G-CAM®

Carbon-in-Ash Analyser

Accurate and reliable carbon-in-ash measurement
Helping optimise combustion control

"Enhancing the performance of our customers plant & equipment"

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Greenbank
Carbon-in-Ash Analyser

Product Overview

Real-time Carbon-in-Ash Monitoring

Greenbank's G-CAM® carbon-in-ash analyser is for use on large electric utility boilers which are fuelled using biomass, black or brown coal. At these generating plants, high levels of unburnt carbon in flue gases may typically suggest poor combustion balance, excess air, poor milling, classification or low boiler temperatures.

The G-CAM® real-time measurement of unburned carbon-in-ash in post-combustion fluegas provides a direct statement to the plant operator of combustion efficiency and provides the ability to monitor and optimise the boiler's performance by changing mill, classifier, burner or air settings.
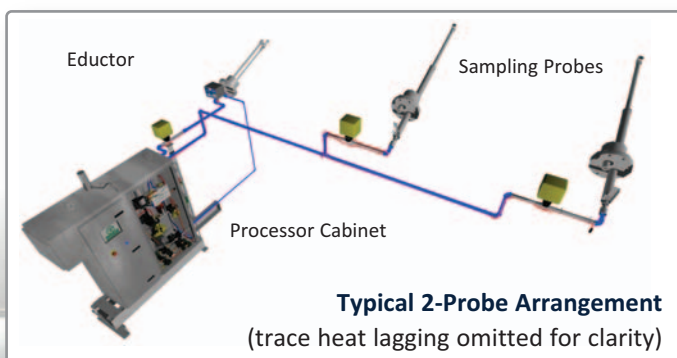
Real-time monitoring of carbon-in-ash will also assist the plant operator in reducing the energy used in the unnecessary heating of combustion air when the carbon-in-ash levels are too low. Also, by analysing alternative pulverising mill groups over a period of time against carbon-in-ash levels will reveal poor performance of specific mills and classifiers.

Robust, Reliable, Accurate and Low Maintenance

The G-CAM® is meticulously designed to be a robust, reliable and highly accurate carbon-in-ash analyser which measures the amount of unburnt carbon-in-ash using the latest state-of-the-art microwave technology.

The G-CAM® system extracts, compresses and analyses samples of fly ash in the post-combustion gases of large combustion boilers, typically sampling and recording on-line data every 6-10 minutes.

Its unique design enables continuous and low-maintenance operation.

Eductor

Sampling Probes

Processor Cabinet

Typical 2-Probe Arrangement
(trace heat lagging omitted for clarity)

Significant Benefits Using G-Cam®
- Accurately identifies levels of unburned carbon-in-ash in post-combustion flue gas
- Provides the plant operator the ability to monitor and optimise the boiler performance and reduce NOx
- Provides the plant operator the ability to reduce energy often wasted in heating excess combustion air
- Identifies poor performance of pulverizing mills and classifier assemblies

Better by Design

High availability at over 98%:
- Fully automated, monitoring duct and ash sampling system temperatures
- Detects optimum conditions before sampling
- Adopts robust wear-protection components

High accuracy at approximately 0.35 %:
- Collects precise volumes of ash and utilises a unique ash-compression technology
- Utilises advanced microwave attenuation and phase-shift technology
- Measures carbon versus known ash volume
- Unaffected by ash density and chemistry including additives such as biomass and pet coke

Rapid and multiple sampling:
- Up to 6 duct traverse, analysis sample points
- Heat-traced sampling pipelines
- Full load sampling circa 6 minutes per probe

Low maintenance:
- Self-cleaning and self-protecting
- Incorporates multi-probe air-purge system
- Remote access support available

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

Operating Philosophy

Innovative and State-of-the-Art Technology

To determine the accurate percentage of carbon-in-ash requires a technology that simultaneously assesses both the carbon and, more importantly, the ash content in a precise amount of fly ash.

The G-CAM® ensures collection and measurement of an exact volume amount of fly ash using a unique sampling and patented compression system.

It adopts the very latest technology to measure changes in attenuation and advanced phase-shift of a microwave signal being passed through the sample.

Reliable, Self-Cleaning and Multi-Probe Sampling

The G-CAM® extracts samples of fly ash, typically from the economiser duct prior to the air-heater, through multiple probes connected to the cabinet via heat-traced pipelines.

During this process, the system maintains the temperature of the fly ash at well above its dew point. This guarantees the fluidity of the ash particulate and alleviates any foreseen materials-handling problem.

The G-CAM® can take up to 6 individual samples across the flue gas duct. It self-cleans and primes itself by ejecting the previous sample down the next in-turn sampling line, in effect, purging it clear before sampling again.

Unique, Accurate, Sampling and Measurement

Once collected, each sample is separated from the flue gas and compressed into an interrogation cell. A microwave signal of just a few milliwatts is passed through the cell and changes in the signal are then compared to a base reference signal.

The microwave's attenuation is heavily influenced by the dielectric properties of carbon. However, assessing the carbon level alone is not enough to provide an accurate carbon-in-ash measurement and more precise analysis is required

Simultaneously, the microwave's phase shift, or slowing of the signal, is greatly affected by the volume of ash present.

Comparing both these changes to a microwave reference signal, on a compressed ash sample of known volume, allows our technology to give a highly accurate carbon-in-ash measurement that is unaffected by the sizing, colour or chemistry of fly ash.

## Intelligent, Automatic and Self Protecting

The G-CAM® is fully automatic and protects itself from contamination by purging air down all the sampling pipelines at boiler start-up and low loads. It monitors the heating system and starts sampling only when it is optimum to do so.

It can be requested to decant an analysed sample into a separate vessel for laboratory analysis and calibration which can be used to verify its high accuracy and on-going performance.
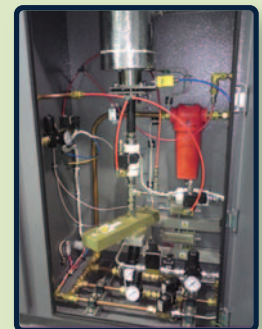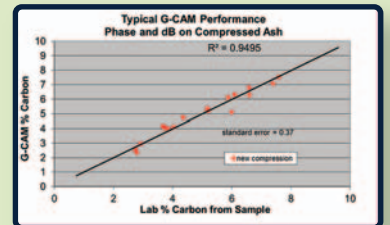
Low Maintenance and Remote Support

The system is designed for 12 months maintenance-free operation.

An optional dial-up access allows Greenbank to remotely monitor the sampling and measurement systems at agreed frequencies.
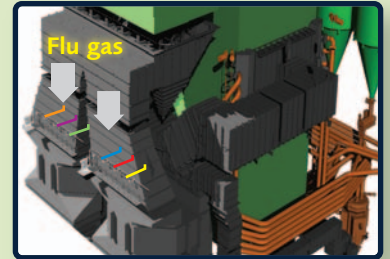
Typical 2 Cabinet x 3-Probe Boiler Installation

Extraction, Compression & Analysis

3-Probe Carbon Cross Duct Trend gives Confidence in Combustion Performance

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General Specification

Performance

Accuracy:
+/- 0.5% for 0-5 % carbon range
+/- 0.6% for 6-10 % carbon range
+/- 0.7% for 10-15 % carbon range

Ash Measurement:
Microwave absorption and phase-shift. 2-3GHz range up to 50% carbon

Availability: Greater than 98%.

Representation:
Up to 6 duct sampling probes per system.

Sampling Rate per G-CAM®:
Sample in 6-10 minutes dependent on boiler load and fuel type.

Processor Cabinet

Air Requirements:
Compressed air supply 60 to 100 psi, minimum ¾" (19mm) pipe.

Control System:
National instruments PLC industrial controller.

Display:
IP65 industrial colour touch screen.

Enclosure:
Dimensions in mm W1105 x H1215 x D405.
2 door, 2.5 mm sheet steel, powder coated.
Floor mounted supplied with plinth as standard.
Wall mounting & rain hood (optional)

Environmental:
Electronics enclosure pressurised with internal temperature control. System includes water, oil and particulate filters to 1 micron.

Power Requirements:
Power to cabinet: 110 VAC, 6 amp cable or optional step-down transformer.

Weight: 200 Kg's net.

Communications

Standard Outputs to plant:
4-20mA current outputs for probe % carbon-in-ash.

Options:
Ethernet OPC for % carbon-in-ash, probe temp and ash loading.

Sampling System

Control Valves and Actuators:
High-temperature stainless steel ball valves with 110 VAC electric actuators controlled by cabinet via 4 core control cable

Eductor Drive:
Eductor installed as close to cabinet as possible

Heat Tracing: 30-35 watts/m heat-tracing wire (600 deg C process temperature stainless insulated) in circuit lengths 6 to 12m. Requires 50mm Rockwool type clad pipe insulation or better (not supplied).

Sample Collection (bypass):
Option for samples to be automatically collected in sample bin

Sampling Probes and Eductor:
Sized per application. From 1" (25mm) or 1¼" (32mm) 316 stainless steel with abrasive-resistant tip.
Probes include type K thermocouple.

Sampling Pipelines:
From 1" (25mm) 316 stainless steel tube with Swagelok fittings or equivalent. The system incorporates a self-cleaning, intelligent, heat-traced ash-handling system. Each pipeline has a recommended maximum length up to 15m from cabinet, dependent on pipe route and probes at a height no less than 1.2 m above G-CAM® cabinet base.

Typical Set-up Scenarios

Probe Numbers:
Up to 300 MW boilers 1 cabinet and 2 probes. Up to 500MW boilers 1 cabinet and 3- 4 probes.
Up to 600MW boilers 2 cabinets and up to 3 probes each or 6 in total.

Cabling Requirements

Cabinet to Probes:
Type K thermocouple cable.

Cabinet to Actuators:
4 core cable, 110 VAC, 1 amp.

Heat Tracing:
Approximately 4 amps @ 110 VAC per 10 m of heated probe and eductor pipework.
Multiple heating cables can be used in 6-12m circuit.