

Safer cokemaking



This feature was written in April 2020, at a time when a great part of the world is under lockdown and physical distancing has become the 'new normal' in many countries. Like many other industries, coke making must prepare itself to operate under the new constraints and challenges that pandemics like Covid-19 bring with them. The uptake of automated coke making processes including manless coke oven machines and remote operating methodologies could experience a fast-track implementation, especially since the technology is readily available and proven to bring significant impact on safety and efficiency. Based on feedback and data from coke plants in different parts of the world, this article highlights a number of safety technologies and systems designed to enable operators to navigate the health and economical challenges presented by the Coronavirus crisis. By **Oana Niculita***

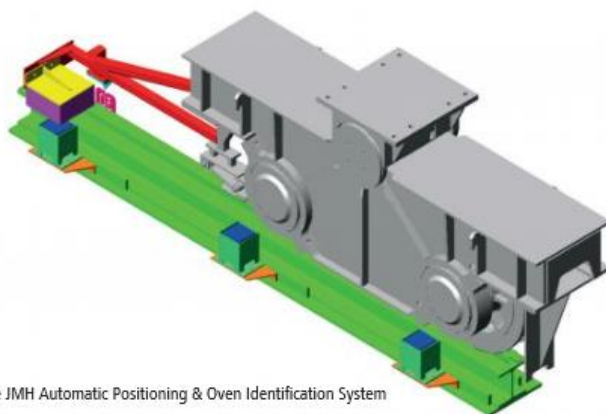
AS the world will continue to deal with the COVID-19 outbreak for a while, governments around the world are issuing recommendations for remote working and physical distancing to ensure the safety and wellbeing of people. Where coke oven batteries are concerned, the highest impact on human health and safety is the ability to remove or limit direct exposure and interaction for personnel in hazardous areas. Automation technologies can be applied to coke oven machinery for the purpose of controlling their operation and removing the requirements for human operators.

However, many coke plants may adopt a multi-phased approach to manless automation, preferring to firstly implement a remote operating mode, to ensure adoption of the new philosophy, and then eventually making the transition to complete manless operation.

Manning on coke oven machines can be eliminated by introducing mechanisms to autonomously carry out all necessary functions including automatic positioning. Remote operation involves the incorporation of all necessary mechanical, control, and communication equipment on the machine to enable remote control

with no operator on board. A remote HMI is separately installed in the battery control room or in a different area and connected to the machine via the existing Data Link system to ensure remote (or future manless) control.

The control system on the coke oven machines is linked to a co-ordinating PLC via the Data Link system, facilitating data transfer to and from the co-ordination system and enabling remote machine operation and eventually future manless operation. The type of data transfer may be the transfer of pushing sequence, cross battery interlocking data, automatic



The JMH Automatic Positioning & Oven Identification System



* John M Henderson Ltd



Power & Fibre Optic Cable Reel installations on Coke Oven Machines

levelling sequence information, recording of operation data, recording event data, or recording information and trends for operation and maintenance.

Some coke plants decide to make possible a more physically remote intervention. Technological developments in the area of data communication and electrical control systems make it possible for supervisors or coke plant managers to access and monitor operations on the battery even while being physically away from the plant. The monitoring team or person may visualise each individual motion of the machines from the comfort of their dedicated remote place from their replica operator interface on their remote desktop or smartphone application for example.

All sequences and operations are available via graphic display pages on the touchscreen monitor/screen. Controlled from the remote HMI via the co-ordination PLC, the remote operator has the facility to monitor and operate every machine movement with the same interlocks as in automatic mode utilising the CCTV images from on board the machine.

Real time CCTV images transmitted from the machines to the control room or the remote location ensure safety is maintained. This has been considered especially useful when prompt decision making and intervention was needed in a timely manner for emergency situations.

Essential safety systems

Fully automatic mode is the next level of operation after the remote method. Started from the machine HMI or from the battery control room HMI, this enables manless operations of complete oven cycles providing that all necessary interlocks are completed via the co-ordination PLC.

• Safety philosophy for remote or manless operation

To implement a higher level of operation as remote or automatic, safety systems must be integrated on coke oven machines. They comprise of installation of necessary mechanical protection and suitably designed PLC programmes on the machines. Interlocks are essential to guarantee that:

- The coke oven machines area is protected against personnel presence during operation
 - Incorrect direction of travel is avoided by the control system
 - Control modes are combined with safety interlocks
 - Alignment of machines is monitored using safety procedures
 - HMIs are displaying accurate process status and alarms.

• Automatic positioning and oven identification system

One of the most important functions of

'unmanned' machines is their autonomous ability to know exactly where they are positioned at any time and be able to transmit that information to the battery control room. The JMH automatic positioning system is a magnetic device consisting of a reader head mounted on the machines and transmitter heads mounted on each oven, bunker and maintenance position. It is a contactless system and provides guaranteed alignment accuracy of 3mm.

The machine will autonomously accelerate, travel at constant speed, decelerate and accurately position to a pre-scheduled oven without any input or requirement from the operator. The oven identification system is used in conjunction with the pushing/charging schedule within the battery control room with communications between the two systems via the data transmission system.

• Data transmission systems

Data communication is an essential element that ensures the reliability of data transfer and it can be provided by either wireless LAN or fibre optic cable reel. Wireless LAN is the simpler system to integrate onto existing machines although cable reels can bring major advantages to plants plagued by trolley wire issues. The cable reel provides a stable power supply with the added benefit of utilising fibre optic



JMH Anti-Collision System installed on a Coke Locomotive

cores, which provide the most reliable data communication system.

Pusher machines and transfer cars have cable reels mounted as standard and on single collecting main batteries. Fibre optic reels can be mounted on charge cars. This solution can be beneficial on plants with a limited number of radio frequencies or plants, which suffer interference.

Anti-Collision Systems

Anti-collision systems are essential for the autonomous operations of the machines. They work in conjunction with the auto positioning system or as a standalone unit. With the stand-alone solution, devices are mounted on each machine and the separation distance is monitored. The system is fully programmable in order to control a deceleration distance point and a travel-inhibit distance point.

When the system is used in conjunction with a data transmission system with machine co-ordination from the battery control room, the oven identification system operates as a back-up in that it can also monitor the relative distance between machines and instruct a long travel speed control action if there is any issue with the machine mounted anti-collision system.

- Personnel protection systems
Manless or remotely operated machines

create an environment where operators are away from the machines, raising, therefore, safety concerns for any personnel who may be located on the battery for different reasons (maintenance or production personnel for areas that have not been or cannot be automated). Personnel proximity detection systems are designed and installed to ensure that personnel are safe from potentially dangerous situations.

JMH's personnel protection system uses safety laser scanners in conjunction with a maximum defined protection zone. It is equipped with an algorithm capable of discerning differences between reflected light from dust and mist and reflected light from objects that must always be detected to ensure safety. Distance is measured by detected signals at two different levels. The system uses built-in cameras allowing video from the scanner to be seen in real time.

- CCTV safety systems

With the latest advancements in high performance anti-corrosion dome CCTV cameras, safety is enabled by providing accurate and reliable views of all angles of coke operation (bunker, machines, ovens and so on) even in an environment of high levels of shock, dust, water resistance, ambient operating humidity (10% to 100%), and operating temperature (-50 °C to

+60 °C). The CCTV systems operate on 360° endless panning and under minimum illumination. They are linked to the control room or any other areas in the network and have mobile terminal capability on iPad, iPhone and Android™ mobile terminals.

Coke oven machine operation under Covid-19 outbreak

Even before the Covid-19 outbreak, the uptake of automated cokemaking processes, including manless coke oven machines and remote operating methodologies, had been adopted at an exponential rate.

Results showed that by reducing the manpower directly involved in coke production, coke operators were significantly reducing the labour cost and process cycle times, while also improving economic efficiency.

Uncharted territory

The coronavirus pandemic has pushed the world into somewhat uncharted territory — and in some industries, like steel making, that might be leading to a significant boom in the efforts towards automation and reducing the number of personnel directly involved in operating the coke oven machines. COVID-19 could be a shock that will unleash a rapid response from coke operators towards fast-track automation, especially given the fact that the technology is readily available and already proven to have a significant impact on safety and efficiency.

Some coke plants may choose to adopt a multi-phase approach starting to automate one area of the battery in a small-scale project, then gradually extending the concept to other areas. Others might go ahead and apply manless technologies on a larger scale.

Charting a more sustainable course

While the outbreak of COVID-19 might bring uncertainty for many in the coke making industry, the appeal of technologies and approaches that decrease site workforce numbers and travel will be growing as the industry seeks to chart a more sustainable course. Like many other industries, coke making must prepare itself to operate under the new constraints and challenges that such pandemics bring with them. Automation can be the answer to many of these challenges. ■