Innovative Mercury Control at a Biosolids Incineration Facility

Frank Sapienza – CDM Smith

Tom Hartye,

Hunter Carson,

Peter Weed – Metropolitan Sewerage District of Buncombe County, North Carolina

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WWTP at Metropolitan Sewerage District, NC

Fluidized Bed Incinerator with Original Venturi Scrubber and Tray Scrubber

Emissions Testing and MACT Limits for Existing FBI

Pollutant	Units (all @ 7% O_2	MACT Limit	7/2009 Data	11/2010 Data	7/2013 Data	Further Control Recommended
Particulate	mg/dscm	18	**18**	13	13.21	Yes
Cadmium	mg/dscm	0.0016	**0.06**	0.0003	0.00018	Yes
Lead	mg/dscm	0.0074	0.0013	0.002	0.0033	No
HCl	ppmvd	0.51	0.13	No data	0.14	No
CO	ppmvd	64	4	N0 data	1.8	No
Mercury	mg/dscm	0.037	**0.12**	**0.08**	**0.099**	Yes
NOx	ppmvd	150	86.8	143	105.2	No
Sulfur Dioxide	ppmvd	15	**13**	No data	**48.9**	Yes
Dioxin/Furan (mass)	ng/dscm	1.2	No data	0.03	No data	No
Dioxin/Furan (TEQ)	ng/dscm	0.1	No data	0.003	No data	No

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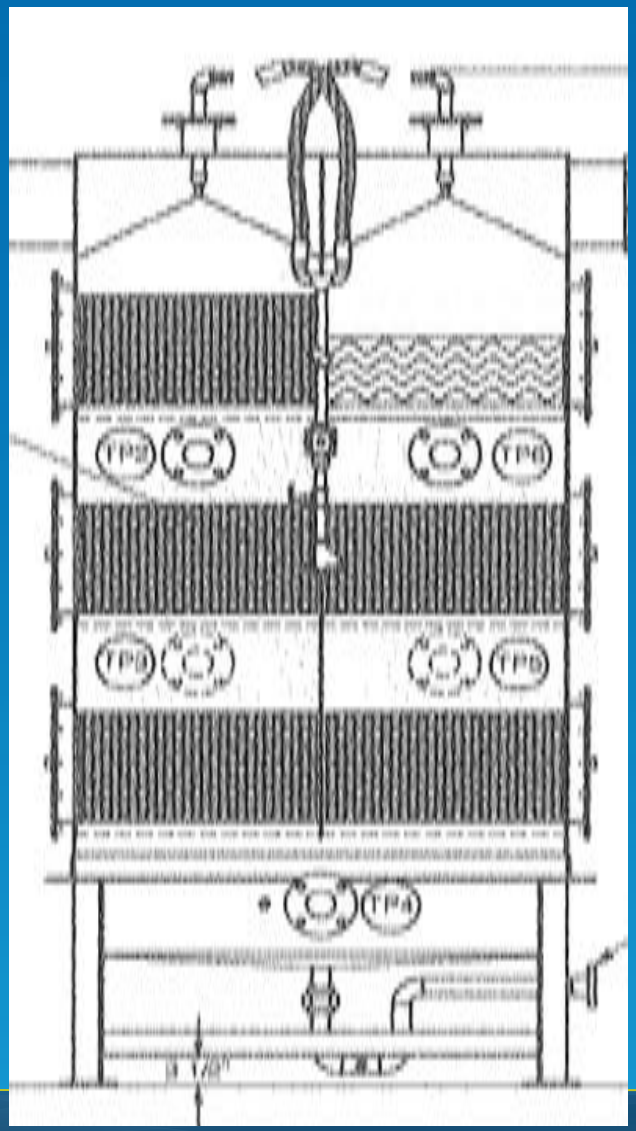
Project Evolution

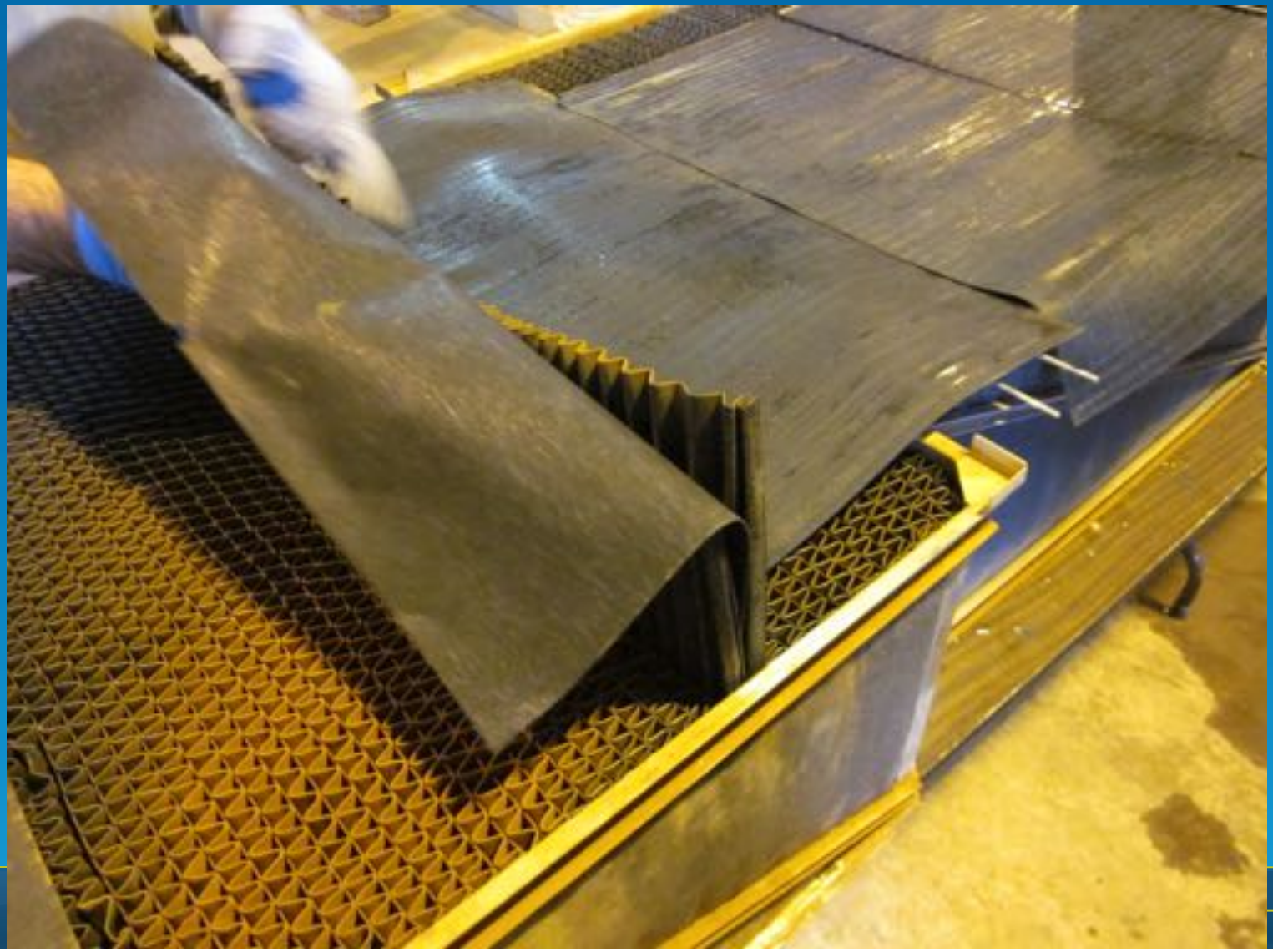
- Based on Stack Test Results, Recommendations were:
  - Provide improved control of PM and Metals
  - Replace existing Venturi and Tray Scrubbers with Multi-Venturi Scrubber by Envirocare
  - Install a Carbon Based Mercury Control System
  - Preliminary Design Developed
- MSD Investigates Sorbent Polymer Composite (SPC) Mercury Control Technology offered by Envirocare
- MSD Decides to Pilot Test the SPC Technology

Pilot Mercury Removal Module



SPC Modules Being Loaded into Pilot Unit

SPC Membrane



Results of Pilot Testing

- Inlet Mercury Conc. Varied from 63 – 106 µg/dscm
- Outlet Mercury Conc. Averaged 4.3 µg/dscm
- 93.4% Mercury Control

- Inlet SO_2 Conc. = 17.6 ppm
- Outlet SO_2 Conc. = 3.1 ppm
- Approx. 82% Control of SO_2

- Based on these results MSD Decided to Install the SPC Technology for Mercury Control

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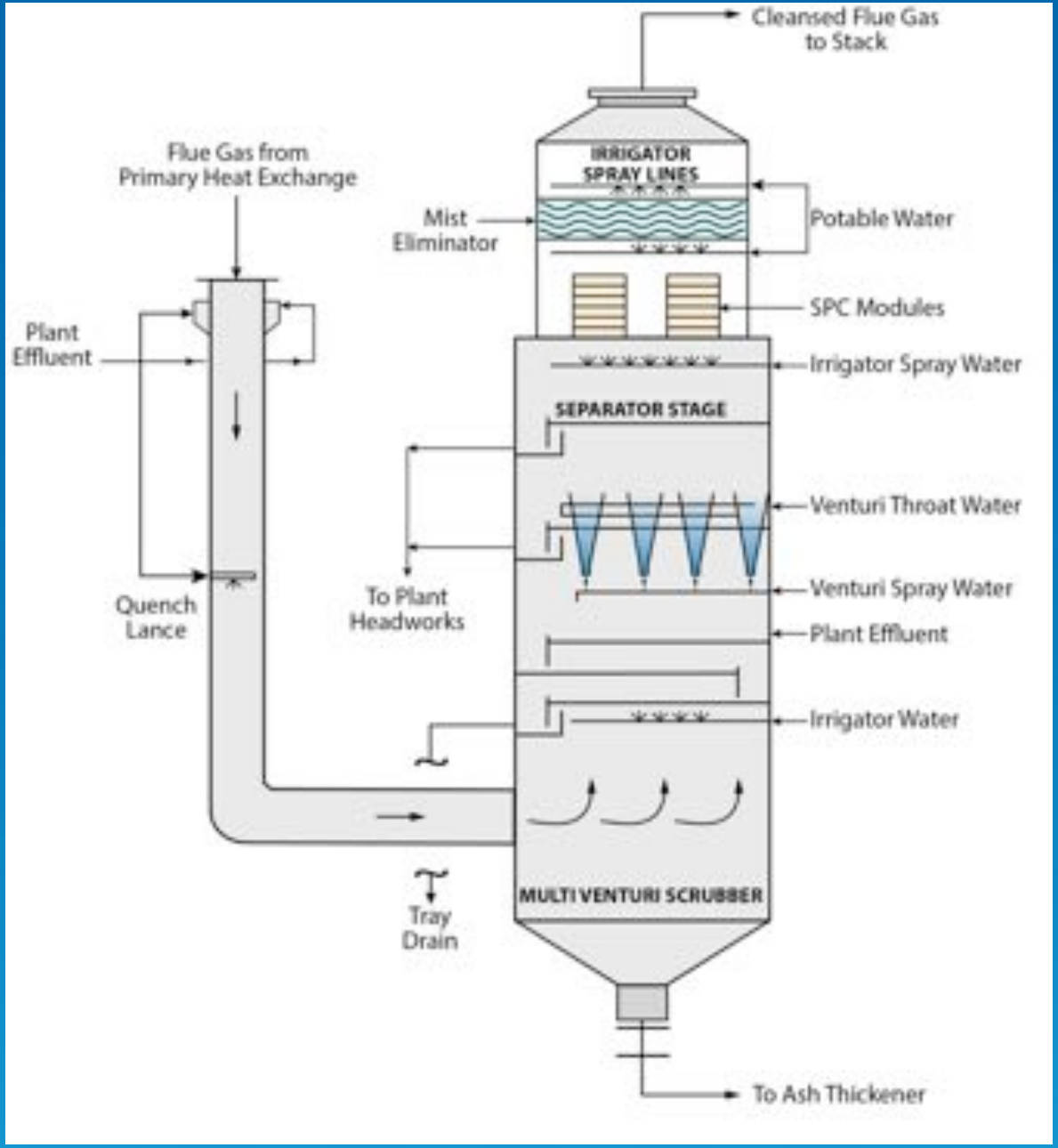
Advantages & Disadvantages of SPC Technology

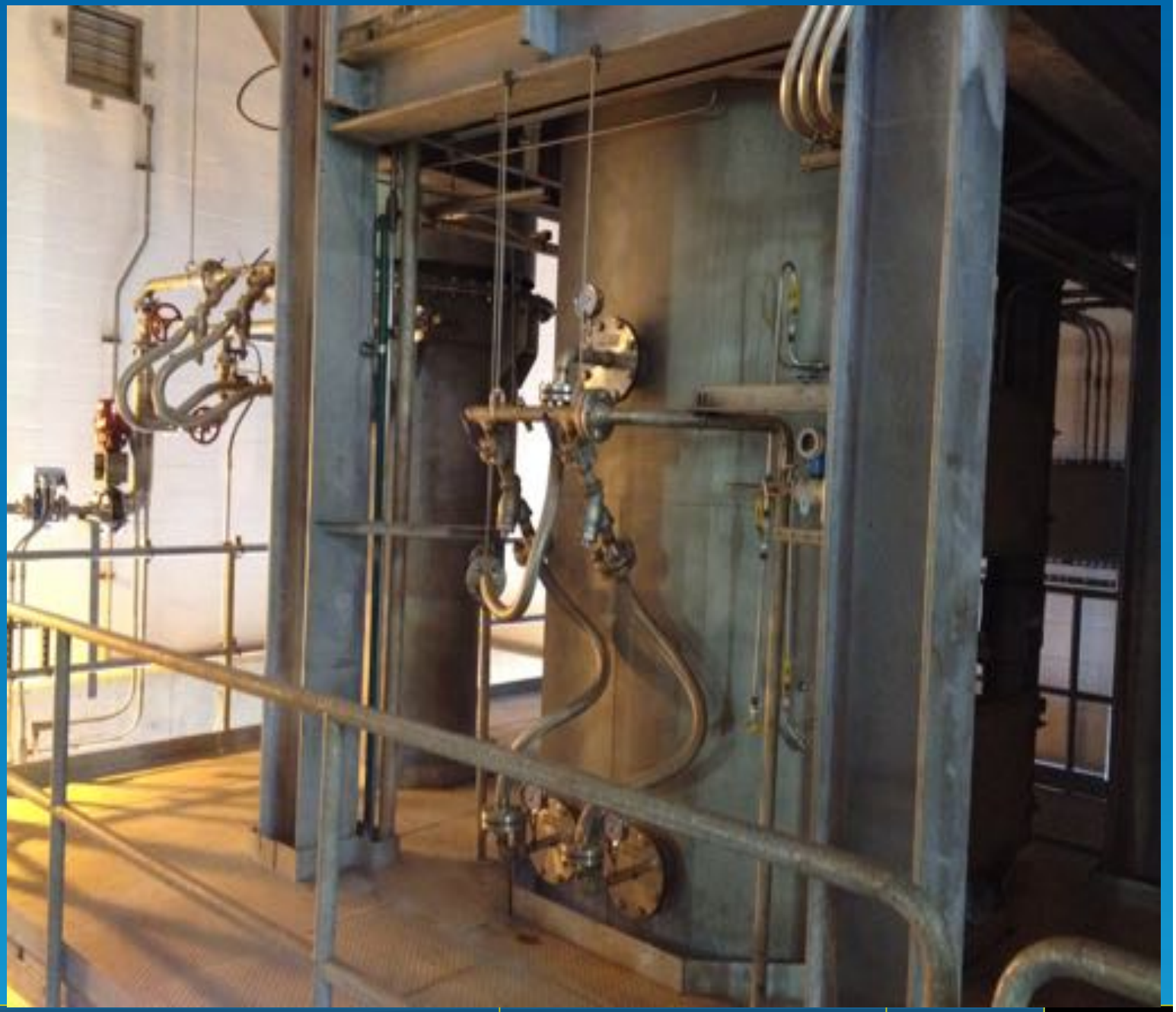
- Advantages
  - Can accept a wet saturated flue gas at 80 – 120 degrees F
  - Does not require preheating flue gas to 160 degrees F
  - SPC Modules can be installed in single cylindrical vessel directly downstream of wet scrubbing system
  - Carbon-based system requires:
    - Additional control of fine particulate matter: Gas conditioning unit or Ultra and HEPA Filters, Reheat Heat Exchanger, Carbon Adsorber, Start-up skid with electrical heater and ID fan
  - SPC Significantly less expensive than a carbon-based system
- Disadvantage - 70% Mercury Control Guaranteed
  - Guarantee up to an inlet Hg Conc. of 0.12 mg/dscm

Quencher Tray Scrubber, Multi – Venturi Scrubber and Mercury Removal Section

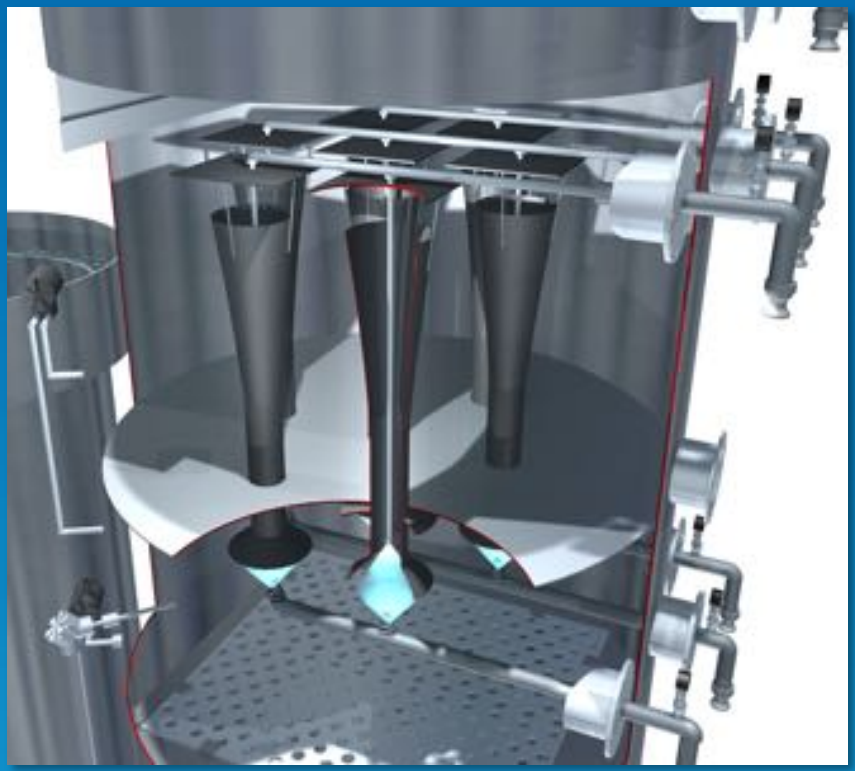


Quencher, Tray Scrubber, Multi-Venturi Section, Separator Tray

Venturi & Throat Spray Vances



Multi-Venturi Pak Scrubber



Courtesy of Envirocare International Inc.

SPC Section on top

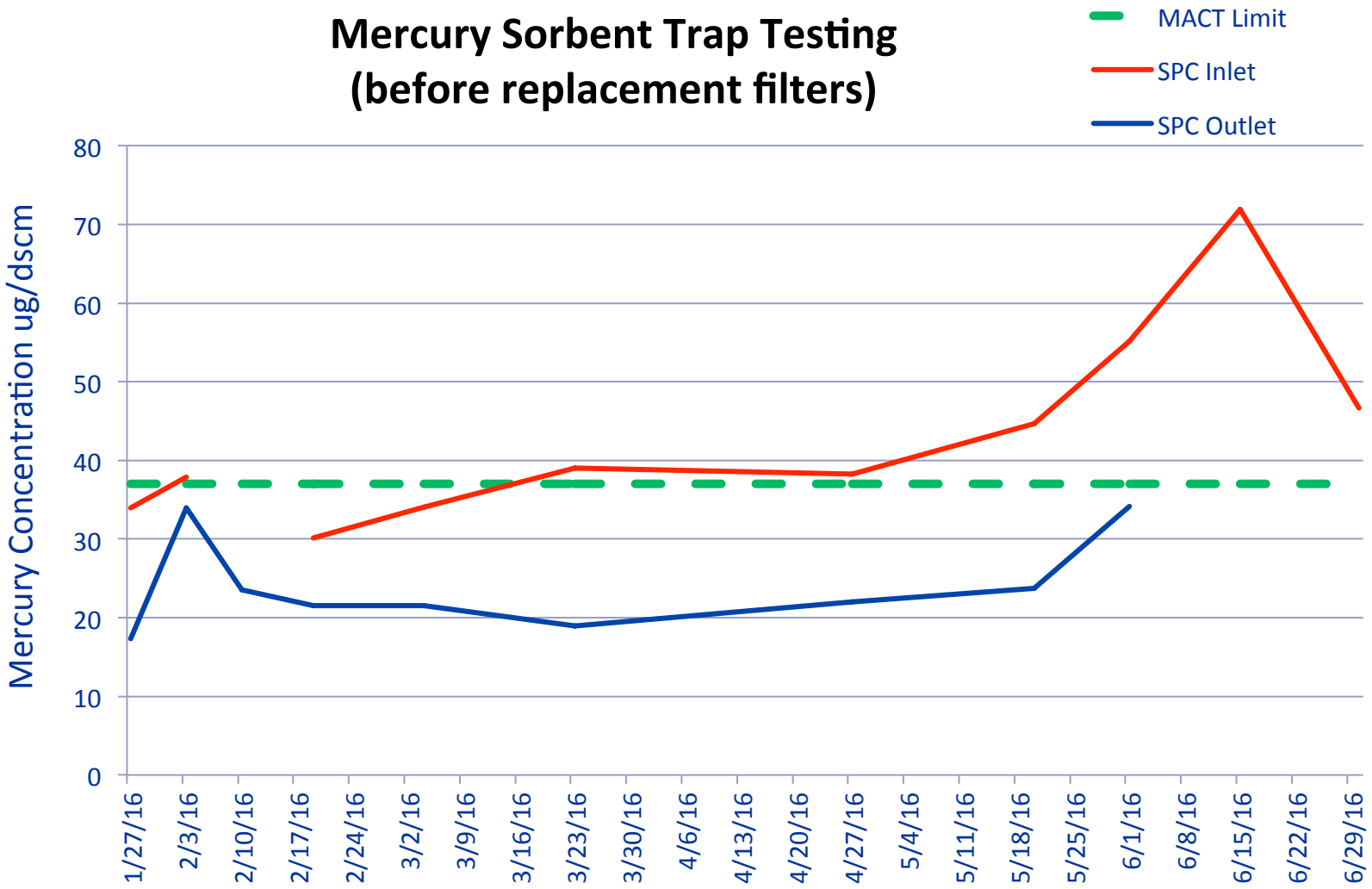
SPC Modules

Emissions Testing Results and MACT Limits

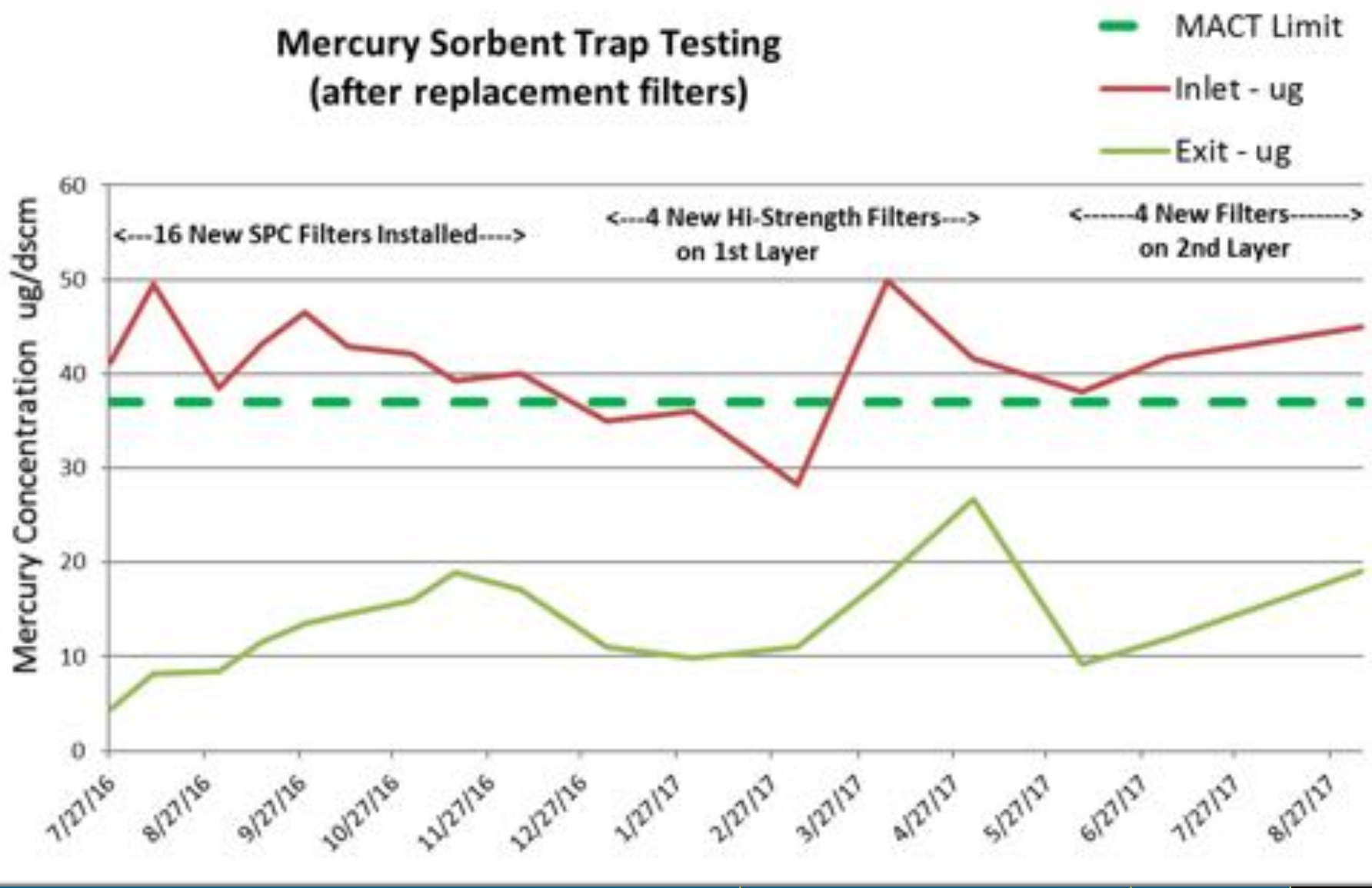
Pollutant	Units (all @ 7% O_2	MACT Limit	Stack Test Results Feb 2-4, 2016	Compliance With MACT
Particulate	mg/dscm	18	4.64	Yes
Cadmium	mg/dscm	0.0016	0.0000655	Yes
Lead	mg/dscm	0.0074	0.00039	Yes
HCl	ppmvd	0.51	< 0.15	Yes
CO	ppmvd	64	1.4	Yes
Mercury	mg/dscm	0.037	0.034	Yes
NOx	ppmvd	150	27.3	Yes
Sulfur Dioxide	ppmvd	15	7.2	Yes
Dioxin/Furan (mass)	ng/dscm	1.2	0.023	Yes
Dioxin/Furan (TEQ)	ng/dscm	0.1	0.00044	Yes

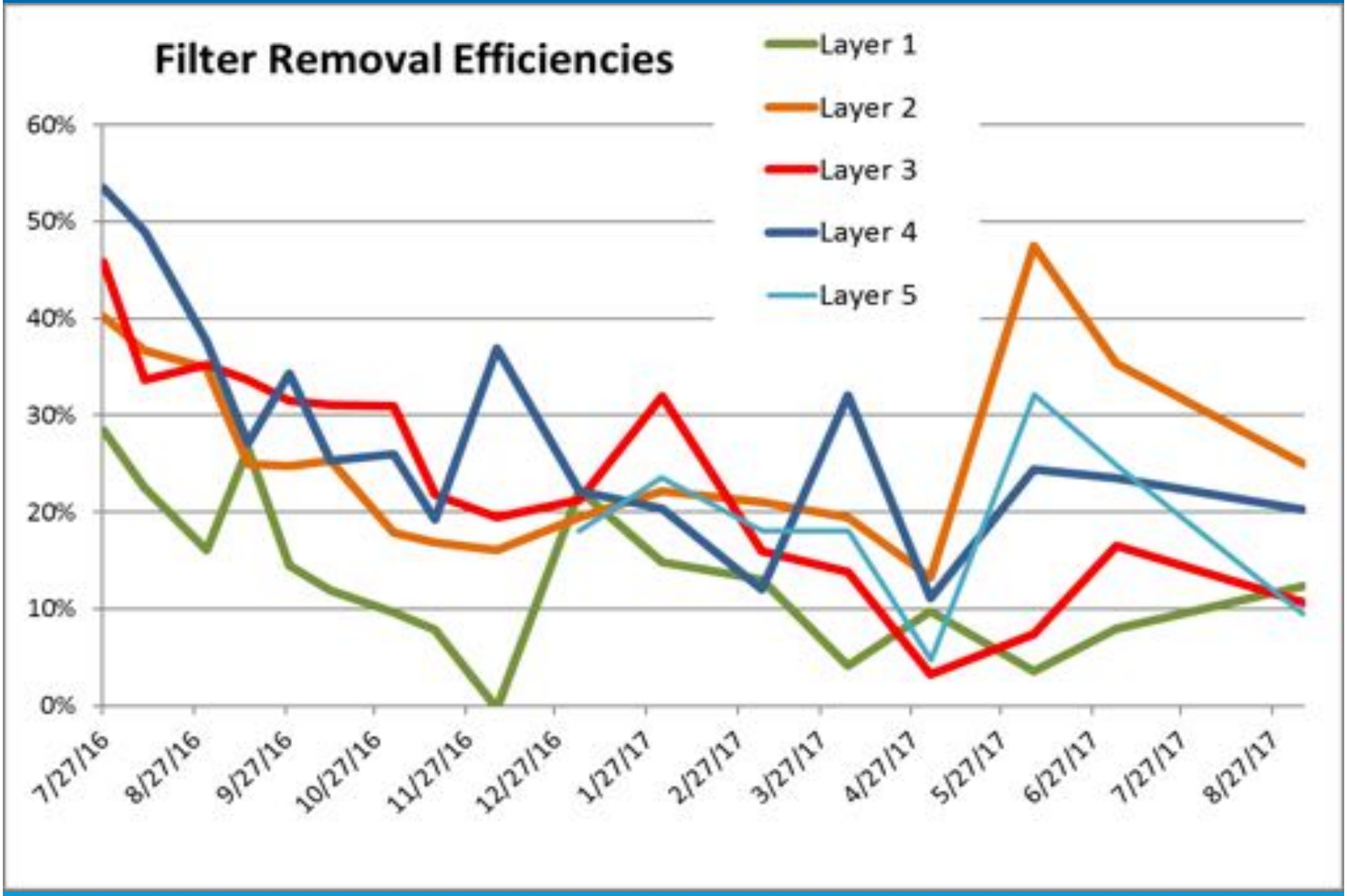
Carbon Trap Sampling Probe

Mercury Removal Results from 1/27/16 thru 6/29/16



Mercury Removal Results from 7/27/16 thru 9/6/17




Filter Removal Efficiencies
Layer 1
Layer 2
Layer 3
Layer 4
Layer 5
60%
50%
40%
30%
20%
10%
0%
7/27/16
8/27/16
9/27/16
10/27/16
11/27/16
12/27/16
1/27/17
2/27/17
3/27/17
4/27/17
5/27/17
6/27/17
7/27/17
8/27/17

Observations and Conclusions

- SPC system is meeting the MACT Mercury limit of 37 µg/dscm
- Mercury Removal varied from 36% to 89%
  - Averaged 67% since replacement filters installed in 7/27/16
- Full scale unit did not replicate the Pilot test results
  - In hindsight a longer pilot testing period is recommended
- Equipment supplier, Envirocare, has been extremely helpful and has supplied many modules, equipment and technical expertise to make the system successful
- Fortunately the design was conservative enough that MSD has always been in compliance