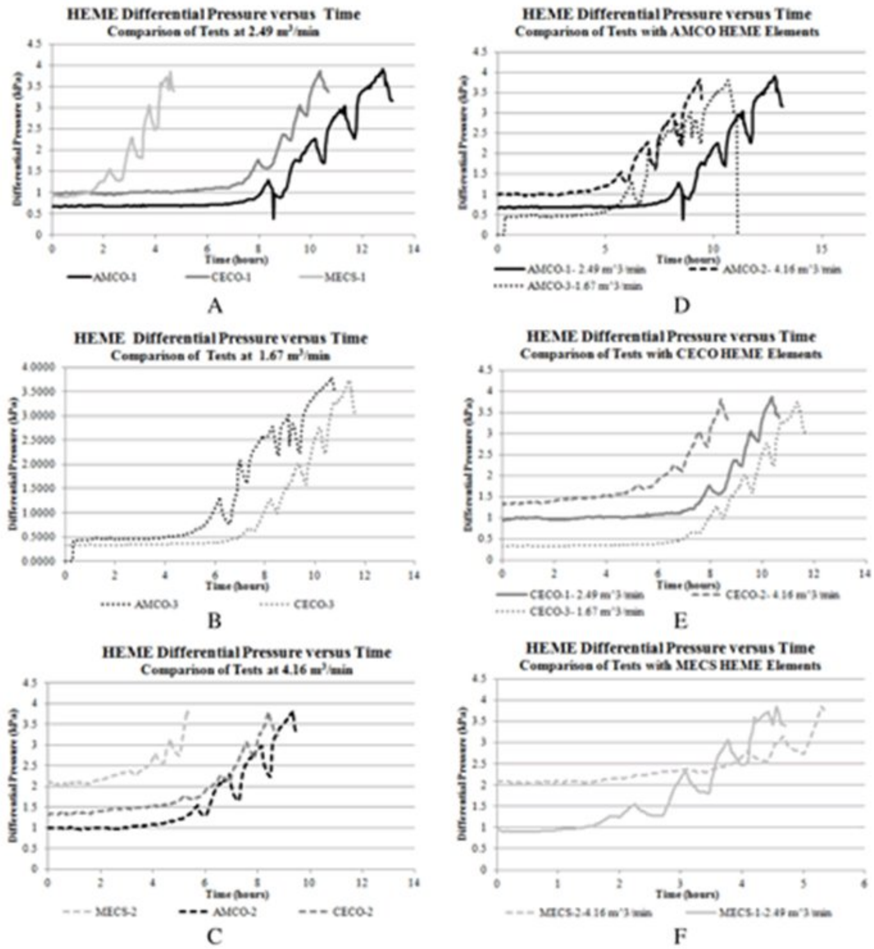


Fig. 6. HEME differential pressure versus time grouped according to test flow rate (A-C) and element manufacturer (D - F).

The dry aerosol mass concentration was for all tests averaged at 340 mg/m^3, which for 2.49 m^3/min (88 cfm) yields a mass loading rate of 837 mg/min (.1 lb/hr).When the HEME element reached a differential pressure of 3.736 kPa (15 in. w.c.) the test stand air flow was shut off and the HEME element removed. Following removal, the element was weighed while still wet, then dried in an oven for a minimum of 24 hours at 90ºC. Finally, the element was weighed again to obtain a final dry mass and total mass loaded. Table VI presents the mass gained for all the HEME elements tested.

Table VI. Final Dry Mass of HEME Elements

	Mass Gained		
Filter Manufacturer:	1.67 m^3/min	2.49 m^3/min	4.16 m^3/min
AMCO	0.9	1.6	1.5
CECO	1.3	1.5	1.2
MECS	N/A	0.7	0.6

HEME Wash-Down Test

The HEME wash-down test consisted of two phases, but the entire wash-down testing was only performed on one HEME element. The first test determined how the HEME element reacts to water spray while the element is clean. Thesecond test consisted of washing the element at different intervals of loading. It was observed during the initial phase of testing that water alone can cause the HEME differential pressure to rise, which must be taken into account when determining the possible success of a washdown. From the initial tests it was seen that the HEME should only be washed for 30 seconds at 68.9 kPa (10 psi) from a nozzle design that sprays a total of 5.3 L (1.4 gallons) of water during that time.

The filtering efficiency of the HEME element varied significantly during testing. Figure 7 illustrates the total filtering efficiency as it changed throughout the HEME wash-down testing. No overall trends were observed in the filtering efficiency over the course of the wash-down testing. The research team expected to see a representative drop in filtering efficiency after each washing as the media structure would degrade, however no appreciable drop in filtering efficiency was observed during these testing activities.

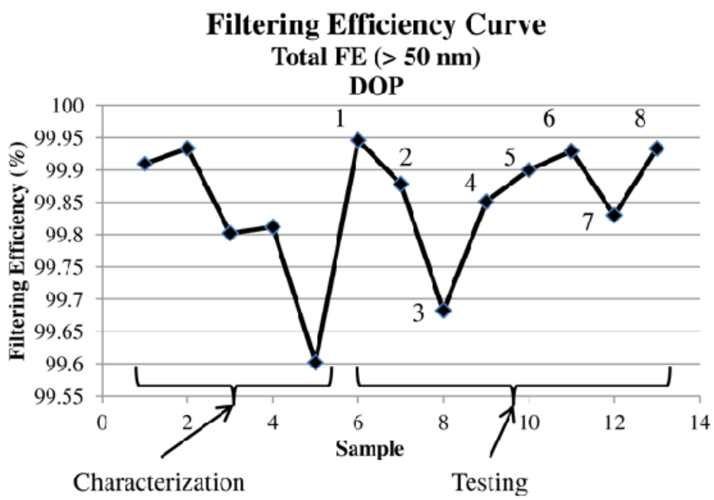


Fig. 7. Total filtering efficiency throughout the HEME wash-down testing

Table VII indicates the points at which filtering efficiency data were gathered. Point 1 represents the initial filtering efficiency measurement made before loading had begun. Points 2 through 6 represent measurements made the day after the loading and wash-down activities took place. After the HEME was washed, a fan was operated overnight to allow the element to dry. The next day the water spray was initiated to raise the humidity to 99%, or a stable high humidity greater than 90%, and then the FE was determined. This allowed the FE measurements for points 2 through 6 to be comparable, as they were all taken when the HEME was ‘wetted.’ Point 7 was recorded immediately after the wash-down was performed to determine if water droplets could be observed downstream of the element. Lastly, point 8 measurements were collected in the same manner as points 2 through 6.

Table VII. Description of the Filtering Efficiency Points for the HEME Wash-down Testing

#	Description
1	Initial, before loading, filtering efficiency
2	Post first 0.25 kPa (1 in. w.c.) loading and wash-down filtering efficiency
3	Post second 0.25 kPa (1 in. w.c.) loading and wash-down filtering efficiency
4	Post 0.75 kPa (3 in. w.c.) loading and wash-down filtering efficiency
5	Post 1.5 kPa (6 in. w.c.) loading and wash-down filtering efficiency
6	Post first 3.74 kPa (15 in. w.c.) loading and wash-down filtering efficiency
7	Immediately post second 3.74 kPa (15 in. w.c.) loading and wash-down filtering efficiency
8	Next day post second 3.74 kPa (15 in. w.c.) loading and wash-down filtering effcieincy

Table VIII summarizes the results of the six loading/wash-down tests conducted by the ICET personnel. The next day wetted differential pressure was close to the initial wet differential pressure, indicating a successful wash-down operation. However, concern remains that some of the loading was just water driven off by the drying, and not the washing of the HEME. The initial mass for this testing was 27.0 kg (59.6 lb) and the final dried mass was 27.7 kg (61.1 lb), an increase of 0.68 kg (1.5 lb). That mass was loaded over a time of 463 minutes.

Table VIII. Results Summary for Wash-Down Testing of HEME-MECS-3

Load #	Date (Load)	Change in dP	Initial Wet dP	Final Wet dP	Time	Next Day Wetted dP	Initial FE	Final FE
1	10/12/2011	0.259 kPa	1.084 kPa	1.343 kPa	76 min	1.258 kPa	99.95%	99.88%
2	10/13/2011	0.249 kPa	1.245 kPa	1.495 kPa	50 min	1.240 kPa	99.88%	99.68%
3	10/17/2011	0.757 kPa	1.238 kPa	1.995 kPa	70 min	1.188 kPa	99.68%	99.85%
4	10/18/2011	1.495 kPa	1.146 kPa	2.640 kPa	73 min	1.238 kPa	99.85%	99.90%
5	10/19/2011	to 3.736 kPa	1.233 kPa	3.786 kPa	134 min	1.250 kPa	99.90%	99.93%
6	10/20/2011	to 3.736 kPa	1.245 kPa	3.736 kPa	64 min	1.288 kPa	99.93%	99.93%

CONCLUSIONS

The results of this study reveal that the AMCO and CECO elements perform very similarly to each other with regards to the total mass loaded, while the MECS falls behind. The CECO elements appear to perform better than the others with regards to filtering efficiency, but the variability in the results requires further testing to confirm. The wash-down testing revealed that, after the wash-down and overnight drying with a fan at a rated flow rate (88 cfm), the differential pressure across the HEME element would return to a lower value close to the original pre-loading value. This suggests that the wash-down procedure does remove particulate matter.

ACKNOWLEDGEMENTS

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PROJECT TEAM

The Institute for Clean Energy Technology (ICET) at Mississippi State University (MSU) was established in 1979 to support the Department of Energy's (DOE) Magnetohydrodynamic (MHD) power program. From its inception, the mission of ICET has been to develop advanced instrumentation, and use that instrumentation to characterize processes and equipment. ICET's testing capability and its ability to rapidly deploy sophisticated instrumentation in the field have been important components of its success. ICET has recently become part of the newly formed Energy Institute at MSU.

ICET has a multidisciplinary staff of 20 full-time employees, including chemists, physicists, computer scientists, and chemical, electrical, and mechanical engineers. ICET employees have leading-edge expertise in the application of lasers to energy and environmental cleanup. ICET's staff is a unique blend of measurement specialists, control specialists, and an experienced engineering and operations staff, primed to carry out ICET's mission. ICET also employs graduate and undergraduate students who further support research operations. ICET also employs a Certified Industrial Hygienist (CIH) and a Certified Hazardous Materials Manager (CHMM). These individuals ensure all activities conducted by ICET adhere to applicable environmental, safety and health practices.

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