Keeping kiLns turning

Digitalisation is transforming the cement industry. Artificial Intelligence (AI)-based predictive maintenance is here and becoming essential for the competitive optimisation of manufacturing assets. AI is a driver in numerous industries, and it has proven to be a powerful tool for cement manufacturing, across the entire industry, independent of plant size, age, or equipment manufacturer. Enhancing the local plant's maintenance functionality, AI provides increased benefits in terms of equipment reliability, availability, efficiency, and monitoring.

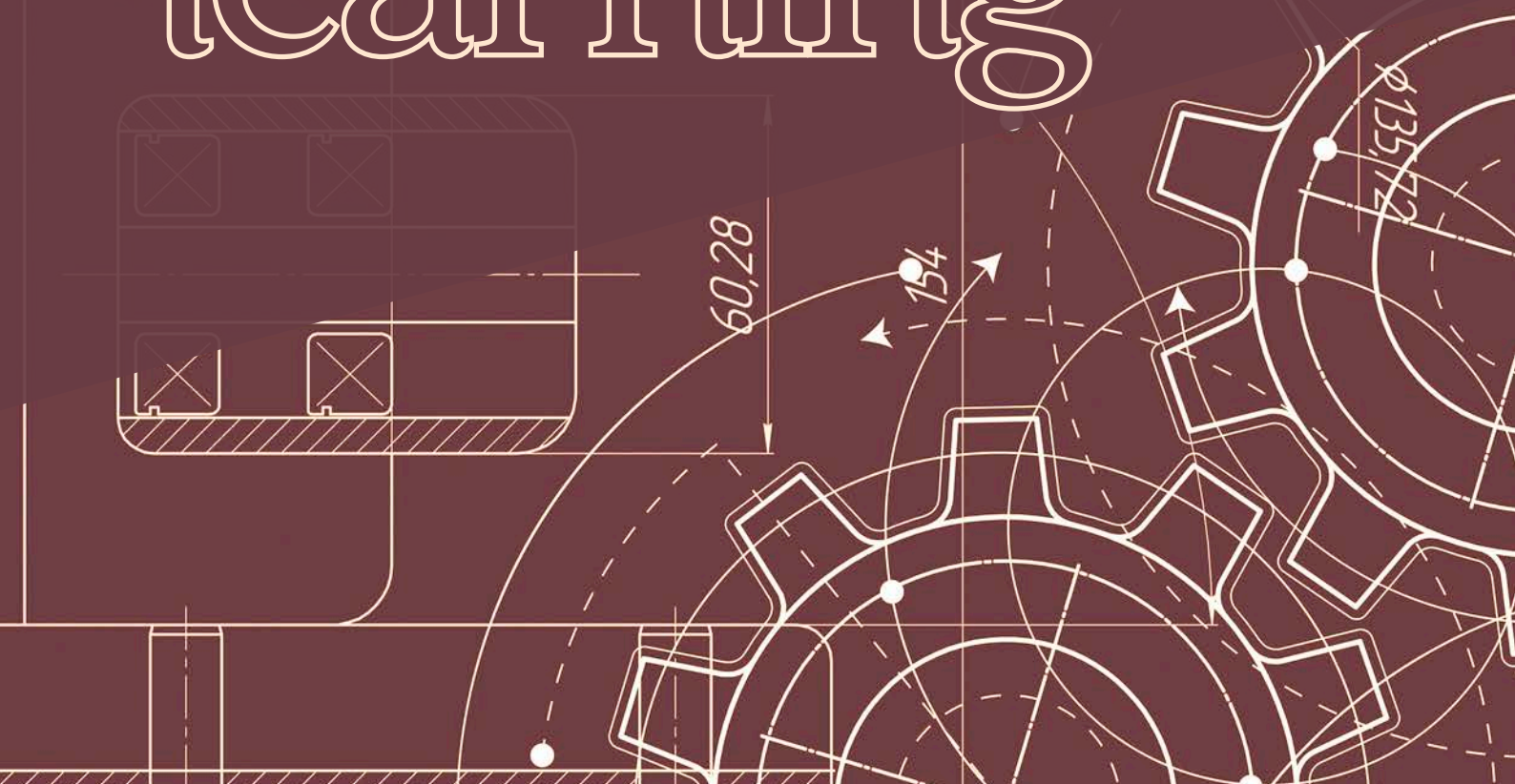
CemAI is an affiliate company of Titan Cement Group providing the cement industry with next-generation predictive maintenance solutions based on artificial intelligence. The solution is a unique mix of a proprietary licensed software and a continuous monitoring and incident resolution service for entire cement manufacturing lines.

The CemAI system has been installed at several cement manufacturing facilities in Europe, Africa, and North America.

"At CemAI, we assembled years of experience in cement manufacturing, inspection, and maintenance and then started to apply an AI and Machine Learning (ML) overlay to that expertise," says Scott Ziegler, CEO of CemAI.

Mary Beth Kramer, CemAI, explains how artificial intelligence and machine learning are now essential tools for cement producers to stay competitive in an industry embracing process optimisation and automation.

with machine learning



Taking a new approach

With a changing workforce of new employees replacing years of institutional knowledge, cement manufacturers needed a digital approach to replace and preserve their legacy products. Fortunately, newer employees are tech savvy, eager to learn AI, and realise how it can improve work life and elevate their job responsibilities. The 'cement plant of the future' exists now through human interaction with AI and ML.

CemAI manufacturing and maintenance experts teamed-up with AI technology company, Precognize (a Samson company), to test the combination of algorithms and sensor data at several pilot plants. Terabytes of historical plant process data needed to be managed and stored – a unique opportunity to digitalise the information. The team recognised that their process could be applied across the entire cement industry and CemAI was born. Current users are gaining impressive results using the technology for operating and managing 'smart factories'.

CemAI enhances current maintenance and operational support.

CemAI's remote monitoring centre collaborates with onsite personnel for diagnosis, troubleshooting, and resolution.

Customers are provided with a 'digital twin' from the plant's historical operation data as established by the existing sensors. This 'twin' creates a point of reference to detect even the smallest, seemingly insignificant deviations from standard operations. CemAI's initial processes simulate the physical asset with a computer model and train it with any historical data available; three to six months of plant-wide data is ideal. A digital audit can identify gaps in plant monitoring. The CemAI system can be up and running in 8 – 12 weeks by their team of engineers with minimal plant involvement.

CemAI's 'specific-to-cement' manufacturing algorithms are enhanced by the company's remote monitoring centres. These centres, strategically located for full global service, receive alerts from the software in real-time. The alerts are analysed by cement plant maintenance experts to develop recommendations and remediation actions shared directly with plant teams. The remote monitoring centres house extensive libraries of prescriptive actions and report key performance indicators to each facility being monitored.

Case study

An example of CemAI's technology in an operational instance, is instructive. At a CemAI-monitored plant in Africa, the data analytics showed a minor increase in the vibration of the main reducer on the kiln drive. The change in vibration was less than 0.5 mm. No alarms were received in the plant control room due to the small change in the vibration. A field inspection of the drive and reducer was performed by plant personnel.

During the inspection, loose pinion bolts connecting the drive to the reducer were found. The maintenance team was able to tighten the bolts and return the reducer to normal operating parameters. Due to the timely alert, coordination, and response, the plant avoided downtime for repair and lead time for replacement parts, which would contribute to a loss of clinker production for a number of days.

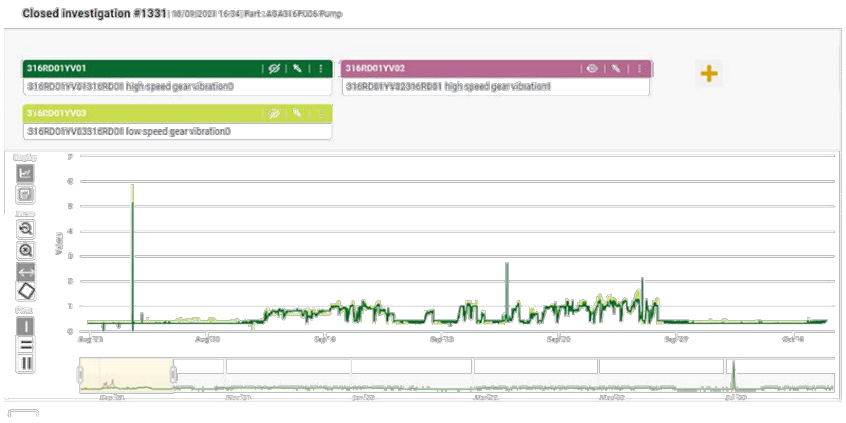
"Our technology can analyse vast amounts of data and detect process disruptions or abnormal

operations – all in real-time. AI never sleeps," says Ziegler.

The CemAI technology monitors important process parameters as well as operations. For example, a tertiary duct air temperature drop – with no process interlock in place – was identified while the damper position showed open. A formal investigation on the tertiary air damper, along with operational controls on the clinker cooler and NOx measurement, was conducted. No process related interlocks were found between the clinker cooler fans and the tertiary air damper. This could lead to significant challenges in clinker cooling and emissions optimisation. A process control change was thus instituted between the clinker cooler fans and the tertiary air damper.

Details and recommendations are shared with plant teams who verify and investigate to restore process and equipment operation.

Tertiary duct air temperature declines lead to investigation.



Minor vibrational changes lead to timely diagnosis.

Summary

Sensors for temperature, vibration, pressure, and other operating parameters play a key role in early detection. Existing sensors can be easily incorporated into the dynamic AI system, as CemAI's algorithm is agnostic to the manufacturer or brand of the sensor. The system also provides a feedback loop for potential sensor or signal failures. As maintenance insights develop, additional sensors can only enhance predictive maintenance outcomes from CemAI technology. A representative single-kiln cement plant may have between 1000 and 5000 signals of various types (temperature, vibration, air flow, pressures, etc.) being tracked.

The CemAI solution complements the expertise of local plant maintenance as the industry moves into the digital age. The operational efficiency and process reliability gained enables manufacturers to get full value from the assets and ensure constant product quality. Digitalisation is the track for optimised operation and machine learning/AI solutions like CemAI can lead the way and help plants take advantage of digital transformation. ■

About the author

Mary Beth Kramer is the President and owner of Kramer Consulting, a public relations, marketing and lobbying firm located in Yardley, PA. For over 15 years, Kramer Consulting has represented clients from the building materials sector including Roanoke Cement Company/Titan Florida/ Titan America, LLC, Oldcastle Materials, the American Concrete Pipe Association, Kerr Pipe and The Concrete Pipe Association of NJ.