Fine-tuning the raw mix

Changing market conditions and customer needs can impact significantly on raw material requirements. This shift in raw material specification combined with the complexities of quarrying the right materials has prompted the Cemex-owned Lyons cement plant in Colorado, USA, to upgrade its raw material analysing capabilities.

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When the Cemex cement plant in Lyons, Colorado, was commissioned its associated quarry and reserves made it suitable and economical to produce an ASTM Type I cement, requiring a low percentage of limestone and a high percentage of shale. As has been the case with many cement plants around the world, changing market conditions and customer demands for ever-increasing cement performance forced the plant to move to Type II and Type V production and eventually oil well cements, which require a much higher percentage of limestone in the mix.

Cemex Lyons cement plant

Cemex's Lyons cement plant, acquired by Cemex in 2000, began operations in December 1969. The works has a capacity of over 0.5Mta of Portland, low-alkali and masonry cement and delivers its output to customers nearly entirely by truck.

The plant serves a market area that covers the Denver metroplex, the Colorado Front Range (which includes counties in Nebraska, New Mexico and Kansas) and counties in Wyoming.

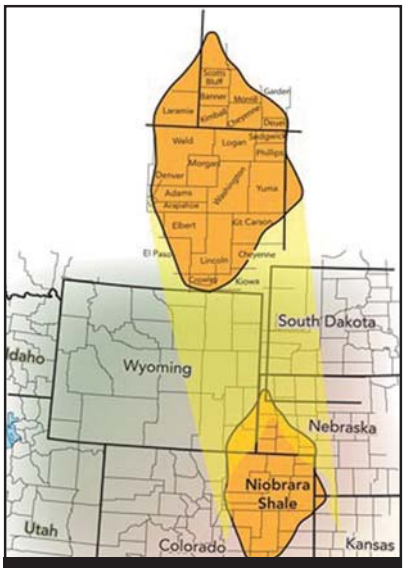

Figure 2: the Niobrara Shale Formation

Figure 1: Cemex Lyons cement plant near Longmont, Colorado, USA

The labour force varies depending on demand at any given time but can be as many as 100 people.

The entire operation occupies 2000 acres on a significant limestone and shale outcrop called the Niobrara formation in Boulder County, northeastern Colorado (see Figure 2).

The plant's original 600-acre quarry was replaced in 1997 with a new 1620-acre quarry, located in the Dowe Flats Valley two miles from the plant. The old quarry was restored to lakes and rolling hills. The plant has invested significantly in protecting the surrounding environment, particularly in the reclamation of mined land at both the new and old quarries. New pollution control equipment was also installed recently.

Time for a new analyser

As is the case with many cement production facilities, the Lyons plant has had to extract raw materials from a complex quarry while at the same time shipping product to meet shifting market conditions and customer needs. In recent years this has necessitated switching to Type II and Type V as well as oil well, cements.

However, as these different types of cement presented conflicting raw materials demands, they required closer control of the raw material mix. To manually control the raw mix an analyst would collect composite samples from a sampler located prior to the pump every two hours.

The analyst would run the sample on an X-ray and make changes to the feeders based on a set of guidelines. The analyst would then call the changes to the control room where they would be entered. The difficulty in achieving these conflicting demands with conventional manual control of the raw mix led Cemex to consider use of an online nuclear elemental analyser to achieve its goals.

Following a review of multiple vendors, Cemex settled on the new LiNX analyser by Sabia Inc due to the equipment's high performance, ease of installation in tight quarters and because no external

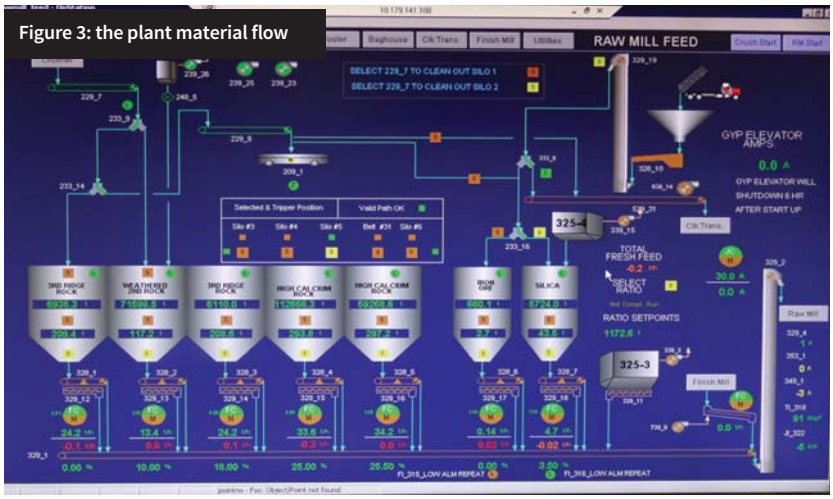

Figure 3: the plant material flow

electronics enclosures were required. Furthermore, the analyser would require virtually no cabling aside from a power and Ethernet cable necessary for installation.

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More responsive system

Since the cross-belt analyser has been installed, the control software automatically makes feeder corrections every 10 minutes.

In addition to more frequent analysis, the control software is able to make changes instantly as it does not have to wait on sample preparation time, analysis and calling results to the control room. This makes the system significantly more responsive to fluctuations in raw material chemistry.

By making small changes more frequently, the system is also able to avoid some of the large swings and overcorrections that often occur with manual control.

A team effort

The successful application of closed-loop raw mix control at the Lyons works was due to the teamwork between Sabia and Cemex Lyons.

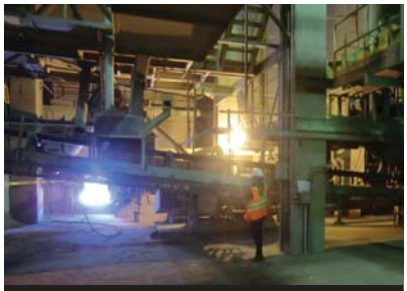


Figure 4: the optimal analyser location upstream of the mill


Figure 5: looking at the mill downstream of the analyser in the same hall

The analyser was ordered in late December 2013 and installed in May 2014. The entire commissioning process involved face-to-face meetings with key personnel before, during and after installation as well as regular conference phone calls with minutes, assignments and follow-up.

In ideal circumstances a PGNA analyser can be installed for automated closed-loop raw mix control without this kind of attention, but it is safe to assume that in such cases the result is not optimal. Cemex's continuous improvement of its overall quality assurance programme encouraged and supported these efforts.

Figure 6 (below): due to the modular nature of the LiNX design, the analyser can fit in a tight space

Figure 7 (right): the in-situ Sabia LiNX Analyser installed with a minimum of structural modifications

Figure 8: the primary operator interface screen

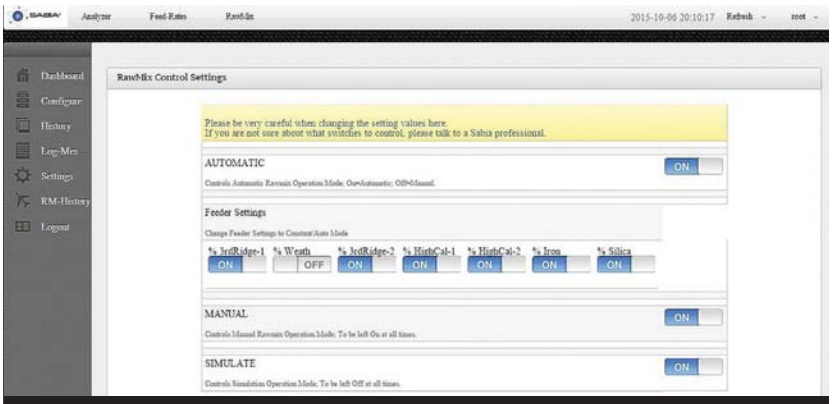


Figure 9: RHEA control settings page

RHEA raw mix control software

First rolled out at Cemex Lyons plant, RHEA is a proprietary bias-based PID control software. It works based on a self-learning multi-variable-predictive algorithm. RHEA provides users with complete control on how to stabilise their raw mix operations.

RHEA's key features include:

- ease of installation
- fast processing and adaptive control to best use the plant's various feeders to output a perfect mix.
- alarms, starvation notification and other features to help with daily operations.

Figures 10 and 11 show the daily LSF deviations and moving averages for mix A (Type II) and mix B (Class C oil well mix) sampled at the raw mill. The dotted red vertical line indicates when the Sabia was installed, ie May 2014. The data shown is unfiltered for days when the raw mill uptime was relatively poor or for events of silo contamination and feeder starvations due to mechanical issues.

Table 1 shows % LSF deviation at two sampling points (raw mill and kiln feed) before and after installation of the Sabia analyser. It can be inferred that conservatively a minimal 30 per cent reduction in LSF deviation can be achieved with a SABIA LiNX Analyzer even in challenging applications.

Ready for a changing market

As shown by these operational results, Cemex Lyons cement plant achieved a significant reduction in C_3S variability, enabling the works to deal effectively with changing market conditions, customer requirements and positioning the production facility to take on future challenges with confidence. ■

Table 1: LSF deviation before and after Sabia installation

	Mix A		Mix B	
	Raw mill	Kiln feed	Raw mill	Kiln feed
Before Sabia	3.55	2.28	4.58	3.00
After Sabia	2.60	1.57	3.11	1.96
Reduction (%)	27	31	32	35

Figure 10: raw mix A

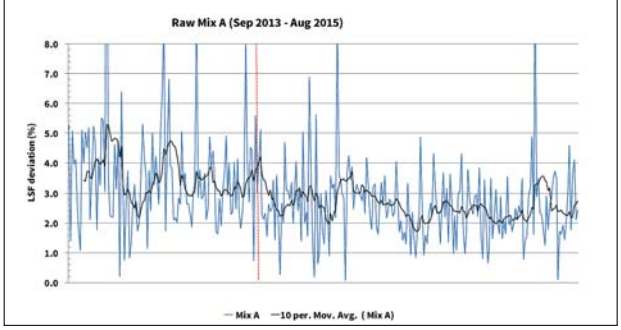
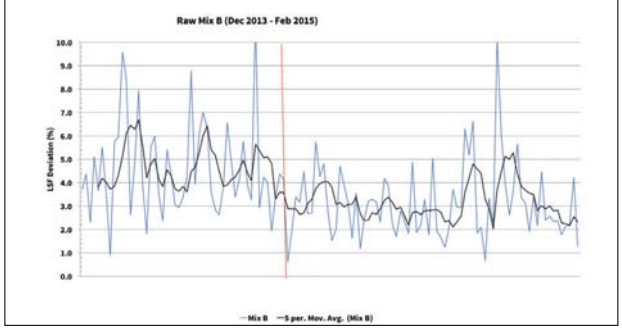


Figure 11: raw mix B



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