How has Industry 1.0 to 4.0 influenced particulate emissions and monitoring

Part 3: Industry 3.0

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Introduction

ENVEA have been at the forefront of environmental monitoring and process control over four decades and with the emergence of the industrial internet of things (Industry 4.0), ENVEA are yet again providing innovative solutions which harness the potential of this new industrial era.

At Clean Air Technology Expo taking place on 11–12 September at the NEC, Birmingham, ENVEA will be demonstrating its range of Particulate Emissions Instruments alongside its advancements in data capture, storage and analytics that will combine the world of industrial particulate and flow monitoring with the latest in smart technology.

In this series of articles, we will be exploring the relationship between industrialisation and particulates and how the rise of industrial processes has driven the emergence of particulate abatement, monitoring and regulation though each of the four industrial eras.

In this third article we will be examining Industry 3.0 in relation to particulates and how advancements in this era still influence industry in modern day manufacturing. Read Part 1 and Part 2 here.

Industry 3.0

Industry 3.0 (1969–2012), often referred to as the digital revolution, was centred around the emergence of computing in manufacturing process.

Following the transition to mass production methods during Industry 2.0 the automation of manufacturing lines through the digital revolution was a significant leap forward in Industry. As with the development of mass production methods in the early 20th century, this era of automation was pioneered within the automobile industry but would ultimately be adopted across manufacturing sectors.

The introduction of Programmable Logic Controllers (PLCs) allowed manufacturing industries to develop repeatable, consistent and controlled manufacturing processes that did not rely solely on human interaction and which allowed manufacturing capacity to expand beyond previous limitations of the workforce. The development of robotics supporting these manufacturing processes allowed wide scale adoption of PLCs and automated processes across industry. With advancements in computing power and the evolution of microprocessors, the benefits associated with automated process control were realised in most industrial sectors.

Supervisory Control and Data Acquisition (SCADA) systems allowed industries to combine the control and precision of automated processes with data monitoring and analytics to better inform and manage processes with developments in networked systems allowing visibility across plant.

Whilst there were many significant technological advancements during this period it is the emergence of large-scale computing in a digital age that underpinned the third industrial revolution.

Particulates during Industry 3.0

The development of particulate abatement from industrial process throughout the 20th century coupled with early particulate monitoring techniques and regulation had dramatically reduced particulate emissions from the early days of the first and second industrial revolution.

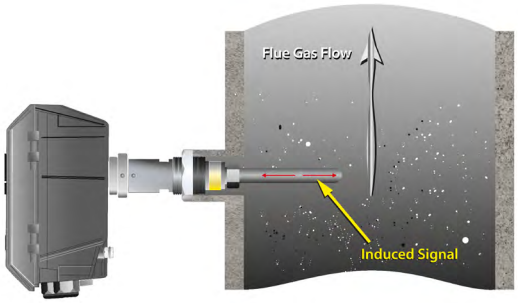
The Industry 3.0 era would see the birth of environmental monitoring as an industry in its own right with technological advancements in instrumentation coupled with increased regulation in western industrialised nations.

The development of a range of effective particulate matter abatement methods (discussed in the previous article) driven by the demand for ever decreasing emissions and awareness of the health risks associated with ultra-fine particles drove the demand for more sophisticated technologies in measuring particulate matter emissions.

Alongside the development of isokinetic sampling techniques, the process of extracting, drying and weighing particulate samples from industrial emissions, a range of new technologies emerged enabling continuous particulate monitoring.

In 1990 PCME Ltd. was formed. Utilising its patented *ElectroDynamic®* technology, it provided a range of continuous monitoring systems that could provide accurate representations of dust concentrations within stacks and outlets from abatement processes.

The correlation between AC electrical charge characteristics of particles and dust concentrations, calibrated to isokinetic samples, enabled validated and certified measurements both supporting compliance to regulation and process control.

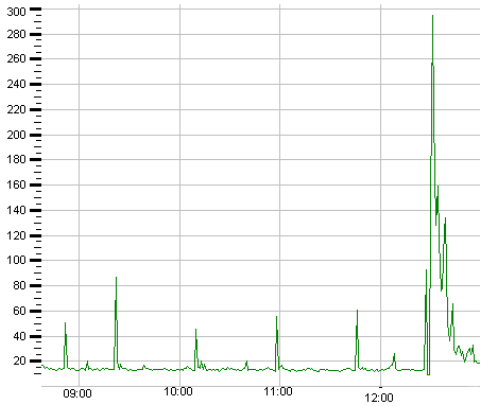


ElectroDynamic® particulate emission measurement technology principle

Technological advancements during Industry 3.0

Further measurement technologies, such as forward scatter, backscatter and dynamic opacity, would emerge during the early part of the 21st century and as the understanding of the response of varying dust signals in relation to operational performance evolved, tools to analyse the particulate emissions data emerged to support both environmental and process monitoring.

Communication methods, such as 4-20 mA outputs and Modbus protocols, for data transfer across wider network systems evolved and the data from particulate sensors became integrated into the PLC and SCADA systems synonymous with Industry 3.0. As well as providing the capability to monitor and report emission limits in line with operating permits, data taken from these sensors, fed through control systems enabled process operators to find cost and efficiency savings through particulate matter readings supporting preventative and scheduled maintenance of abatement systems such as baghouses.



Data Viewer provides graphical analysis of emission trends and events

This led to the development of software packages, such as PC-ME DUST TOOLS, providing even greater analytical capabilities to process operators collecting and storing data from large networked system of sensors across site giving even greater control and visibility from the control room.

As with most industries, the methods and principles of automated factories, the use of PLCs and data capture and storage are integral to current continuous particulate monitoring. The techniques and systems used to drive the modern factory work in harmony with the instruments and data used to monitor their particulate emissions.

Particulate Emissions Control in 2019

In 2019 particulate emissions are monitored in multiple locations across industrial sites.

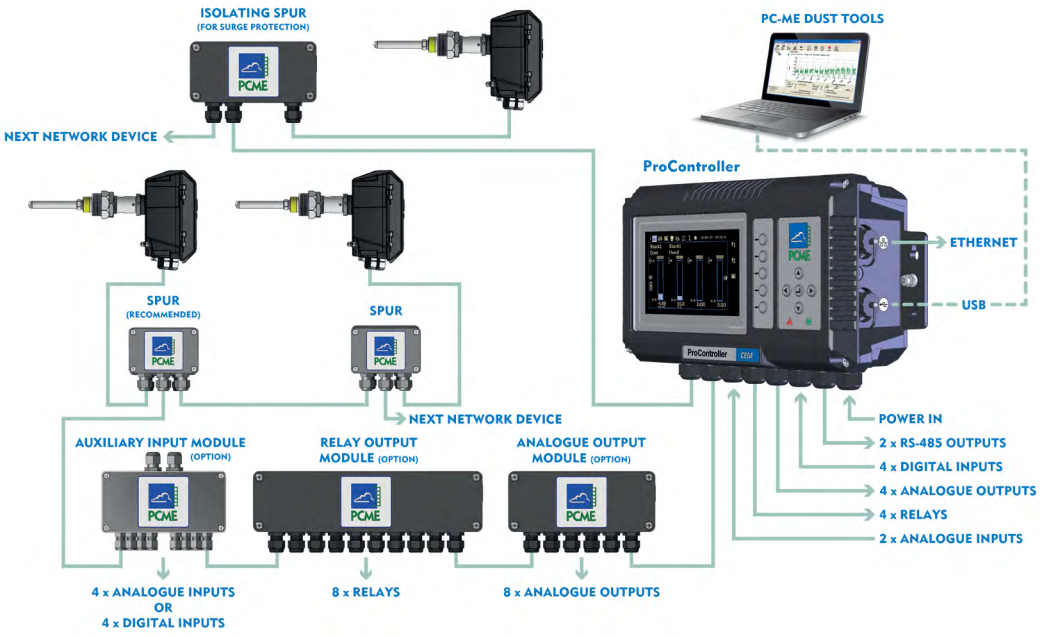
The most heavily regulated industries are required to continuously monitor any particulate emissions to air. The benefits achieved through monitoring at various locations throughout the process, including through various stages of abatement, requires multiple sensors positioned at various locations across site.

ENVEA provide the capability for these sensors to be networked through a single multi-channel control system.

With the ProController Multi-Channel system, up to 32 channels can be connected to a single device utilising a variety of network devices to extend both power and communication transfer across many hundreds of metres whilst maintaining constant reporting and logging of the critical data.

The ProController system can control sensor types across the range of technologies allowing sites to establish a network of ENVEA particulate and flow instruments regardless of the differing technologies required at each measurement point.

The system enables the data to be captured with a variety of logging options, averaging results to meet permit and process control requirements.



The control functions within the ProController enable a level of programmable logic control, pioneered during Industry 3.0, with control of automated self checks, calculations of results to manage process normalisation for environmental reporting and the ability to take in digital signals from plant control systems, such as the plant stop function, which tags data recorded during process downtime.

A range of alarm functions are available to the operator via the ProController system. These alarms alert the operator to increases in readings, providing early warning to deteriorating abatement processes, reducing downtime and avoiding breach events. They also alert the operator to power or communication interruptions across the network as well as providing status alarms for instrument self-check results.

Isokinetic sampling train used to extract particulate samples in order to calibrate particulate monitoring systems

In addition to the local control, a full range of communication methods are available for output of the data and alarms. Signals can be taken in real time over 4-20 mA or RS485 directly back to plant-wide PLCs, allowing constant monitoring of sensor readings and alarm status.

The development of Ethernet networking capabilities has expanded the reach of networked devices. With Ethernet connectivity as standard, the ProController can be added to a sites network allowing secure communication both to and from the controller across site.

For sites without existing data capture and control systems, or those requiring a more advanced analytical tool, ENVEA provide the PC-ME DUST TOOLS software. As well as providing continuous communication to the controller with real time measurement and reporting tools, commands and sensor configurations can be backed up and generated within the software. Automatic download of data is available with analytical tools, such as PREDICT (discussed in the previous article) which enables sites to better manage baghouse performance.

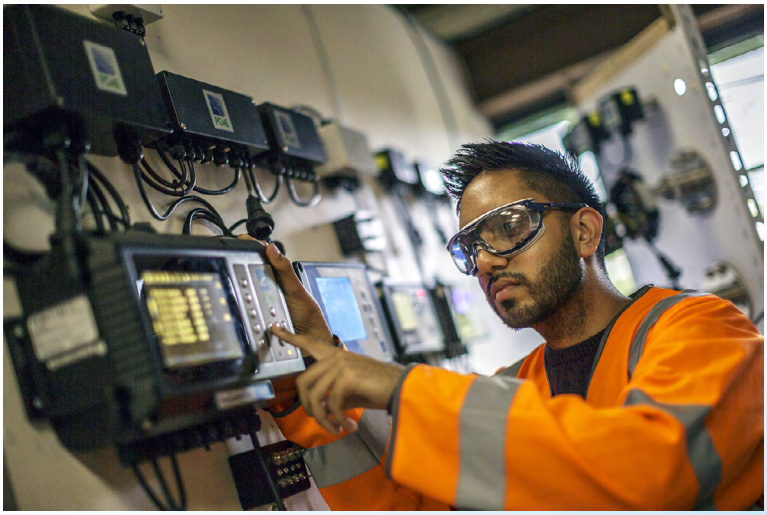
The ProController provides flexibility for sensor configuration, networking, data output and control functions. It enables sites to integrate the range of ENVEA Particulate and flow systems into sophisticated PLC systems and via PC-ME DUST TOOLS software enabling the level of automation and control developed throughout Industry 3.0 in the world of particulate and flow monitoring.

Industry 4.0 in Particulate Monitoring

Now, as we enter the fourth industrial revolution (Industry 4.0 – Industrial Internet of Things) ENVEA is well placed to provide the tools required to enable the transition from local area network control to CLOUD-based computing and data storage with interconnected factories and automated process.

As discussed in our first article, the technology and functionality within the ENVEA range of sensors provides the capability to effectively manage compliance to operating permits for Particulate emissions with combined particulate and flow measurements.

This includes the automated self-checks with active logging to validate the readings meeting the requirement under EN14181 and PS-11. The networking, logging and reporting capabilities of the ENVEA multi-channel control system and PC-ME DUST TOOLS software coupled with this sensor technology ensure this data is available to operators and can be submitted to regulators in the required format.



Centralised particulate emission and flow data logging for regulatory and process data analysis

The benefits of the LEAK LOCATE range of sensors, discussed in our second article, demonstrates how the concept of preventative maintenance through data analysis can be achieved utilising PC-ME DUST TOOLS software and interconnected signals from plant operations to more effectively manage baghouse performance.

The network capabilities of these sensors ensure centralised data logging with the capability to store and output this data to PC-ME DUST TOOLS and site-wide PLCs.

Utilising these existing technologies, analytical tools and networking capabilities, ENVEA will be launching its next generation control system and analytical software for Industry 4.0 at Clean Air Technology Expo taking place on 11–12 September at the NEC, Birmingham.

To learn more about the launch of these new products visit us on Stand 138 and look out for our final article in this series examining Industry 4.0, detailing how ENVEA will be providing the tools in line with the Industrial Internet of Things and looking to the future in industrial Particulate and Flow monitoring in this new industrial era.

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