CODEL
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Energy from Waste Application Brochure

GCEM40 & GCEM40E

In-situ and Extractive Single or Multi-species Infrared Absorption Analysers

MCERTS MC16029600

TÜVRheinland CERTIFIED
Tested AMS Regular Surveillance
www.tuv.com ID 0000050624

ISO 9001:2015 Quality Certification

ISO 14001:2015 Environmental Certification

Monitoring Solutions SmartCem **www.codel.co.uk**

The Background:

Energy from Waste (EfW) plants serve as critical infrastructure for sustainable waste management, transforming non-recyclable waste into usable energy through advanced combustion or thermal processing technologies. These facilities play a dual role by reducing landfill dependency and generating renewable energy, such as electricity and heat, to support local and national grids.

Our customers typically include large-scale EfW plants, municipal waste operators, and private waste-to-energy companies that operate within highly regulated environments. They are responsible for adhering to stringent emissions standards set by environmental directives like the Industrial Emissions Directive (IED) and must continuously monitor and report pollutant levels to ensure compliance.

With diverse operational footprints ranging from standalone facilities to integrated sites handling both waste processing and energy generation, these plants require reliable, accurate, and cost-effective emissions monitoring systems. This enables them to meet their environmental and regulatory obligations while optimizing plant efficiency and maintaining community trust.

By partnering with these organizations, we deliver tailored emissions monitoring solutions designed to meet their specific challenges, from reducing maintenance costs to improving data accuracy and facilitating seamless compliance reporting.

The Problem:

EfW plants play a crucial role in sustainable waste management by converting waste into usable energy. However, operating within the framework of strict environmental regulations presents significant challenges. The Industrial Emissions Directive (IED), a cornerstone of European Union environmental law adopted into UK regulations, imposes stringent limits on emissions, requiring EfW plants to adopt advanced monitoring and control technologies.

Key Challenges:

Compliance with Emission Limits: The IED sets strict limits for pollutants such as nitrogen oxides (NOx), sulphur dioxide (SO2), carbon monoxide (CO), particulate matter (PM), and heavy metals. Non-compliance can result in significant fines and reputational damage, making continuous emissions monitoring essential.

Monitoring and Reporting Obligations: EfW plants must continuously monitor and report emissions data to demonstrate compliance. This requires sophisticated Continuous Emissions Monitoring Systems (CEMS), capable of providing accurate, real-time data. Meeting these reporting standards can be technically and financially challenging.

Operational Costs and Downtime: Implementing and maintaining emissions control equipment increases operational costs. Additionally, unexpected downtime caused by equipment failures or regulatory inspections can affect energy production and profitability.

Energy From Waste - Case Study

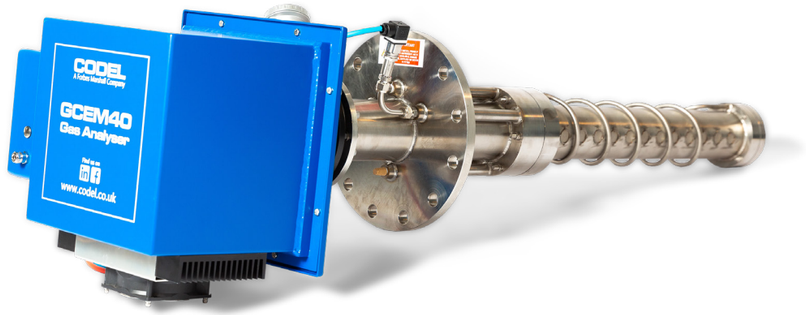
The Solution:

To address their compliance challenges, the plant turned to CODEL's GCEM 40 Series, a reliable and accurate solution for robust raw gas monitoring. Specifically designed to measure critical pollutants like HCl and SO2, the GCEM 40 provided the precision and dependability required to meet strict regulatory standards.

The plant installed the GCEM 40 monitoring system directly into their flue gas stream, ensuring real-time measurement of HCl and SO2 concentrations. Its advanced robust NDIR technology offered highly accurate readings, even in challenging environments with fluctuating temperatures and dust levels.

By integrating the GCEM 40 into their operations, the plant gained full visibility of its flue gas composition, enabling proactive adjustments to reagent levels to improve the efficiency of flue gas desulfurisation while maintaining compliance.

In addition to ensuring compliance, the GCEM 40 helped the plant minimize the risk of costly downtime. Its continuous monitoring capabilities allowed operators to quickly identify and address potential issues, such as equipment malfunctions or changes in emissions levels, before they escalated into more severe problems. This predictive insight not only avoided extended shutdowns but also reduced repair costs by catching faults early. By enabling timely interventions and maintaining operational continuity, the GCEM 40 proved to be a cost-effective and efficient solution for the plant.



Summary of Benefits:

- CODEL's GCEM 40 minimizes costly downtime by detecting faults early, preventing equipment damage, and reducing the risk of extended plant shutdowns.
- The GCEM 40 optimises lime usage, reducing costs, minimising waste, and ensuring regulatory compliance. Many customers see a return on investment within 6 to 12 months, making it a cost-effective solution for flue gas treatment.
- The GCEM 40 is designed with low-maintenance operation in mind, reducing the need for frequent servicing and minimizing downtime. Its robust design ensures reliable performance, allowing plants to focus on efficient operations without the burden of extensive upkeep.
- CODEL's GCEM 40 is an in-situ emissions monitor that measures CO, SO_2, and HCl in a single analyser, offering a key advantage over traditional extractive systems.

The GCEM40 series is the latest generation of CODEL's world renowned in-situ monitors. Our development, knowledge and practical experience have been utilised to produce this advanced technology gas analyser which gives complete flexibility of use on process or emissions applications whilst delivering super accuracy and repeatability at a very competitive price.

The analyser uses a field proven in-situ 316 stainless steel probe designed for the harshest stack conditions to measure directly in the flue stream. The probe design, featuring a probe shield, ensures accurate measurements even in extremely high dust environments, handling dust loads up to 100 g/m^3. Without the probe shield, the GCEM 40 can measure effectively in conditions up to 400 mg/m^3.

All models are fitted with a probe mounted temperature sensor Pressure, CO2 and H2O can be measured as an additional option to provide fully normalised data in mg/Nm3.

Designed for use primarily on combustion processes, the GCEM40 series measures key pollutants such as CO, NO, NO2, NOx, SO2, CH4, CO2 and H2O using an infra-red spectroscopy to ensure that there is no cross sensitivity from other contaminants in the gas stream.

Features and Benefits

- In-situ stainless steel probe measurement.
- CO, NO, NO2, NOx, SO2, CH4, HCl, CO2 & H2O
- Gas temperature and pressure sensors, on-board normalisation
- Export of data to SCADA, DCS and Data Acquisition System
- Analogue & serial digital output
- Certified to MCERTS

Typical Applications

- Large Combustion Plants
- FGD Process
- Renewable Energy
- Steel Plant
- Small Combustion Plants
- Power Generation
- Power Generation
- SCR and SNCR Process
- Energy From Waste
- Metals Processes
- Glass Manufacturing
- Chemical Plant

The GCEM40 Series has MCERTS certification which signifies the accuracy and reliability of its measuring capabilities.

The GCEM40 series analysers can be configured in either single or multi-gas mode to give operators a full range of options. Fully automated zero and span calibrations are performed using clean dry compressed air and protocol gas mixtures to provide long-term accuracy along with minimal maintenance requirements.

Remotely mounted pneumatics in a panel allow zero air to be injected automatically to verify the zero calibration as well as clean and protect the filters on the probe. Span gas can be injected manually to verify the analyser response.

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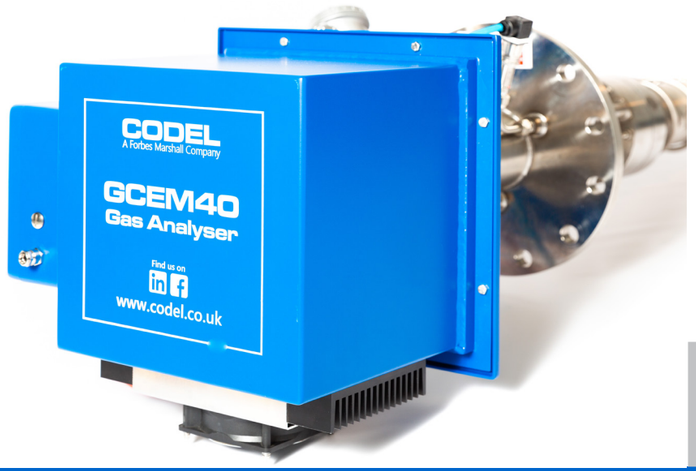


Technical Specification

Sensor Unit

Operating Principle	NDIR gas filter correlation
Span	0 to 3000ppm (CO, NO, SO2) 0 to 25% (CO2, H2O)
Certified Ranges	0-500ppm, 0-1000ppm for CO,NO & SO2 to EN15267
Response Time	<200secs
Accuracy	+/-2ppm, +/-2mg/Nm3 or +/-2% of span
Resolution	1ppm, 1mg/m3, 1mg/Nm3
Calibration	Zero - automatic every 24 hours Span - manually on demand
Probe Length	1m , 2m and 2.2m (NEW low weight 1m)
EMC	EN50270:2006,EN61000-3-2+A1&A2:2009,EN61000-3-3:2008
Low Voltage	61010-1 (Edition 3)
Analogue Ouput	5 x 4 to 20mA isolated, 500Ω load, fully configurable from keypad.
Logic Ouput	5 x volt-free SPCO contacts, 50V, 1A max, configurable as alarms 1 x volt-free SPCO contact, 50V, 1A max, for data valid
Serial Output	RS485 modbus configured
DDU display	32-character alpha-numeric back lit LCD
Keypad	4-key soft-touch entry
Construction	Probe - 316L stainless steel Head & DDU - Powder coated aluminium (IP66)
Ambient Temperature	-20 to +50°C Certified -20 to +55°C On request
Flue Gas Temperature	up to 300°C (standard probe) up to 400°C (high-temperature probe)
Power Requirements	24V DC @ 15A
Compressed Air Requirements	Dry & oil free, 20 litre/min @ 4bar for calibration and purging; 2 litre/min @ 4bar normal operation
	-20 to +55°C On request
	up to 300°C (standard probe)
	up to 400°C (high-temperature probe)
	24V DC @ 15A
	dry & oil free, 20 litre/min @ 4bar for calibration and purging;
	2 litre/min @ 4bar normal operation

Options

Dust Sheild	For applications with over 400mg of constant dust loading
Power Supply	110/220VAC , 50Hz +/- 10%, 400VA to 24V DC @ 15A

The GCEM40 Series can be GSM enabled allowing online remote diagnostic information for technical support.

Challenges Faced by Energy-from-Waste (EfW) Operations

Operational Costs & Downtime

- High costs associated with maintaining and operating emissions control equipment
- Unexpected failures or inspections can disrupt energy production
- Need for accurate, reliable monitoring to minimise inefficiencies and reduce costs

Regulatory Compliance - Strict emissions limits for pollutants such as:

- Nitrogen oxides (NOx)
- Sulphur dioxide (SO_2)
- Carbon monoxide (CO)
- Particulate matter & heavy metals

Risk of hefty fines and reputational damage for non-compliance

Advanced monitoring systems are essential for staying within regulatory limits

How CODEL Supports EfW Operations

Post-Combustion Monitoring

- Measures carbon monoxide (CO) and oxygen (O_2) after combustion
- Helps optimise the fuel-to-air ratio for improved efficiency
- Reduces pollutant formation and protects plant equipment
- Feeds data into automated systems for continuous combustion control

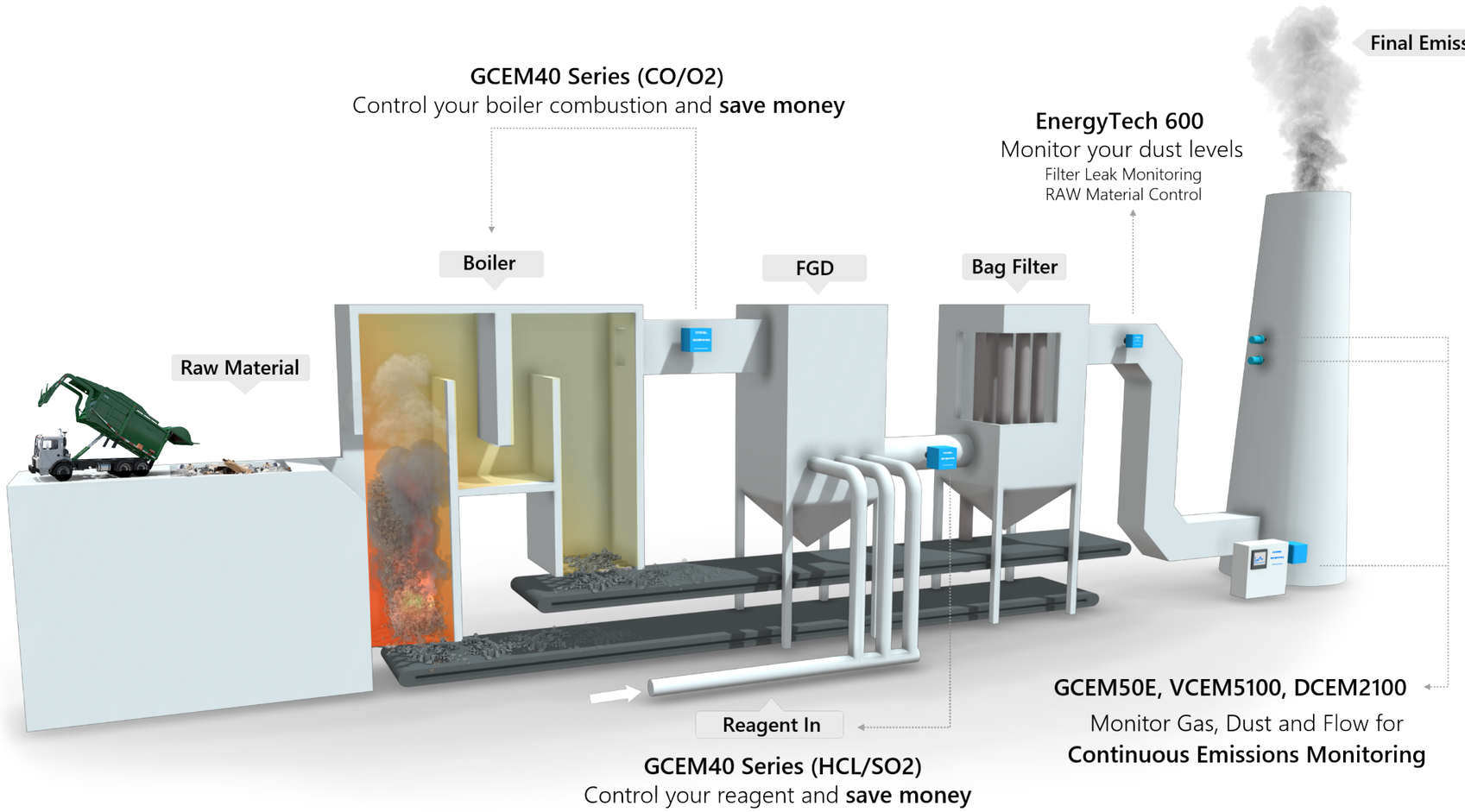
Raw Gas Monitoring

- Monitors sulphur dioxide (SO_2) and hydrogen chloride (HCl) in untreated flue gas
- Enables precise adjustment of treatment materials like sorbents
- Minimises emissions before gases are released into the atmosphere
- Helps reduce unnecessary costs while ensuring regulatory compliance

The CODEL Solution

GCEM 40: Reliable Process Monitoring

- Designed for harsh conditions, measuring SO_2 and HCl with precision even in high dust environments
- Provides continuous monitoring, giving operators full visibility of process conditions
- Helps optimise fuel levels and sorbent additions, improving plant efficiency and reducing emissions



Operational & Compliance Benefits

Post-Combustion Monitoring

- Minimises costly downtime by detecting potential equipment malfunctions early
- Supports regulatory compliance by ensuring stable emissions control
- Optimises combustion and sorbent injection, reducing fuel consumption and unnecessary reagent use
- Enhances overall plant efficiency, leading to significant cost savings

The GCEM40E hot extractive multi-channel gas analyser is CODEL's industry-proven continuous emissions monitor for difficult applications. Designed exclusively for use on a wide range of applications where the flue gas temperature is abnormally high, low or saturated.

Three decades of development, knowledge and practical experience have been utilised to produce this advanced technology gas analyser which gives complete flexibility of use on process or emissions applications whilst delivering super accuracy and repeatability at a competitive price.

Many conventional extractive systems require the sampled gas to be cleaned and dried to a very high standard prior to analysis, invariably resulting in a high maintenance demand. Such elaborate pre-conditioning is not required; the GCEM40E creates 'perfect' duct conditions in a temperature controlled chamber within a separate free-standing cabinet.

Process conditions are extracted using a heated probe system which has an option of compressed air blow-back for excessively dusty applications. Once the sample has been drawn it is simply cooled (or heated) then transferred along a heated sample line, without further conditioning, to be measured using a CODEL multi-channel analyser housed in the cabinet.

Features and Benefits

- Single or Multi-gas infrared analyser
- Analogue outputs, relay outputs and RS485 serial output
- Automatic normalisation to STP using integral sensors
- Optional Oxygen sensor for normalisation to mg/Nm3
- Automatic verification using bottled audit gases
- Suitable for small or large ducts

Typical Applications

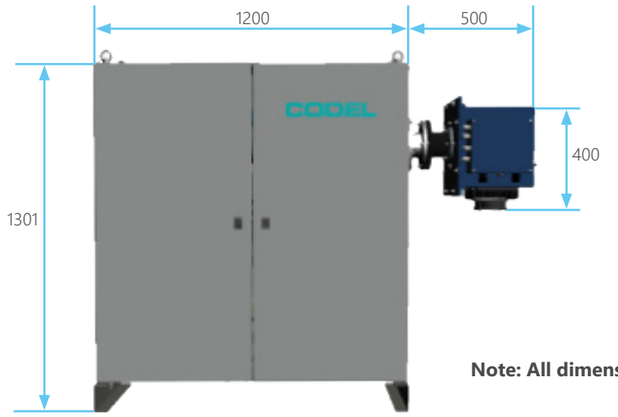
- Emission Monitoring
- Combusion Processess
- Gas Turbines
- Crematoria
- Steam Boilers to 50MW
- Thermal Oxidisers
- Animal Carcass Incineration
- Biomass Boilers
- Diesel Engine Sets
- Small Diameter Stacks
- High Temp Applications
- Silo Monitoring

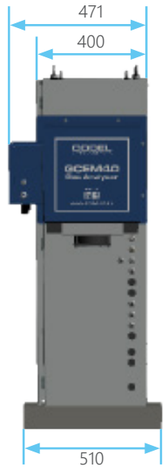
Heated measurement chamber (PTFE coated 316L SS) with precise temperature control over 5 zones and integral pressure measurement

Environmental agencies demand that continuous emission analysers have the facility to prove their performance using known concentration audit gasses. The GCEM40E provides the facility to automatically check and control zero calibration point using clean, dry compressed air or nitrogen. Where independent span checks are required, bottled gases of known concentration can be injected directly into the measurement chamber.

The GCEM40E analyser is capable of measuring a range of CO, NO, NO2, NOx, SO2, CH4, HCl, CO2, H2O and O2 and with integral temperature and pressure sensors can compute fully normalised data directly in mg/Nm3.

Overall Dimensions





Note: All dimensions are in mm

Technical Specification

Sensor Unit

Gas Species Options	CO2, H2O & O2 as standard plus up to maximum 4 gases from: CO, NO, NO2, NOx, SO2, HCl, CH4		
Measuring units	ppm, mg/Nm^3, mg/m^3 , %		
Response Time	Less than 200 Seconds (T90)		
Gas Temperature	Below dewpoint to 1300°C		
Calibration	Automatic and manual zero/span verification		
Gas Species	CO, NO, NO2, NOx, SO2, HCl, CH4	02	CO2, H2O
Max Measuring Range	0 - 6000 ppm or 0 - 6000 mg/Nm3, higher ranges available on request	0.1 - 25%	0 - 25%
Accuracy	+/- 2ppm or 2% of span	0.5% O2	0.5% or 2% of span
Resolution	+/- 1ppm	0.1% O2	0.1%
Zero & span drift	+/- 2ppm or 2% of span per month	N/A	0.5% or 2% of span
Linearity	+/- 2% of span	N/A	2% of span
Repeatability	+/- 5ppm or 1% of span	0.5% O2	0.3% or 1% of span
Ambient Temperature	-20°C to +50°C		
Optical Path Length	2 Meters		
Construction	Corrosion resistant epoxy coated aluminium housing sealed to IP66		
	-20 to +50°C Certified		
	-20 to +55°C On request		
	up to 300°C (standard probe)		
	up to 400°C (high-temperature probe)		

Compliances

EMC	89/336/EEC directive compliant
Low Voltage	73/23/EEC directive compliant

Analyser Cabinet

Analogue Outputs	4-20mA current outputs for each gas channel supplied, isolated, 500Ω load max, fully configurable from software	
Logic Outputs	up to 8 x volt-free SPCO contacts, 50V, 1A max, configurable as alarm and system status contacts	
Inputs	4 x 4-20mA as standard (upto 8 total optional	
Serial Data	RS232 / RS485 (modbus protocol)	
Construction	Mild steel construction powder coated to IP55	
Ambient Temperature	-20°C to +50°C	
Power Supply	220 - 240VAC @ Min 2500W (With optional sample line add 66W/m + sample probe power consumption)	
Air Dryer	Minimum 20L/min @ 6 Bar	

Options

Heated Sample Line

Dual Core	Sample + span gas lines, self regulating heating up to 180°C. Mains supply for sample probe.

Heated Sample Line

Standard Probe	<2g/m3, dust load, no back purge (Optional filters for higher dust loads >2g/m3)
Standard Probe with Back Purge	<2g/m3, dust load, back purge (Optional filters for higher dust loads >2g/m3)

Stack Gas Temperature

Type K Thermocouple	0 - 300°C / 0 - 600°C / 0 - 900°C Options Availbale

Data Presentation (optional)

CODEL SmartCEM Software	Via integrated 15" Touch Screen Panel PC or external PC

The GCEM40E can be GSM enabled allowing online remote diagnostic information for technical support.

VCEM5100 - Gas Velocity Monitor

Two robust infrared detectors are used for the prime sensing, mounted on the stack or duct typically 1m apart in the direction of flow. High efficiency air curtains are fitted to considerably extend the time between maintenance of periods and window cleaning (typically 1 year).

The VCEM 5100 represents the latest generation of CODEL's unique flow monitors. These systems measure the velocity of stack gases using a highly accurate time of flight measurement that is derived from a cross-correlation analysis of the infra-red emissions of the turbulent gas.

The VCEM 5100 is a standalone unit which can be easily integrated into an existing or proposed CEMS system It includes a dedicated Data Display Unit for local data interrogation.

Features and Benefits

- Non-contact infra-red sensing.
- Continuous measurement.
- Suitable for hot and dirty gases.
- No limit on upper gas temperature.
- No moving components.
- High availability, low maintenance requirement.

Typical Applications

- Large Combustion Plants
- FGD Process
- Renewable Energy
- Small Combustion Plants
- SCR and SNCR Process
- Power Generation
- Cement Plants
- Energy From Waste
- Pharmaceutical
- Dust Collectors
- Incinerators
- Petrochemical

The VCEM 5100 has both TUV and MCERT certification which signifies the accuracy and reliability of its measuring capabilities.

DCEM2100 - Opacity/Dust Monitor

The DCEM2100 provides a continuous measurement of opacity or dust concentration in flue gases by continuously measuring the transmissivity of visible light across a process duct or stack.

Its dual-pass optical arrangement is based on twin transmissometers measuring in opposing directions through the same section of the gas stream, providing not only an accurate average of the dust loading, but also providing a unique dynamic assessment of any misalignment errors due to stack movement.

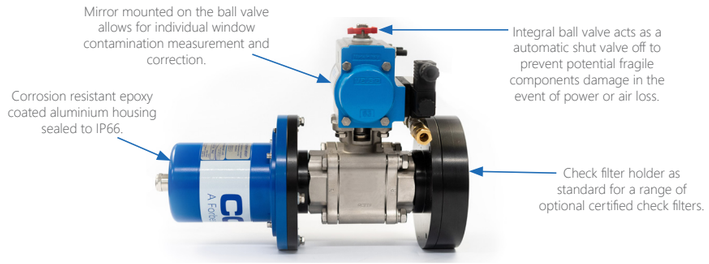
The measurement of opacity or particulate (dust) emissions from a process stack by measuring changes in optical transmission is simple in concept, but the monitor must be insensitive to any other factors that degrade the optical transmission such as contamination of optical surfaces or gross misalignment.

Features and Benefits

- Various path lengths from 0.5m to 15m with longer path lengths available on request
- Certified range of 0 to 0.1 Ext (0 - 20% opacity or 0 - 10 mg/m3 at 5m)
- Automatic shut-off valve in case of compressed air or power failure
- Fully selectable measurement range in % opacity, mg/m3,mg/Nm3 , extinction
- TUV and MCERT certified.

Typical Applications

- Cement industry
- Waste incineration
- Monitoring of filter plants
- Monitoring of ventilation units
- Steel industry
- Wood industry
- Power industry
- Chemical industry



The DCEM2100 is CODEL's proven dust monitor, designed for use in various applications and certified to QAL1.

EnergyTech 600 - Tribo Electric Dust Monitor

The EnergyTech 600 continuous dust monitor uses proven tribo-electric sensor technology to measure mass particulate concentration by detecting the frictional charge from particle collisions.

Its advanced electronics process the signal and provide output via RS485 or 4-20mA, with a built-in display for live data, configuration, and calibration. Measurement levels can be corrected to mg/m³ using an integrated calibration function.

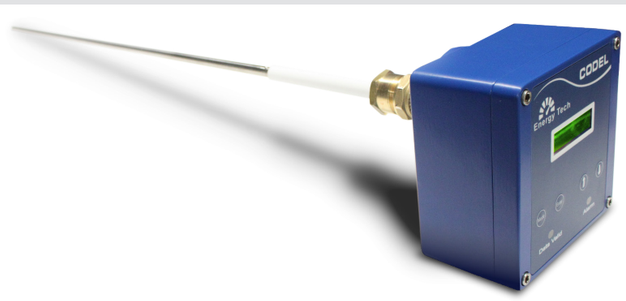
Highly sensitive, the EnergyTech 600 detects dust concentrations below 1mg/m³ in small ducts. It requires no critical alignment or optical surfaces, making installation simple with minimal maintenance, just occasional probe cleaning, offering a cost-effective solution for dust collector monitoring.

Features and Benefits

- Direct sensing method, actual particulate concentration.
- Automated online zero and span checking facility.
- Integrated calibration function for mg/m3 output.
- Easy installation with minimal maintenance required.
- Adaptable, suitable for virtually all dust collectors.

Typical Applications

- Industrial Manufacturing
- Chemical Manufacturing
- Woodworking and Sawmills
- Recycling Plants
- Pharmaceutical
- Power Generation
- Cement Plants
- Energy From Waste
- Mining Operations
- Dust Collectors
- Incinerators
- Petrochemical



CODEL Cloud - Realtime data reporting hub

Embrace the power of real-time data with our state-of-the-art online software, CODEL CLOUD.

The ultimate solution for instant, accurate, and actionable insights. Our software revolutionizes the way you view and handle instrument data, providing a seamless and dynamic experience in the online realm.

Elevate your decision-making processes, enhance operational efficiency, and unlock new possibilities.

Experience the future of data management today with CODEL CLOUD.

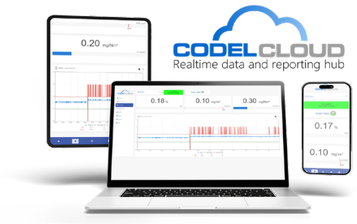
Features and Benefits

- Wireless Environmental Monitoring of Any Plant Size
- Faster Environmental Compliance Reporting for Management
- Performance Monitoring and proactive maintenance
- Monitor Multi-Site Operations and Multiple instruments
- Early Warnings to Eliminate Unplanned Downtime

Typical Applications

- Large Combustion Plants
- FGD Process
- Small Combustion Plants
- SCR and SNCR Process
- Cement Plants
- Energy From Waste
- Dust Collectors
- Incinerators

CODELCLOUD
Realtime data and reporting hub



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