

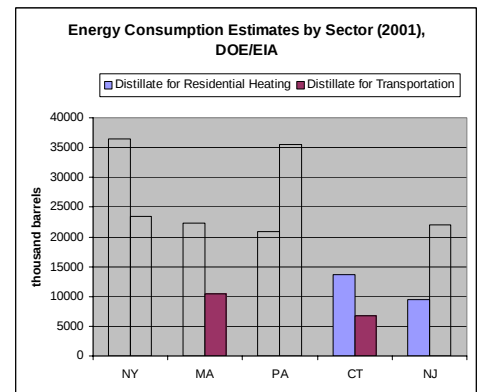
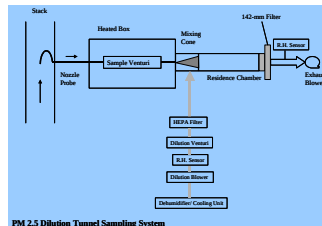
IMPROVED EFFICIENCY AND EMISSIONS WITH LOW-SULFUR HEATING OIL AND CONDENSING APPLIANCES

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ABSTRACT

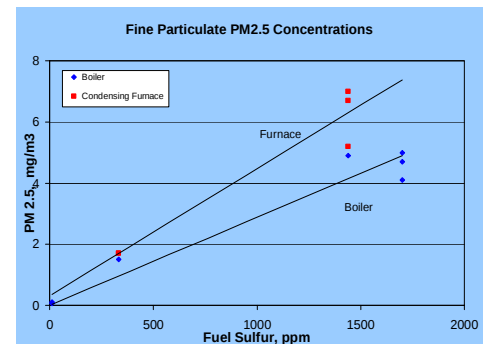
High levels of fine particulate matter (PM_{2.5}) in NYC and surrounding metropolitan areas have been attributed mostly to diesel engines with contributions from oil used for heating during the wintertime. No. 2 heating oil consumption, typically high-sulfur, is concentrated in the Northeast region with about 3.4 billion gallons (1997 data) used annually in the Mid-Atlantic states (NJ, NY and PA). Improved energy efficiency of furnaces and boilers with significant reductions in sulfur oxides and total particulate matter can be achieved through the use of low-sulfur fuels. Reducing sulfur levels even further to ultra-low levels, which is now available as transportation diesel, allows for continued advances in condensing oil-fired systems. These advances allow for up to 10% improvements in energy efficiency or 94% efficient systems. Brookhaven National Laboratory is developing these technologies with the objectives of quantifying the efficiency benefits in addition to characterization of emissions. These new technologies offer significant energy benefits but it is not known what their impacts will be on particulate emissions. For example, in the case of condensing boilers do these systems provide an opportunity to capture some of the particles on wet surfaces before being emitted? This poster will present specific data on the correlation between sulfur levels and PM_{2.5} using a new, portable dilution tunnel sampling system for condensing boilers and furnaces in residential systems.

Schematic of PM_{2.5} Measurement System EPA Conditional Test Method CTM 39



Project Begins in FY2005 with Initial Findings to Date:

- Particulate matter emitted from oil-fired, residential combustion systems are smaller than 2.5 microns
- Data on the cast-iron boiler suggests that the amount of PM_{2.5} that is emitted out of the stack along with the flue gases is directly proportional to the amount of sulfur in the fuel source.
- Fine particulates were measured under steady state operating condition of the heating system; almost all of the mass from the fine particles consist of sulfates and water associated with sulfates.



Planned Test Program (2006-07)

Condensing Boiler (Oil and Gas)
Condensing Warm-air Furnace (Oil and Gas)
Systems with Low NO_x Burner

Regular Heating Oil (0.2 %S)
Low Sulfur Oil (0.05 %S)
Ultra-Low Sulfur Oil (0.0015 %S)*
Biodiesel B20
Biodiesel B100



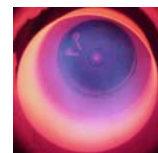
- Condensing Furnace
- Condensing most of the time
- Efficiency 93.1 %



- Condensing Boiler 1
- Condensing occasionally
- Efficiency 90.3 %
- Mixed baseboard / radiant



- Condensing Boiler 1
- Never condenses
- Baseboard
- Efficiency 89.3 %



Low NO_x (Blue Flame) Burner

* Assistance provided by Mr. Dan Gianfalla of ConocoPhillips (Atlantic Dist.) in obtaining ULS fuels is very much appreciated.