THE MATTABASSETT DISTRICT

Who Are We?

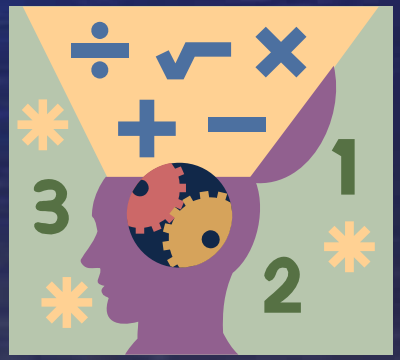
- 1. A regional 20 MGD facility serving New Britain, Berlin, Cromwell, and parts of Middleton, Newington, and Rocky Hill, CT. We are located south of Hartford, CT.
- 2. A Fluidized Bed Incinerator is used to process the biosolids.

What Happened ?

- The District failed an annual stack test. The mercury emissions limit was exceeded.
- The limit was 266 micrograms per cubic meter, stack test result was 322 micrograms per cubic meter.
- A Consent Order was issued to The District by CTDEP to reduce mercury emissions.

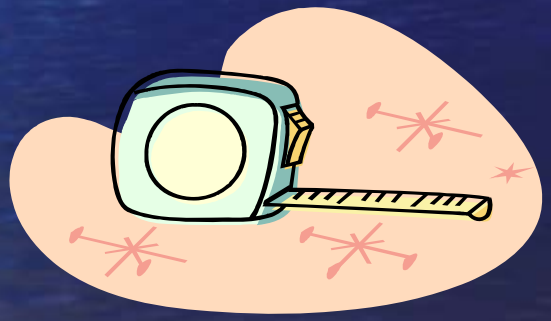
Options for Compliance

- Electrostatic precipitator.
- Baghouse.
- Carbon injection.
- Chemical injection.
- Carbon Absorption.



Carbon Canister

- Installed in September 2002.
- 12 inches of 4 mm carbon, 10 foot by 10 foot.
- Donau Carbon furnished the package.



Why a carbon canister?

- Readily available.
- Proven technology.
- Reasonable cost.
- Recommended by incinerator consultant.
- Should be no problem for a wet based venturi exhaust scrubbing system.
- Carbon canister was initially slated as a demonstration project.
- It will fit!

Carbon Canister Installation

First Stack Test Results

October 16, 2002

181 Micrograms in
3 Micrograms out
98% Removal

Problems

- Initial success was quickly dampened by operational problems.
- Carbon fluidized.
- The clay based inerts in the carbon were breaking down. Inerts are necessary to minimize a fire hazard.
- Perforated plates began to foul.
- Cleaning of the perforated plates proved challenging.
- After trying several methods unsuccessfully, sandblasting them seemed to work the best.

More Problems

- Unfortunately, the plates began to wear, and eventually required replacement.
- Operating temperature became an issue.
- Moisture became a problem.
- Differential pressures continued to rise.
- Initial design was 4 inches of differential pressure, but rose to 10 inches.

More Problems ?

- Mercury removal was impacted by problems.
- Carbon was fouling, but why?
- Plates would not secure carbon within the bed.
- The carbon that was to last 3 to 5 years was lasting 3 to 4 months.

Still More Problems !

- The carbon that was removed was now hazardous – for mercury.
- The District had to register as a Large Quantity Hazardous Waste generator.
- Unfortunately, the waste carbon has to be exported to Canada.

The carbon works --- right?

- As expected, mercury removal results varied. Condition of the carbon, and the perforated plates did influence removal rates.
- Typical inlet mercury concentrations ranged from about 100 to 200 ug.
- Typical outlet mercury concentrations ranged from 3 to 132 ug.
- Mercury removals ranged from 97% to 30%.
- Yes, the carbon will work!

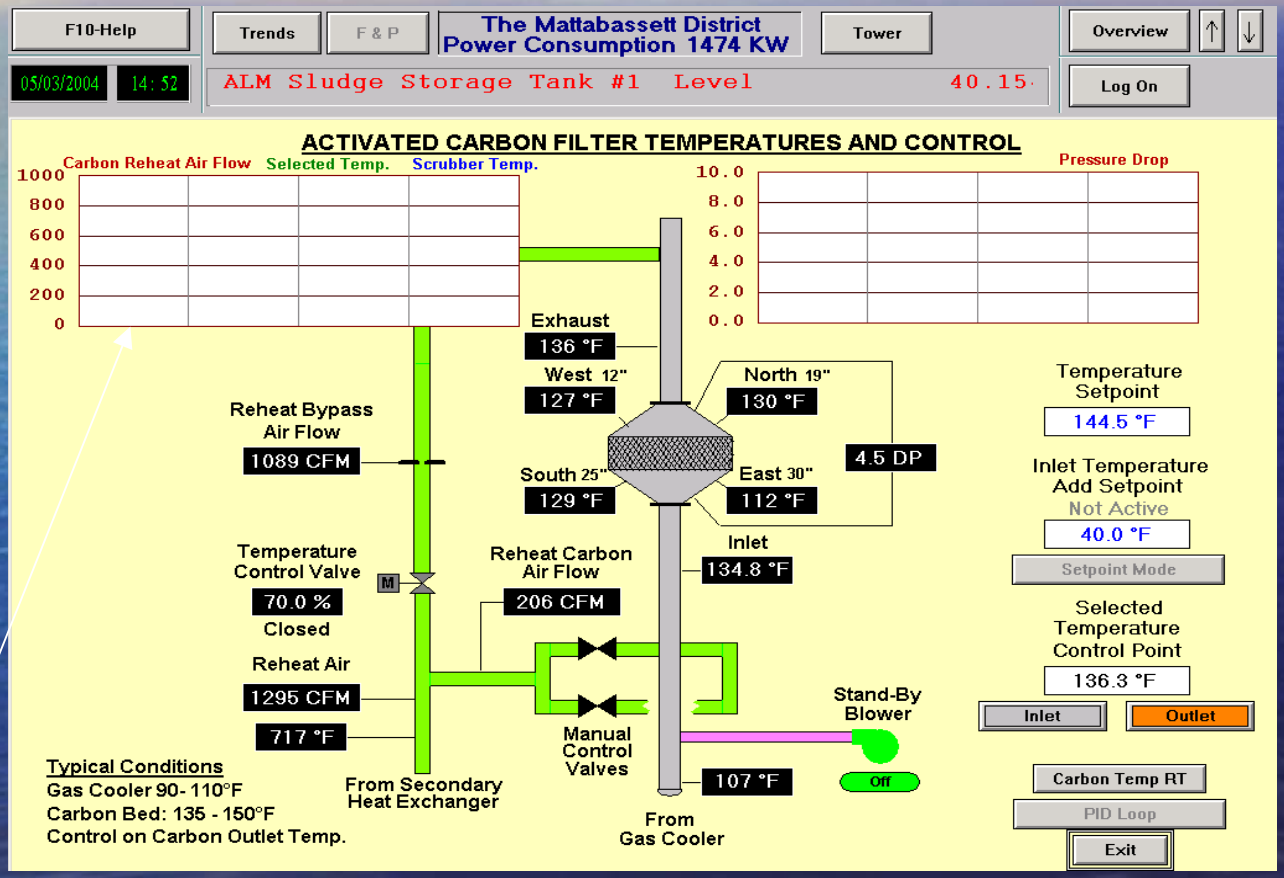
What To Do?

- Solve one problem at a time.

First Solution

- First resolve temperature problems.
- Install additional thermocouples to monitor temperature within the carbon canister.
- Install SCADA based automatic temperature control system.
- Insulate carbon canister (wind was causing lower temperatures).

Temperature Control Graphic



Real time trending of temperatures and differential pressure.

What Next?

- Clay based inert material within the carbon was failing, but why?
- When the inert material failed, the particles that remained were very small. Those small particles contributed to flow distribution problems and fluidization of the carbon bed.

Next?

- Resolve breakdown of inert material.
  - Sodium hydroxide used for SO_x control was attacking the clay based inerts in the carbon.
  - After analysis by Donau Carbon, the clay based inert material was changed to a zeolite based material, which appeared to work.

Next Problem

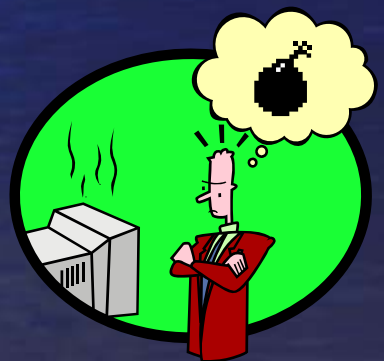
- Moisture getting into carbon, despite temperature control.
- Existing mesh style demister was not removing moisture effectively.

Replace Mesh with a Demister Tray

(Don’t forget wash down nozzle)

Next Problem (s)

- Carbon perforated plates were still fouling.
- The particles were very, very small and sticky. Siloxanes? First time that word came up.
- Increase carbon size from 4 mm to 6 mm to reduce operating differential ?
- Flow Distribution problems.



Original Inlet Diffuser was not effective. Top plate was added with marginal improvement.

Baffles were original but not totally effective.

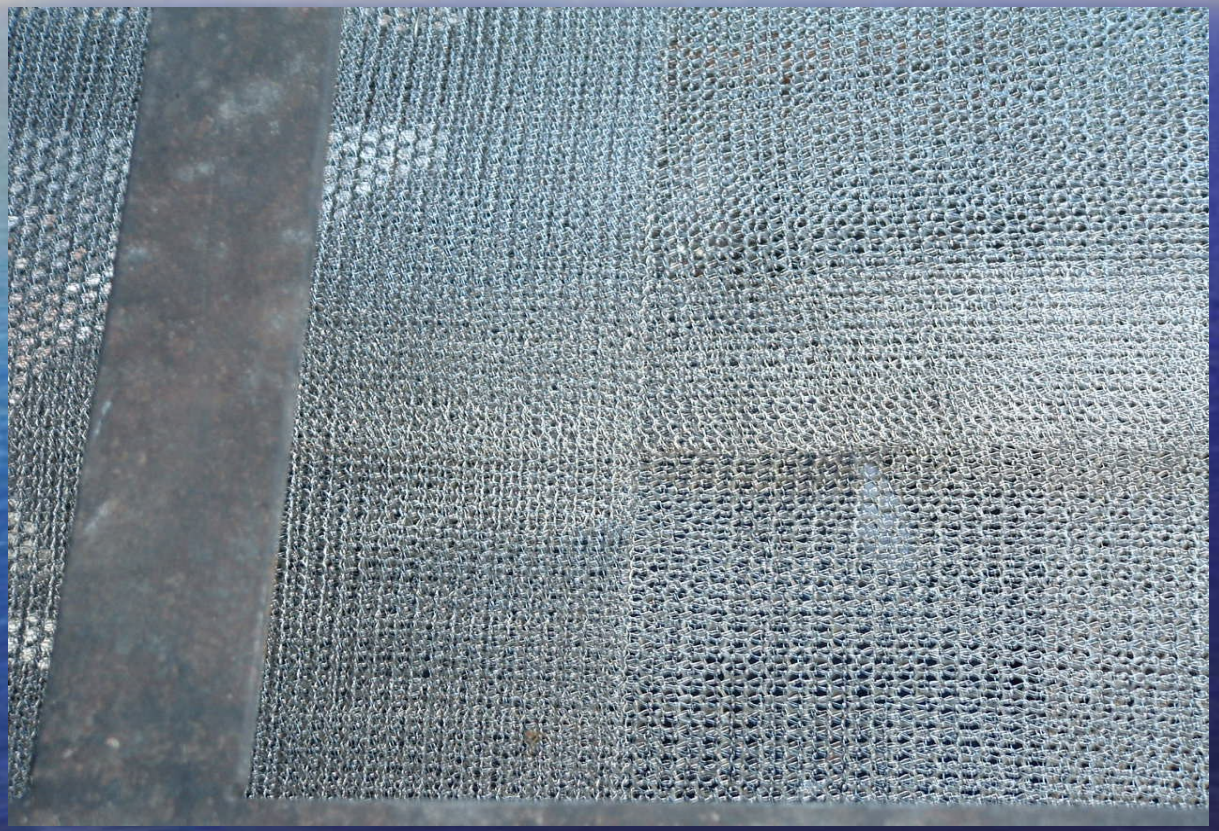
The plate was added, there is a 2 inch dia. Hole in the center. Marginal improvement.

Revised Diffuser, seems to work fine. But, more work remains.

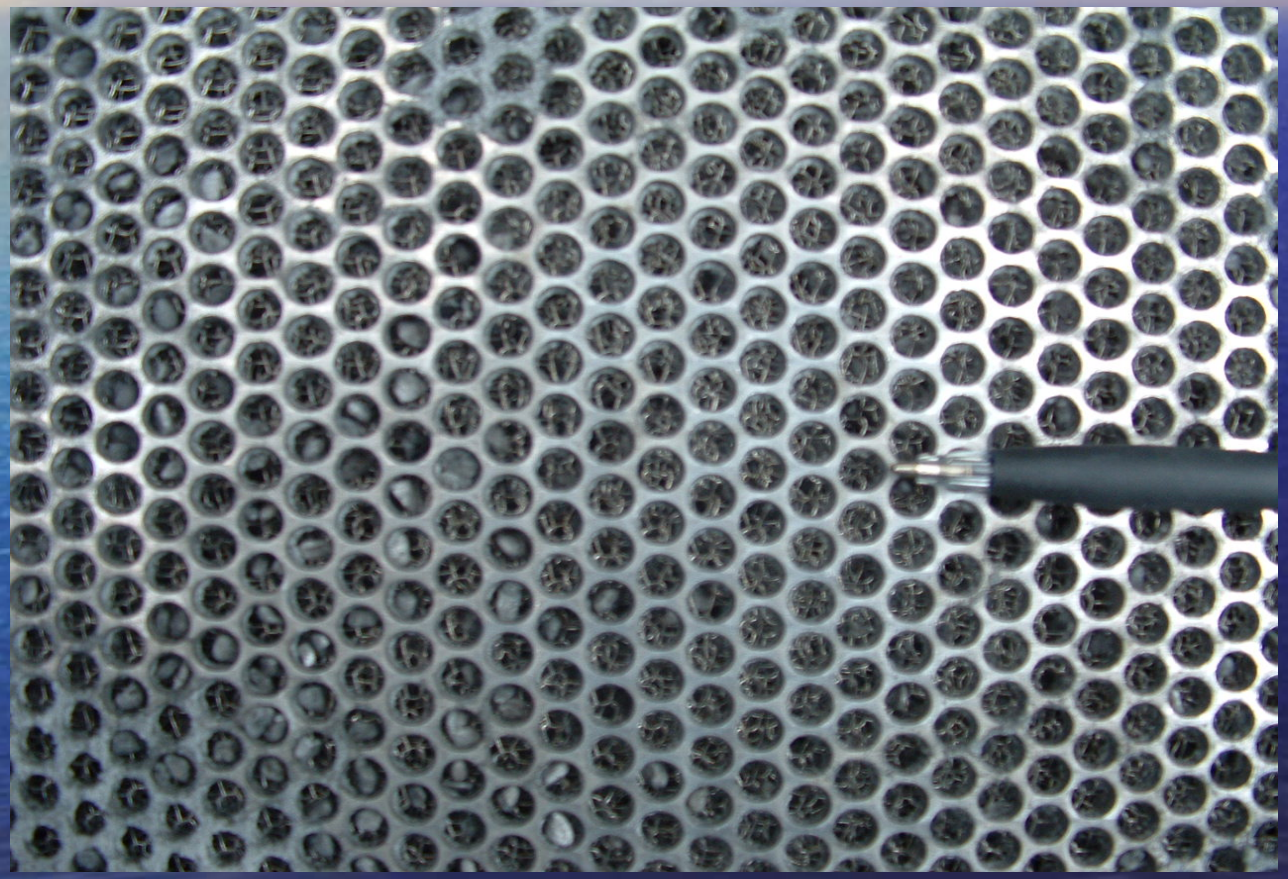
Next Problem (s)

- The 3/16 perforated plate and poly mesh did not work satisfactorily.
- Pressure (caused by fine particles) was actually causing failure of the original perforated plates (they would blow out). Redesigned hold down clamps.
- Increase perforated plate diameter to 5/16 and increase carbon to 9 mm.
- Begin investigation of particle analysis and size distribution.

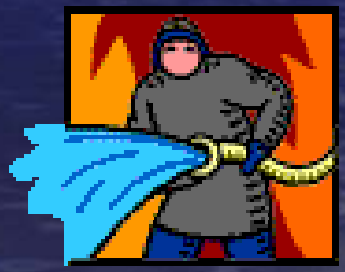
Lower Mesh, 3/16 Dia Perforated Plate – What it should look like!



Clean 5/16 dia. Perforated Plate



Dramatic example of fouling, Why? (How do we clean this?)



Fouled Inlet Perforated Plates

Fouled Top Screens

What else should we check?

- Venturi appears to function normally.
- No evidence of heat exchanger leakage.
- Increase carbon size to 6 or even 9 mm but will it compromise removal of mercury?
- Try a polypropylene mesh, as it has a very high open area.

New Mesh Support System

Poly Mesh Replaces Perforated Plates

Polypropylene Mesh Failed

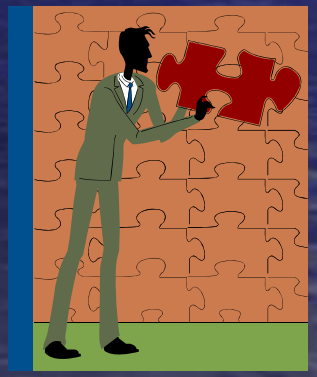
Redesign top hold down brackets. Another problem solved.

Carbon Canister Conclusions

- Demonstration project/stack tests documented that the process definitely works.
- Submicron particles reduce efficiency of absorption and life of the carbon.
- Recommend vertical rather than horizontal carbon orientation. Indoors, not outdoor location.
- Hazardous Waste generator status.
- Expensive waste carbon disposal costs.
- Need to have system that will not allow hot air into canister if power fails.
- Need to maintain temperature, even when incinerator is not in service.
- Need a UHF to capture submicron particles.

Problems Solved?

- Contacted APC Technologies; based upon recommendations from carbon supplier and incinerator consultant.
- APC manufactures a moving bed, ultra high efficiency filter (UHF) which should capture the very fine particles.
- Scheduled a test to collect and analyze particle size and distribution.
- Determine if a UHF is applicable.



Stack Test Results

- Particle size analysis was performed.
- Data indicated that the particles were very fine, less than 0.053 microns. 40% to 60% of the particles fell into that range.

Further Investigations

- A pilot test using UHF filter technology was scheduled.
- Several types of media fabrics were tested, including a carbon impregnated filter.
- Results indicated that 91% to 99.6% of the submicron particles were captured.

Mercury Removal?

- The pilot test employed two filters.
- A UHF filter and a carbon impregnated filter.
- Mercury removal was 47% to 55%, with two filters.
- But..... mercury removal at that level was not anticipated
- What next?

Detour

Next phase, was the data real?

- Schedule another pilot test to determine if initial UHF data can be replicated.
- Determine if additional carbon filters will increase mercury removal.
- Determine if the moving bed filters would be classified as a hazardous waste.

Preliminary Results?

- A UHF filter does not remove mercury, as it is in the gas phase. The UHF filter is very effective at removing the submicron particles.
- The moving bed carbon filter can reduce mercury from 50% to 67%.
- The filters did not test as a hazardous waste.

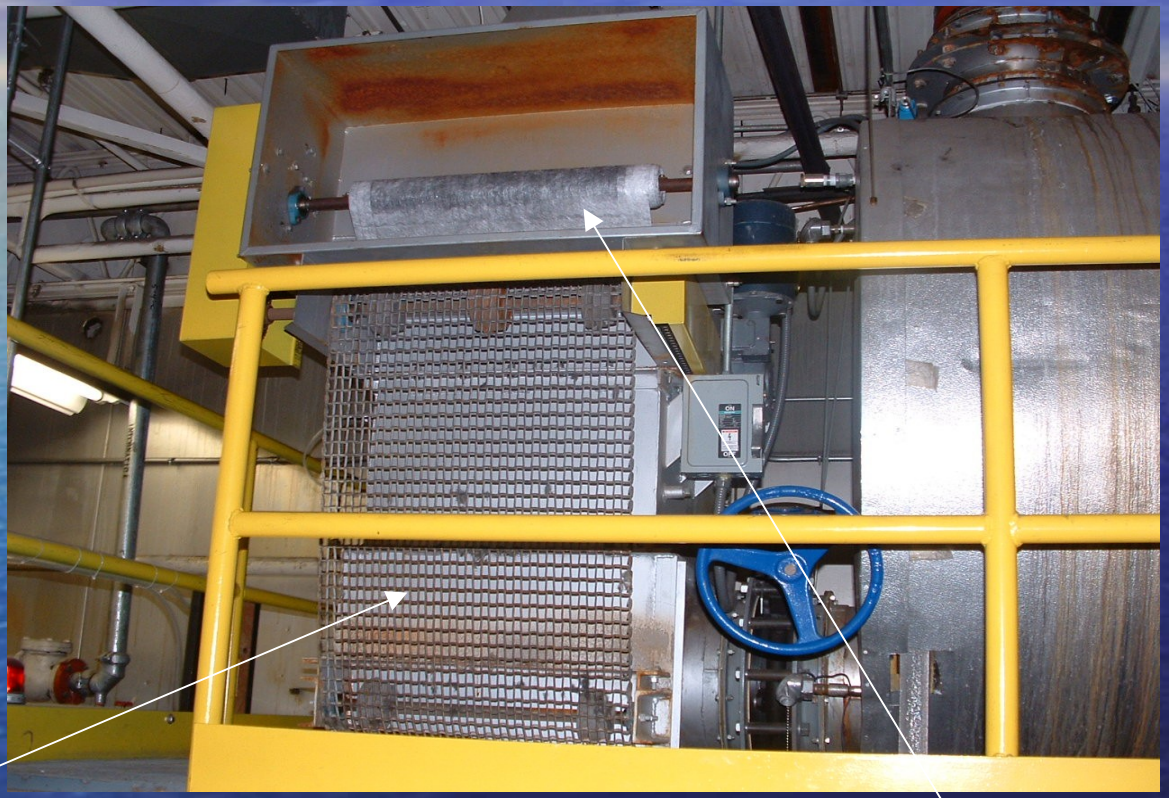
Dramatic Example of Submicron Capture.

Inlet

Outlet

Side View of UHF Unit

UHF Unit



Moving grid system

Filter – note discoloration (particulate capture) The filter is on a roll. The filter and grid system rotate.

UHF Conclusions

- Pilot testing demonstrates that the process definitely works.
- Full scale pilot testing being considered.
- Results suggest we can remove approximately 30% of the mercury per stage.
- Temperatures are not a serious concern.
- Spent filters are not a hazardous waste.
- Moisture is not a problem.
- Appears easier to maintain.
- Fouling is not an issue.
- Need controlled velocities for maximum removal.

What Next?

- Analyze installed and operational costs for each system.

Questions?