Since the September 2015 deadline, more than 100 Portland cement manufacturing facilities across the US now have stricter emission standards in their cement kilns and associated clinker coolers.

To meet these new standards put forth by the US's Environmental Protection Agency (EPA), facilities must have precise knowledge of emissions, a task made easier with the help of process instrumentation.

The new rules of the game

With the NESHAP guidelines, rather than using particulate matter continuous emission monitoring systems such as gas analyzers, manual stack testing is now required.

Site-specific operating levels will need to be established using continuous parametric monitoring systems, with the allowable emission standard changing to 0.07 pounds per ton of clinker production for existing plants. For newly built or reconstructed plants, the source standard is changing to 0.02 pounds per ton of clinker production.

The EPA is also changing the alternative organic hazardous air pollutants (HAP) standard from nine parts per million (ppm) to 12 ppm.

Existing standards for mercury, THC (hydrocarbons) or HCI (hydrochloride) have not been changed. This revision in organic HAP standards is estimated to save over $50 million (US) in production costs.
Evolving standards in cement production

The EPA has added work practice requirements for open clinker storage piles that will reduce fugitive dust emissions from these sources. The final rule also contains a definition of open clinker storage piles and requires that a source’s operation and maintenance plan include the steps the facility will take to minimize fugitive dust emissions from open clinker storage piles.

According to the EPA, reduction of these substances from open clinker storage piles.

SITRANS WB300 belt scale is suitable for weighing the hot clinker after it leaves the kiln and storage, the following process instrumentation

In order to establish measurement of clinker production monitoring requirements is considered a violation.

Clinker production monitoring requirements

In order to determine hourly clinker production, one of two methods must be used:

1. Install, calibrate, maintain, and operate a permanent belt scale system to measure and record weight rates in tons per hour of the amount of clinker produced. The system of measuring hourly clinker production must be maintained within ±5% accuracy.

2. Install, calibrate, maintain, and operate a permanent belt scale system to measure and record weight rates in tons per hour of the amount of material fed into the kiln. The system of measuring hourly clinker production must be maintained within ±5% accuracy. The clinker production rate must be calculated using a kiln-specific feed to clinker ratio. This value must be maintained and verified monthly.

How can instrumentation help?

In order to establish measurement of cement production and storage, the following process instrumentation should be considered:

Belt scales for pan and belt conveyors

SITRANS WB300, for example, is a specialized belt scale for use on pan conveyors or apron feeders. It is designed to operate at elevated temperatures as the clinker leaving the kiln can be up to 400 °C (752 °F).

Pan conveyors do not use rubber belting, but feature steel pans that are hinged and travel on rails. The SITRANS WB300 can support these rails in order to measure the continuous flow of clinker in tons per hour (tpn).

The heavy-duty shear beam load cells are mounted directly to the rail supports for fast reaction time and accurate weighing. Self-aligning spherical rod ends are mounted perpendicular to each other to ensure that the dynamic frame of the scale maintains its position for maintenance free conveying and alignment.

SITRANS WB300 is accurate to ±2% over a 33-100% rate range. That means that the scale is as accurate at 33% of the nominal flow rate as it is at 100% of that rate. The scale can monitor the flow rate of clinker production after the material is discharged from the kiln and before it is stored in the silo to support option one above for clinker production monitoring.

The Siemens Milltronics MSI belt scale has more approvals than any other belt scale on the market. It was designed for use in the cement industry. Its proven design has lasted in production facilities for over 30 years. Materials feed into the kiln in the form of limestone, clay, or shale, which can be done via a belt conveyor.

Belt scales can also be added to conveyors feeding fuel or alternative fuel into the kiln to make the clinker. The MSI features a single idler design with two triple beam stainless-steel parallelogram load cells.

The load cells of the MSI do not react against horizontal forces from the belt, a proven feature of the MSI. This unique design ensures optimum performance in harsh conditions and dusty environments.

Flow rates up to 12,000 tons per hour can be monitored at ±0.25% accuracy over a 20-100% rate range. The combination of two MSI belt scales in tandem can achieve ±0.25% accuracy for critical application monitoring. The Milltronics MSI can monitor the flow rate of material into the kiln to support option two above for clinker production monitoring.

Radar level measurement in clinker coolers

SITRANS LR560 is the world’s only 78 GHz FMCW two-wire radar for non-contacting level measurement. The transmitter features an extremely narrow four-degree beam, which allows for accurate level measurement in applications with obstructions and also allows for the unit to be mounted on a high nozzle or standoff.

With a range of up to 100 meters (328 feet) the device is extremely versatile for inventory monitoring as well as process measurement.

The clinker exits the kiln at temperatures of over 1800 °F (1000 °C) and must be cooled before moving to the clinker silos. The clinker is pushed with a metallic grate and air is directed from below to cool the clinker.

The depth of clinker on the cooler grate affects not only the production rate of the facility, but also the quality and consistency of the final product. Traditionally, the bed depth of clinker on the cooler is inferred by measuring a secondary effect.

The two most common secondary measurements are:

• The hydraulic pressure on the grate drive: the higher the pressure, the more material the grate is moving.
• The cooling air pressure: the higher the back pressure, the more material is present.

The problem with using secondary measurements for clinker bed depth control is that the response rate is slow, as there is an inherent time lag between the inferred measurement and the control device.

Accuracy is also compromised, as the measured secondary effect is rarely linear or even repeatable. Direct measurement of the clinker depth has traditionally been fraught with problems, especially due to the extreme high temperature of the product and the ambient environment directly in front of the kiln.

Stories from the field

Longyuan Construction Anhui Cement Company, Ltd. is a Chinese producer of cement. The company found that decreased stability and durability of its belt scales was a growing problem. Operators would calibrate the belt scales, but after just a few days, measurement accuracy decreased to a point outside of Longyuan’s mandated range.

After careful consideration, Longyuan selected a Milltronics MMI belt scale with a Milltronics BW500 integrator and a SITRANS WS300 speed sensor.

After successful completion of belt scale calibration, accuracy results are now in line with Longyuan’s requirements of ±0.25%. These belt scales reduce the need for ongoing maintenance expenses and also help the company operate more smoothly. Facility downtime is therefore lessened, keeping Longyuan up and running for longer periods of time.

And for level measurement in a clinker bed, St. Marys Cement in Ontario, Canada, uses radar technology to gain better control and lower their operating cost.
Evolving standards in cement production

Directly measuring the level of the clinker means that measurements are immediate, and there is no lag time. Also, it is more accurate as measurements are not inferred from a secondary source.

Lastly, since there is only one instrument that is measuring the level, it costs less than using a secondary measurement device. The extreme temperature inside the kiln is reduced to nominal levels at the radar transmitter by using a one-meter long pipe extension. The very narrow beam is ideal for this extension pipe.

Changing times, changing standards

Siemens is the only supplier that can provide complete industrial automation solutions for the cement industry.

PLCs, DCS systems, drives, motors, gas analytics, pressure, temperature, flow, positioners, recorders, motion control and monitoring, HMIs, and communication.

Level solutions include radar, ultrasonic, guided wave radar, and capacitance technology, and Siemens weighing solutions include load cells for weighing bins or hoppers with compact mounting units for easy installation of vessels up to 2000 tons.

Like them or not, the new EPA regulations are a reality for the US cement industry. With more controlled processes thanks to process instrumentation, cement producers can help ensure a healthier environment for future generations.

For more information on the EPA’s NESHAP guidelines for Portland cement production facilities, visit: http://www.epa.gov/airquality/cement/

With the aid of a wave guide, SITRANS LR560 handles temperatures of up to 1800 °F (1000 °C) on the clinker cooler.

SITRANS LR560’s highly durable polyetheramide lens antenna and narrow four-degree beam angle make it ideal for level measurement in clinker production.