Figure 1. Mason City cement plant.

THE MASON CITY EXPERIENCE

KEVIN GORDON, THERMO FISHER SCIENTIFIC AND JEFF HOOK, LEHIGH CEMENT COMPANY, USA, UNVEIL THE NEW CB OMNI FLEX SYSTEM AT WORK INSIDE THE MASON CITY CEMENT PLANT.

Introduction

Lehigh Hanson cement company is part of Lehigh Hanson Inc., member of the HeidelbergCement Group. Recently, Lehigh Hanson decided to install Thermo Fisher Scientific's latest online PGNAA analyser at its cement manufacturing plant in Mason City, Iowa. This new system is called the Thermo Scientific CB Omni Flex. It is a unique, new generation analyser that offers real time analysis of raw materials, as well as the intriguing option of using either an electronic neutron generator or californium (Cf-252) as the source of neutrons.

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Figure 2. The CB Omni Flex at the Mason City plant.

Background

The Mason City cement plant (Figure 1) has been operating since 1911. The Mason City area was selected for the plant due to the availability of quality raw materials, a large deposit of limestone, glacial till and blue clay. The majority of the operating plant was modernised in the mid-1970s and currently has a rated capacity of 730 000 tpa clinker production. The main equipment in the plant consists of a Polysius double rotator raw mill, a four stage precalciner FLSmidth kiln system, three 1250 hp and one 3500 hp FLSmidth ball mills for cement. The plant operates year round and employs 125 people.

Heidelberg's global presence requires it to continuously consider flexibility with the various core technologies that it uses for process control. One of these technologies is Prompt Gamma Neutron Activation Analysis (PGNAA) for online elemental analysis, which is an essential process control tool for achieving consistent stockpile and raw mix chemistry. PGNAA requires the excitation of substance by emitting neutrons into the material. These neutrons are sourced using a radioactive isotope called californium 252, or by using an electronically driven neutron generator.

Since Cf-252 is a radioactive isotope, regulations govern the importing, exporting and handling of these sources. Regulations can vary by country and often create challenges in expediting projects on a timely basis. With this in mind, Lehigh Cement decided that a flexible system would be in its best interest and chose the Thermo Scientific CB Omni Flex.

Table 1. The relative advantages of the Cf-252 and neutron generator options

Cf-252	Neutron generator
Small physical size	No need for regulated isotopes
No failure modes/ unmatched reliability	This technology is well understood and decades old
Low cost per neutron	Ability to turn off to save tube life
Less shielding required	Ability to turn off for safety reasons

CB Omni Flex

Depending on the source of neutrons chosen, the Thermo Scientific CB Omni Flex uses PGNAA or Pulsed Fast and Thermal Neutron Analysis (PFTNA) to determine in real time the elemental composition of bulk materials being transported on a conveyor belt. The system analyses the entire material stream and is not subject to the added variance and cost associated with material sampling. The CB Omni Flex allows the customer to choose which excitation source they wish to use at the time of purchase. Then, during the life of the product, the customer can elect to change from one neutron source to another at any time. Since it is difficult to predict the long-term costs, reliability and availability of the different neutron source options, this feature gives the user unrivalled flexibility to adapt to changing market conditions and performance requirements.

With the CB Omni Flex, the buyer has the option of selecting how they would like their neutrons sourced. This decision should be made carefully. There are advantages and disadvantages that the user should take into account.

A past concern regarding analysers using neutron generators has been the loss of accuracy related to having just a single source. A single point source can result in diminished sensitivity to the outside edges of the material cross-section on the belt. This issue was addressed by using different materials surrounding the tunnel cavity to achieve virtually equal sensitivity to all parts of the cross-section, thereby mimicking the accuracy found in Cf-252-based analysers.

Another source selection criterion is the duty cycle of the analyser. Cf-252 has a half-life of 2.6 years, necessitating replenishment after 2 – 3 years. While the neutron generator does not require replenishment, neutron generator tubes do require periodic replacement. Generally, a neutron generator tube can last more than 9000 hours, depending on the neutron flux used. Therefore, analysers used in raw mix applications with 24/7 operation can anticipate a tube life of approximately 500 days, or 1.37 years. In contrast, analysers used for stockpile control could run for more than five years without tube replacements, since the neutron generator can be turned off when not in use and less neutron flux is required.

For the relative advantages of the Cf-252 and neutron generator options see Table 1.

With the regional uncertainties and variety of changing rules that govern the transport and ownership of radioactive isotopes, an investment in neutron flexibility seems a prudent choice. The CB Omni Flex allows the end user to protect their investment by

allowing for the two neutron sourcing options to be swapped out at any time, if the customer wishes to switch.

The Mason City experience

The decision to source the neutrons initially with a neutron generator at the Mason City plant was to test this option, add flexibility throughout the organisation, and to protect against any possible supply interruptions of Cf-252.

Recently, the Mason City plant was faced with a situation whereby limestone was being wasted due to the heterogeneity of MgO concentrations throughout the existing limestone quarry. With no way of controlling the MgO content at the quarry, the plant would often run below the target percentage and thus waste limestone, which could otherwise have been used in the cement manufacturing process. This was effectively reducing the life of the quarry, as well as wasting limestone. Therefore, the Mason City plant decided to install the analyser to acquire real time, minute-by-minute results to monitor the limestone being sent to the plant.

The analyser shown in Figure 2, was installed in April 2010 and the company quickly observed the positive impact. Figure 3 shows that the percentage of MgO in the final clinker has increased significantly since installation. In 2009, the average MgO in the clinker was approximately 2.07%. With the addition of the analyser in 2010, allowing real time control and monitoring, the average MgO in the clinker was increased to 3.03%.

The analyser computer, often referred to as the Opcon, is located in the lab and is monitored during production. The quarry manager, who is responsible for attaining targets for the limestone, utilises the Omni Net software, shown in Figure 4, to monitor the information. The software is a web based software tool, which allows the user to access critical process data from remote terminals such as PDAs, laptop computers and desktop computers. The software provides a flexible means to dispatch process quality information throughout the plant.

Initially, a key concern for the Mason City plant was the availability of the new CB Omni Flex system. The site could not risk a situation arising whereby the analyser was not available due to problems with the neutron generator. After the first nine months of operation, the analyser and neutron generator have been proved to be very reliable. The neutron generator was unavailable for only 6 minutes during that period and was able to recover itself with no assistance from site personnel.

Conclusion

The addition of the CB Omni Flex has allowed the Mason City plant to increase the MgO of the limestone and thus significantly reduce costs as well as lengthen the active quarry reserves. With the release of the CB Omni Flex, the cement producer now has a flexible option to protect its investment for years to come.

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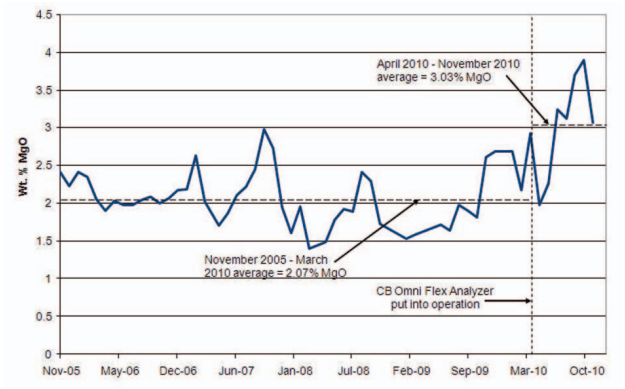

Figure 3. Weekly average MgO weight % in clinker at Mason City from late 2005 through 2010.

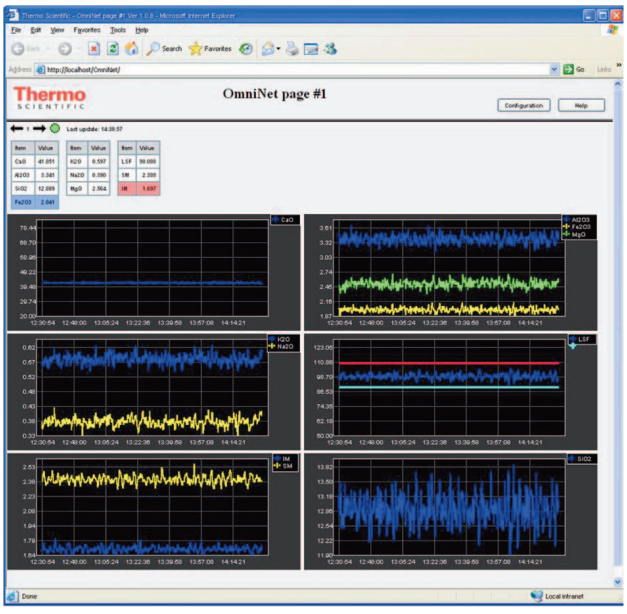

Figure 4. Thermo Scientific Omni Net software allows remote access to monitor analysis information.