The safety and efficiency of modern thermal power plants relies on accurate measurement and careful control of operating conditions. Employing many decades of experience and expertise, AMETEK Land provides instrumentation and monitoring systems that are ideal for:

- Monitoring coal transport, storage and preparation
- Maximising efficiency of coal-fired furnaces and boilers
- Ensuring emissions compliance

This application note aims to provide an overview of the many technologies available for monitoring essential operations in coal-fired power generation and their respective limitations and advantages.
OXIDISING FUEL

Oxidising fuel has two tell-tale characteristics which can be used to give an early indicator that spontaneous heating is occurring:

1. CARBON MONOXIDE

As oxidation occurs, carbon in the fuel is converted to carbon monoxide. Even in an industrial environment, ambient air contains very little CO, so an increased concentration is a sure sign that oxidation is occurring. CO monitoring is only effective in an enclosed space because air movements in open areas will disperse the gas before a measurable concentration can build up.

2. TEMPERATURE INCREASE

Although it takes longer to give an unambiguous indication of spontaneous heating, an increase in the temperature of the stored coal indicates that spontaneous heating has taken place.
A 600 MW baseload power station requires several thousand tons of coal per day. From coal stockpile through to boiler, there are many transfer points and storage areas that must be monitored for the onset of spontaneous combustion.

If these areas are not properly monitored, the plant could risk unexpected physical and financial losses, along with possible shutdown. Sub-bituminous coals have been increasingly used in recent years because of their wide availability, low sulphur content and low cost. These coal types have a lower heating value and exhibit a tendency to react with oxygen in the air.

The oxidation makes them self-heating and so such coals have a reputation for spontaneous combustion, which has resulted in fires at facilities that previously had excellent safety records. Many facilities that have switched to sub-bituminous coal are discovering that increased monitoring is required to assure safe and continuous operations. Fortunately, several technologies are available to give an early warning of spontaneous heating before a hazardous condition is reached.
COAL STORAGE PILES

Coal storage piles can be monitored by infrared imagers that are typically mounted above and to the sides of the pile, frequently supported with pan and tilt motorised mounts. This enables the equipment to be programmed to ‘patrol’ the pile's surface and detect developing hot areas before they become a problem.

In order to prevent false alarms these systems typically require embedded logic to ignore non-target sources such as hot vehicles that are operating in the areas of pile monitoring.

It is a radiometric thermal process imager, offering high accuracy across a wide range of applications.

Using a high-resolution sensor, the flexible, option-rich ARC Imager delivers detailed thermal images with excellent stability.

The ARC Imager’s four lens options allow a clear view of a target at any distance with outstanding clarity, providing early hotspot detection. Data processing is performed within the imager without the need for a separate signal processor, allowing continuous and fully automated monitoring of remote storage areas.

An alarm output alerts operators when hotspots are detected, allowing preventative action by plant personnel. Variable warning levels and smart false alarm prevention ensure that action is only taken when needed.

The ARC Imager is designed specifically for outdoor industrial environments and can be supplied with housing accessories to match even the most arduous environments, delivering the ultimate in reliability and measurement availability.

The ARC Imager is ideal for monitoring storage piles for any signs of early stage combustion and spontaneous heating.

COAL TRANSPORT | AMETEK LAND SOLUTION - THERMAL IMAGER

ARC Imager

IDEAL FOR MONITORING COAL STORAGE PILES TO DETECT HOT SPOTS.

A low-temperature, rugged process thermal imager, the ARC Imager is ideal for monitoring coal storage piles to detect hot spots.

FEATURES

- High-resolution radiometric thermal images
- Four lens options
- Wide ambient temperature range
- Four configurable areas of interest
- Viewer software as standard

BENEFITS

- Excellent temperature accuracy
- View any target, at any distance, with outstanding clarity
- Suitable for installation in just about any climate
- Rangeable target settings always keep the target in view
- User-friendly software control
CONVEYOR SYSTEMS

Hot inclusions on coal or coke conveyors can go undetected before causing substantial damage. Traditional methods such as visual inspections or single-point pyrometers often have difficulty detecting these hot spots on a moving conveyor. A high-speed infrared scanning system provides the most reliable and accurate solution for continuous monitoring of emerging hot spots. This can reduce downtime and help eliminate costly conveyor belt repairs.

There are three key locations for scanner placement:
1. Above the coal conveyor belt to detect hot inclusions on or close to the surface
2. Looking at the curtain of coal as it falls from one section of belt to another. This allows a scanner to see deeper into the coal and detect hot inclusions
3. Under a belt just after a transfer point. The freshly uncovered belt will have a thermal fingerprint of any hot items that have been in contact with the surface

The systems need to be small enough to be positioned under a belt just beyond the point where the material has been transferred. They need to measure the entire belt surface and alarm if any areas are above a designated temperature. Alarms can trigger water sprays or suppression systems. Alternatively, hot material can be diverted to a safe area so that it does not pass to the next stage of the process.

COAL CONVEYING | AMETEK LAND SOLUTION - INFRARED LINESCANNER

HotSpotIR
HIGH-SPEED SCANNING SYSTEM FOR DETECTING HOT INCLUSIONS

HotSpotIR is a compact, fixed-focus, high-speed scanning system specifically developed to detect hot inclusions at an early stage.

Designed for industrial environments, it rapidly identifies hot material on a moving conveyor, preventing damage and avoiding costly shutdowns.

With high-resolution monitoring across 1000 temperature spots, user-adjustable scanning speeds up to 100 Hz, and repeatability of ±0.5 °C (±0.9 °F), HotSpotIR can detect hot spots as small as 25 mm (1 in) in diameter.

Easy to install, it uses non-contact infrared scanning to measure from 20 to 250 °C (68 to 482 °F).

HotSpotIR utilises a dedicated processor to monitor the entire belt surface, activating an alarm which can be linked to fire suppression systems. The continuous monitoring means hot spots can be detected and the alarm triggered in a hundredth of a second, allowing the operator to respond quickly.

The results are safer employees, reduced risk of damage and downtime, and lower insurance costs.
MONITORING COAL STORAGE SILOS

Carbon monoxide (CO) monitoring is a fast and unambiguous indication of spontaneous combustion in an enclosed space such as a storage silo. Ambient air has a very low concentration of CO, but a large amount of CO is produced as spontaneous combustion begins. A rapid rise in CO concentration is therefore a clear sign that preventative action is required.

Detection systems need to be designed to continuously monitor the atmosphere inside silos to quickly respond to any significant increase in CO levels. This is crucial to allow time for preventative action to avoid damage to plant or injury to personnel. Detection systems typically extract sample gases from the silo headspace. Alarm threshold levels can be set to best suit the plant’s individual operating conditions.

Oxygen (O₂) measurement is also an option for oxygen-limited silos which need to continuously monitor O₂ levels.

Silowatch PROVIDES A CONTINUOUS INDICATION OF THE CO CONCENTRATION

AMETEK Land’s Silowatch rapidly detects the build-up of carbon monoxide (CO) in storage silos, providing a continuous indication of the CO concentration.

If the CO level reaches a user-set limit, the instrument alarms to allow preventative action to be taken before a fire starts or an explosion occurs, increasing plant safety and reducing downtime.

FEATURES

- Specifically designed for storage silos
- Sensitive, 2 ppm detection limit
- Automatic calibration verification
- Optional O₂ measurement
- Simple sample probe with dust filter and blowback
- Z-purge available for hazardous areas

BENEFITS

- Rapid indication of onset of spontaneous heating
- Protects expensive equipment and prevents downtime
- Integrates with plant operating system
- Dual-stream option continuously monitors one or two locations
- Highly reliable in aggressive environments
**MONITORING COAL MILLS**

Carbon monoxide (CO) monitoring also provides an excellent early warning of a possible mill fire.

A fast response to an increase in CO concentration is especially important in pulverisers, where there is a risk that burning material may be introduced, and a hazardous condition can develop in less than a minute.

The risk is highest during mill start-up and shut down as the concentration of combustible dust passes through the explosion range. If burning material is present at this time, ignition is highly likely.

Typically, these types of systems extract a sample from the classifier outlet. If the CO level reaches a user-set limit, the instrument alarms to enable preventative action to be taken before a fire starts or an explosion occurs, increasing plant safety and reducing downtime.

A higher alarm setting is generally needed where mills use recycled combustion gases for coal feed heating.

**FEATURES**

- Specifically designed for coal mills
- Sensitive 2 ppm detection limit
- Automatic calibration verification
- Rugged sample probe with abrasion shield, large-area filter and blowback
- Freeze-protected sample line

**BENEFITS**

- Fast response – T90 less than 50 s.
- Minimised false alarms
- Dual-stream option continuously monitors one or two locations
- Uninterrupted on-line maintenance with external sample filter
- Suitable for installations down to -20 °C (-4 °F)

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**STANDARD START UP**

- **250 PPM**

**NORMAL OPERATION**

- **10 PPM**

**MILLWATCH OFFERS INDEPENDENT ALARM POINTS**

- **300 PPM**
- **50 PPM**

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**COAL STORAGE | AMETEK LAND SOLUTION - CO MONITOR**

**Millwatch**

**RAPID DETECTION OF THE BUILD-UP OF CO IN A HORIZONTAL OR VERTICAL-AXIS MILL**

Millwatch detects the rapid build-up of CO in a horizontal or vertical-axis mill, giving a continuous indication of the CO concentration.

User-selectable alarm relays give an additional warning that a hazardous condition is developing.
Maintaining safe and efficient combustion from a boiler relies on the accurate monitoring of many parameters. The dynamic nature of the process means that the key products of combustion require monitoring and control on a real-time basis. Parameters include furnace exit gas temperature, oxygen and combustibles (CO, hydrocarbons) boiler efficiency, slagging rates and nitrogen oxide (NOx) production.

Gas analysis systems can be installed from the furnace exit to the stack exit. Analysers that utilise various technologies can be used to measure a wide range of emissions including O₂, CO, CO₂, NO, NO₂, SO₂ and sulphuric acid dew point.

Oxygen and combustibles analysers are ideal for combustion control and NOx reduction. A comparison of these analysers has demonstrated their improved reliability and response versus conventional oxygen-only in-situ probes. In addition, the hot-wire catalytic detector used by AMETEK Land offers reduced measurement drift and increased sensitivity to low-level CO changes, while better resisting the poisoning effects of SO₂.

Infrared technology provides a proven non-contact method for furnace exit gas temperature measurement. This can be used as a tool in reducing NOx emissions and indicating possible boiler slagging conditions.

Thermal imaging inside the boiler provides important information on the boiler tube conditions. Measuring tube temperatures and detecting slag build-up allow operators to

THE AMETEK LAND SOLUTION

**Infrared Borescope**

**MEASURES TEMPERATURE PROFILES INSIDE BOILERS AND FURNACES**

Specifically designed to measure temperature profiles inside boilers and furnaces, the AMETEK Land Borescope creates continuous, high-definition thermal images using cutting-edge imaging technology.

- **HIGH ACCURACY FOR OPTIMUM CONTROL**
- **SIMPLE TO INSTALL AND OPERATE**
- **INTEGRATED AIR PURGE AND WATER COOLING**
- **DUST-FREE OPTICAL SYSTEM**
- **AUTO-RETRACT PROTECTION SYSTEM IN EVENT OF PURGE FAILURE**

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**Lancom 200**

**MEASURES SULPHURIC ACID DEWPOINT TEMPERATURE**

The Lancom 200 is a portable Acid Dewpoint Monitor that uses conductive cell technology to deliver accurate, periodic measurements of the sulphuric acid dewpoint temperature (ADT) in combustion processes. Easy to use ADT monitoring enables operators to balance acid emissions with efficiency. This reduces the risk of corrosion while increasing combustion efficiency.

- **OPTIMISE THE FLUE TEMPERATURE TO IMPROVE EFFICIENCY**
- **AVOID COLD-END CORROSION**
- **FULLY PORTABLE – JUST Requires A COMPRESSED AIR SUPPLY**
- **EASY TO MAINTAIN**
- **STORES READINGS FOR LATER ANALYSIS**

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**Lancom 4**

**PORTABLE MEASUREMENT OF UP TO EIGHT FLUE GASES**

A portable multi-gas analyser, the Lancom 4 is able to measure up to eight flue gases in a range of combustion and emissions processes. It supports combustion efficiency with simultaneous measurements for O₂ and CO. These can be combined with a true NOx measurement and SO₂ monitoring for emissions reduction and a hydrocarbons measurement to support safety.

- **MONITORS UP TO 17 COMBUSTION PARAMETERS**
- **ONE INSTRUMENT FOR ALL MEASUREMENT NEEDS**
- **EASY TO CARRY AROUND AND OPERATE**
- **HIGH-QUALITY COLOUR DISPLAY AND USB SUPPORT**
- **CONFIGURABLE TO MATCH APPLICATION NEEDS**
AMETEK Land has been a key part of the AMETEK Process and Analytical Instruments Division since 2006. Sister company AMETEK Process Instruments is also part of this group, contributing to the comprehensive coal handling combustion solutions available to global customers.

Visit ametekpi.com for further information.

**WDG 1200/1210**

STACK-MOUNTED O₂ PROBE FOR COMBUSTION OPTIMISATION

A stack-mounted, in-situ O₂ probe for combustion optimisation, the WDG 1200/1210 range features integrated control and display electronics for a standalone flue gas analysis solution.

Using AMETEK Land’s industry-proven zirconium oxide sensor, the analyser has a unique design for easy field maintenance.

- SIMPLE USER INTERFACE FOR EASY, FLEXIBLE OPERATION
- FULLY FIELD-SERVICEABLE, WITH REMOVABLE INNER TUBE STRUCTURE
- VERSATILE PROBE AND MOUNTING
- RUGGED, RELIABLE DESIGN
- PROVIDES ESSENTIAL COMBUSTION EFFICIENCY MEASUREMENTS

**WDG-VCM**

O₂, COMBUSTIBLES AND METHANE, FIELD SERVICEABLE ANALYSER

A fully field-serviceable combustion analyser, the WDG-VCM has a close-coupled extractive design offering a fast response in a wide range of flue gas applications. Able to measure O₂, combustibles and methane, it provides a complete solution for combustion control and safety. The optional blowback allows the instrument to be mounted in processes even where high dust concentrations are present.
EMISSIONS MEASUREMENTS

Emissions of gases and dust from power plants and other industrial sources are regulated to protect public health and the environment. Plant operators worldwide must monitor and report these emissions to demonstrate compliance with regulations.

Continuous emissions monitors provide essential feedback for optimising the process and for demonstrating compliance with relevant emissions rules. Within the European Union, compliance monitors must be certified as meeting the QAL1 standard according to EN 15267, and this has become a de facto requirement in many other countries. In the United States, analysers must meet Performance Specifications defined by the US EPA.

THE AMETEK LAND SOLUTION

4500 MkIII
ACCURATE AND RELIABLE CONTINUOUS OPACITY MONITOR

A high-specification opacity and dust monitor meeting US and European standards for monitoring combustion processes, the 4500 MkIII is the most accurate and reliable continuous opacity monitor available.

Using a highly homogenous LED light source to minimise sensitivity to optical misalignment, the monitor ensures compliance limits are met with confidence, avoiding the risk of regulator fines and lowering costs through operational efficiencies.

- UNMATCHED, CLASS-LEADING OPACITY MONITORING
- EN 15267 AND QAL1 APPROVALS THROUGH MCERTS AND UBA
- CERTIFIED TO ASTM D6216 AND US EPA PS-1
- EASY OPERATION WITH INTUITIVE BUILT-IN DISPLAY
- MULTI-PRISM RETRO-REFLECTOR REDUCES THERMAL DRIFT
- NO CONTINUOUSLY-MOVING PARTS

4650-PM
STABLE AND ACCURATE LOW-RANGE RESULTS IN STACKS AND DUCTS

Providing a high-sensitivity, forward-scatter laser measurement for particulate matter, the 4650-PM delivers stable, accurate low-range results in stacks and ducts where water droplets are not present in the flue gas.

Consisting of a stack-mounted probe and separate control unit, the 4650-PM enables closer emissions control, with a more accurate measurement than similar PM monitoring systems.

- REDUCED SENSITIVITY TO CHANGES IN PARTICLE SIZE
- VERY LOW DETECTION LIMIT
- MEETS US EPA PS-11
- LARGE-AREA COLLECTION OPTICS FOR HIGHEST SENSITIVITY
- NO MOVING PARTS IN THE MEASUREMENT PATH
- COMPREHENSIVE CONTROL OPTIONS

4750-PM
MEASURES PARTICULATE MATTER IN STACKS AND DUCTS RELIABLY

Utilising a back-scatter laser technique, the 4750-PM provides accurate, reliable measurements of particulate matter in stacks and ducts. It can be used in all combustion processes where condensed water is not present.

With a rugged design suitable for a range of applications, it features a highly stable optical system offering a low detection limit, and can be used as a continuous emissions monitor for compliance or process monitoring.

- LARGE AREA COLLECTION OPTICS
- HIGHLY STABLE AND RELIABLE
- NON-INTRUSIVE SENSOR
- WIDE MEASUREMENT RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM
Highly accurate and reliable non-contact opacity and dust monitors are required to ensure emissions compliance. Low-level measurements of particulate matter (PM) generally use laser light scattering, which can achieve a lower detection limit than is possible with an opacity monitor. UV-based SO₂ analysers, such as AMETEK Process Instruments’ 9900 series, are considered to be the industry benchmark for accuracy for accuracy in testing for sulphur emissions. A rugged single or multi-component analyser can be integrated into a Continuous Emissions Monitoring System (CEMS) or used alone. It can be configured to measure most gas species that absorb in the UV spectrum, such as NOₓ, H₂S and SO₂.

A portable multi-gas analyser, the Lancom 4 is able to measure up to eight flue gases in a range of combustion and emissions processes. It supports combustion efficiency with simultaneous measurements for O₂ and CO.

These can be combined with a true NOₓ measurement (including both NO and NO₂) and SO₂ monitoring for emissions reduction and a hydrocarbons measurement to support safety.

- LONG LIFETIME LED LIGHT SOURCE
- NO MOVING PARTS
- PATENTED, ALL-GLASS, MULTI-PRISM RETROREFLECTOR
- WIDE OPERATING TEMPERATURE RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM

A single or multi-component gas analyser, the 9900 can be used alone or as an integrated part of a Continuous Emissions Monitoring System (CEMS).

Available in rack mount (RM) or wall mount (WM) versions, it can be configured to measure most gas species that are absorbed in ultraviolet (UV).

**AMETEK PROCESS INSTRUMENTS 9900RM/WM**

**USED ALONE OR PART OF A CONTINUOUS MONITORING SYSTEM**

CO gas detection offers a fast, sensitive means to detect the presence of oxidising coal.
AMETEK LAND SOLUTIONS FOR COAL-FIRED POWER PLANTS

Our in-house service centres provide after-sales services to ensure you get the best performance from your system. This includes technical support, certification, calibration, commissioning, repairs, servicing, preventative maintenance and training. Our highly trained technicians can also attend your site to cover planned maintenance schedules and repair emergency breakdowns.

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