



Success in the removal of acid problems in kiln inlet gas analysis in Cementos Lemona

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High sulphur content in the raw material and fuel has left Cementos Lemona facing the burden of expensive repairs and long downtimes due to acid-damaged gas analysers. FLSmidth's KilnLoq HW Laser System stands up to these high-acidity challenges and has thus ensured Cementos Lemona reliable and effective operation.

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KEYWORDS: Gas analysis, Kiln inlet, Probe system, Hot/wet gas, Laser gas analysis

El alto contenido de azufre y combustible en la materia prima obligaba a Cementos Lemona a hacer frente a reparaciones costosas y largos periodos de inactividad debido a los analizadores de gas dañados por el ácido. El sistema láser de HW de KilnLoq soporta estos desafíos de alta acidez y, por lo tanto, garantiza el funcionamiento fiable y eficaz de Cementos Lemona.

PALABRAS CLAVE: Análisis de gas, Entrada de horno, Sistema de sonda, Gas caliente / húmedo, Análisis de gas láser

INTRODUCTION

In 2015 & 2016, Cementos Lemona had experienced serious problems with repeated probe clogging and time-consuming maintenance over an extended period of time and had decided to upgrade the existing Siemens probe and gas analysis system to a gas analysis system from FLSmidth with the patented KilnLoq probe. "We chose the KilnLoq solution as it is the most robust probe on the market, and it has been recommended to us by other plants in the CRH Group", explained Iñigo San José Ortiz, process manager at Cementos Lemona.

The supplied kiln inlet system was based on the patented KilnLoq probe mounted inside an automatic extraction device (Photo 1), a probe water cooling system due to the high temperature inside the kiln, an air tank to secure enough air and pressure to perform the powerful probe filter cleaning and finally an analyser cabinet containing gas conditioning equipment as well as the control of the complete system. To minimise the risk of condensation, the gas conditioning system was equipped with an -30°C cooler to remove as much water as possible from the gas sample before it enters the analyser for measurement of CO, NO, SO₂ and O₂. By cooling the gas to -30°C, the gas sample will only contain approximately 400 ppm water.

The result was an elimination of the probe problems experienced prior to the upgrade due to more stable and reliable measurements as well as a much more precise fuel regulation which provided fuel cost savings.

PHOTO 1. The KilnLoq kiln inlet system



THE CHALLENGE

However, later on problems started to arise at Cementos Lemona. The service team experienced gas analyser failures, unreliable O₂ measurements, low gas flow issues and more. The problems centred around acid formations in the gas conditioning system, despite a -30 degree cooler being part of the delivery. This resulted in many hours spent on calibration and maintenance of the system as well as an escalation of the costs due to analyser damage and the need of several expensive repairs. But not only was Cementos Lemona faced with significant repair costs, they were also object to the risks posed by analyser downtime. During the often time-consuming repair processes, the plant had no choice but to run without a gas analysis system, effectively running the kiln blind and decreasing the potential for optimisation while risking increased emissions output. Thus, at some point Cementos Lemona invested in a redundant analyser in order to ensure continuous measurement during the downtimes caused by repairs.

At Cementos Lemona, the process is characterised by a high sulphur level in the raw materials used. Moreover, the fuel used is partly pet coke and partly alternative fuels,

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including shredded tyres. Sulphur content in the fuels combined with the sulphur in the raw material is creating substantial challenges. As a thumb of rule, to avoid problems caused by SO₃ and Cl, "the Cl concentration times two plus the SO₃ concentration" should not surpass 3,5 in the hot meal material. For Cementos Lemona the concentration was as high as 8 (Table 1).

This problem does not only exist at Cementos Lemona. Many pyro plants are looking to minimise their environmental footprint as well as fuel cost through the use of alternative fuels, such as tyres, and while this can be environmentally beneficial, the higher sulphur content of these alternative fuels entail serious problems. High sulphur processes and the use of high sulphur raw materials, depending on their geological characteristics, elevate the risk of acid damage to gas analysers, resulting in increased repair costs, higher risks from analyser downtime and reduced efficiency.

TABLA 1.

MATERIAL QUALITY AT CEMENTOS LEMONA

Process information on material qualities

Process information on material qualities	Hot meal
Volatile analysis	
Content of Chlorine, as Cl (%)	2.07
Content of Sulphur as SO ₃ (%)	3.86

WHY ACID PROBLEMS IN GAS ANALYSIS SYSTEMS?

While the coolers used in conventional cold/dry gas analysis systems lower H₂O concentrations in the gas-phase, they still allow for acid formation that can cause serious damage in the analyser measurement chamber. Cold/dry systems conduct analysis in dry conditions at temperatures around 5 °C – a danger zone for acid formation. The acid concen-

tration depends on the SO₂ concentration, the SO₂ to SO₃ conversion rate, the concentration of water as well as the concentration of NO₂ in the process according to the below equations (1-3):



Whenever one of the above components is available, acid formation occurs. As a gas, the acid compounds are usually not particularly corrosive. However, when the temperature of the gas drops below the acid gas dewpoint, an acid mist can form. The acid mist can turn into a fine aerosol, or it can condense on a cold surface. Acid mists pose several problems, due to the small size of the mist particles and the corrosivity of the liquid form of the acid. Aerosol formation occurs when the bulk temperature of the gas drops is below the acid dewpoint of the gas. Much like the formation of fog, the acid gas condenses into tiny liquid droplets. The most common problem with acid aerosol formation is the inability to capture the aerosol, causing damages to the overall gas-conditioning system especially the analyser.

The new KilnLoq HW Laser System stands up to these high-acidity challenges by heating all parts to 180 °C, thus maintaining temperatures above the acid dew point and preventing the formation of acid aerosols and condensation.

SOLUTION

During 2016, several solutions were discussed and due to the fact that Cementos Lemona wanted to measure SO₂ as well as CO, NO and O₂, the only solution to avoid acid problems was to install a new analyser where everything was heated above acid dew point. In June 2017, a test installation of the newly developed FLSmith's KilnLoq HW Laser System was commissioned, a state-of-the-art hot/wet analyser based on laser technology that works in combination

with FLSmith's kiln inlet probe system. The upgrade consisted of a replacement of the cold/dry analyser with a hot/wet laser-based analyser, while reusing the existing KilnLoq probe. As a hot/wet system, the temperature of all parts is kept above the acid dew point, so acid damage is avoided. No expensive maintenance. No equipment downtime (Photo 2).

The KilnLoq HW Laser System is developed by FLSmith and Rosemount and offers the most accurate hot/wet gas analyser with the lowest possible maintenance. Combining two proven technologies – the patented KilnLoq probe and Rosemount's CT5100 laser analyser – the KilnLoq HW Laser System is the only laser-based hot/wet kiln inlet solution on the market. The system not only solves the problem of acid damage to gas analysers, it also offers precise readings, potential for process optimisations and efficient, lower cost maintenance. It is applicable in a number of industries with rotary kilns, such as lime, cement and mining.

The KilnLoq HW Laser System was supplied by FLSmith Gas Analysis Technology in Denmark and commissioned in cooperation with a gas analysis specialist from the FLSmith office in Madrid. Subsequently, the system has been serviced and supported by the latter.

PHOTO 3. The hot/wet laser-based analyser at Cementos Lemona



PHOTO 2. The KilnLoq HW Laser System



TABLA 2.

AN OVERVIEW OF CEMENTOS LEMONA'S ACTUAL COSTS IN 2016, EXTRAPOLATED TO 5 YEARS

Lower gas analyser maintenance • From approximately 5 hours per week to max. 2 hours per month	1.180 man-hours
Less drift on analyser, requiring less frequent calibration • From approximately 1 hours per week to once per year (1 hour)	255 man-hours
Elimination of repairs and change of parts resulting from acid problems	100.000 EUR

RESULTS

The implementation of the KilnLoq HW Laser System delivered immediate benefits. By eliminating the acid formation in the gas conditioning system, the system's repetitive long downtimes due to acid-damaged gas analysers were ceased completely, thus ensuring continuous measurements of O₂, NO, CO and SO₂. Measuring SO₂ was one of Lemona's key objectives which was now possible. This development also re-established the plant operators' trust in the measuring results.

One of the most noticeable benefits to Cementos Lemona was the dramatic reduction of man-hours spent on the gas analysis system. The hours of maintenance and calibration previously required every week were removed, and uninterrupted analysis became possible again.

One of the other key benefits was the heavy decline in money spent on analyser repairs as well as additional wear and spare parts that are not needed for a hot/wet laser-based system (Photo 3).

As any cement plant, Lemona needed reliable analysis of the process gases at the kiln inlet to compete in the tough cement market. Kiln inlet gas analysis systems deliver essential data because when a gas analyser goes down, the kiln is at risk of consuming too much energy, polluting the environment and, at worst, unscheduled stoppages, causing production losses and unnecessary wear on expensive equipment. FLSmidth's hot/wet gas analysis system is a guarantee for retrieving such essential data, even in tough, high-sulphur processes.

With the successful implementation of the KilnLoq HW Laser gas analysis solution, Cementos Lemona has continued its core operation of cement production with reliable and stable operation, and they are now very satisfied with their gas analysis system.

COST BENEFITS OF THE KILNLOQ HW LASER SYSTEM

Removing the risk of acid damage to gas analysers at Cementos Lemona meant less overall maintenance and resulted in significant savings on man-hours, part costs and repairs. An upgrade from a cold/dry to a hot/wet gas analysis system approximately costs EUR 70.000.

Thus, as shown in the table above, the payback time is very fast (Table 2). 