



Greenbank Advanced Instrumentation & Measurement [GAIM]

StackMaster – Real Time Particle Size Analyser



INVESTOR IN PEOPLE



GAIM StackMaster

Greenbank Terotech, in partnership with their R&D company GAIM Ltd, have developed the StackMaster technology for on-line, non-intrusive measurement of particulate in stack flue gas. The technology has been developed from a need to measure particulate density and size distribution at any desired location in the stack real time.

The objective is a low maintenance technology that is non intrusive and external to the stack, which generates real time particulate monitoring that correctly weights for differently sized particles. Measured parameters are the particle size distribution giving % particles in customer required size ranges and a particulate density expressed as mg/m³.

The development was customer driven, with a requirement for an improvement over optical type opacity stack measurements. These work well for opacity but their relationship to particulate falls down when the particle size distribution changes in the flue gas. A simple analogy is comparing water mist to rain, where the opacity reduces, but total particulate mass increases. Reflectance of light is inversely proportional to the diameter of the particles.



The main benefits of the StackMaster are:

- Reduction in stack manual sampling costs and frequency
- Real time alarm for poor precipitator performance.
- Identify poor milling / classification by adjusting mill loadings.
- Include in any boiler optimisation strategy
- Allows future identification of particulate matter by size, such as PM10
- No need for constant recalibration of opacity monitors
- I/O and plant interface is via NI Field-point PLC controllers.
- ISO-Kinetic.
- No material handling.
- Low maintenance with only 2 static optical devices located outside the stack.



StackMaster captures multiple images per second and rapidly determines the number of particles and the particle size distribution. Calibration is required for the specific set up location and densities to be used in calculations. The system rapidly calculates the mg/m³ from the number of particles measured their size and the known volume of interrogation from the laser and CCD alignment. The particle size outputs as % and mg/m³ are outputted as 4-20mA. The system then repeats the process. A 4-20mA signal of MW load is taken from the plant so that the system shuts down when not in use.



Enhancing Performance

"It is our vision to excel and lead the world in our area of expertise."

GAIM StackMaster

Laser System

The laser system is designed to comply with BS EN 60825-1 and BS EN 60101-1. All covers are interlocked, so that the laser cannot be run if any cover is removed.

The laser comes with a solenoid driven safety shutter.

All optical equipment is located physically outside the stack but can measure at almost any point along the diameter desired inside the stack. A pulsed laser beam is spread through a lens to give a pseudo sheet of laser light in the chimney. This sheet of laser light is pulsed on and off under system control as many times as required and projected into the flue gas.

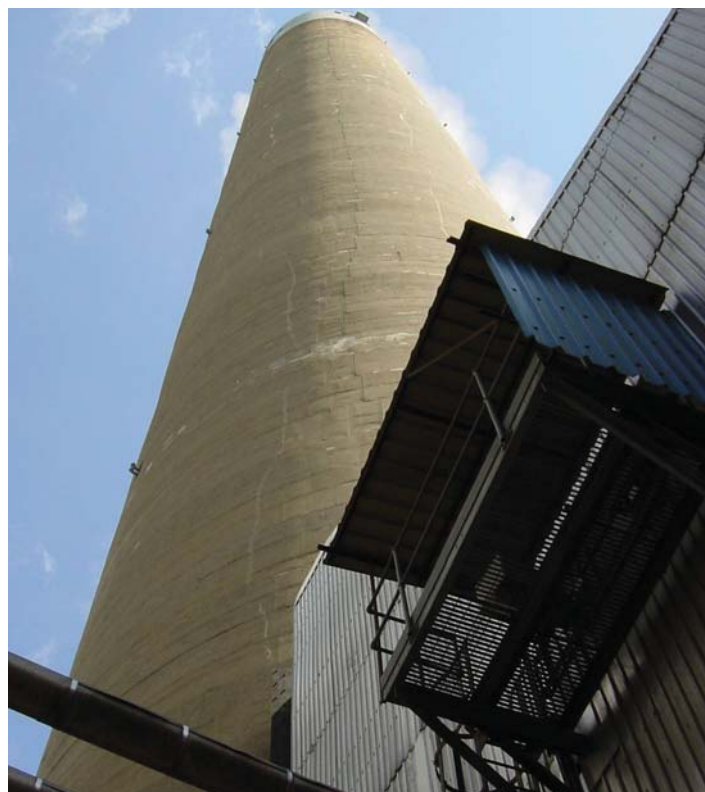
A fast high resolution CCD, the camera measures the scintillation from particles passing through and hence is real time and ISO-kinetic.

Each frame is a true density measurement of the dust under interrogation.

Note: the pulsed laser allows crystal clear images to be taken of even the smallest micron dust particles at the centre of the stack.

This is because of a phenomenon called "MIE scattering" that we refer to as the magnification factor.

This is where a micron sized particle will reflect laser light and be magnified on the CCD image to a much larger size





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The focus, magnification, and Greenbank developed StackMaster filters allow the technology to interrogate diffused particles at any radius required within the stack.

StackMaster requires well diffused particulate flow, which dictates the best location to apply the measurement technology well up the stack

Shutters automatically close when the laser turns off

Sensors / Optical Equipment

- Laser with optics fully enclosed for parallel beam laser sheet including mounting
- Laser plate / slit for laser alignment.
- Laser generator / local control in IP65 cabinet
- Electrical interlocks for local ports of entry into the stack.
- Mounting and high resolution rapid CCD camera
- Optional industrial compressor fan for air cleaning curtain for optical equipment

Industrial Vision System & PLC

Enclosure Housing:

- IP65 cabinet with LED indicators on cabinet for laser on/off
- Rapid control with trigger for synch with laser
- PLC type compact vision system for rapid analysis, complete with StackMaster software
- Power supplies and control for laser

I/O

- 4-20mA for mg/m³ and particle size
- 4-20mA input for boiler load MW

Electrical Requirements

- 110 VAC for control cabinet / laser control
- Optional 415 VAC 3 phase for local air compressor

Accuracy

- Better than BS6069 that applies to variance of dust



The Greenbank Group UK

Incorporating:

Greenbank Terotech
Greenbank Materials Handling
GAIM

Head Office: Hartshorne Road, Woodville, Derbyshire DE11 7GT. United Kingdom

Tel: +44 (0)870 607 8880 Fax: +44 (0)870 607 8889

Web: www.greenbankgroup.com Email: info@greenbankgroup.com

