



**Daniel Hansted-Martin, HASLE Refractories, explains how Lafarge Canada's Exshaw Cement Plant has reduced abrasion and chemical challenges and tripled the lifetime of the refractory lining in the facility's Riser Duct using a precast Modular Lining.**

**S**et in pristine surroundings at the foot of the Canadian Rocky Mountains, Lafarge's modernised cement plant showcases environmental and economic efficiency. Built in 1906, as 'the Western Canadian Cement & Coal Company', the Lafarge Exshaw Cement Plant is Canada's biggest cement factory with a capacity of 2.4 million tpy. Over the years, the plant has had six lines in operation, however, today only line K#5 and K#6 are being operated. Each has a production capacity of 2200 tpd and 4200 tpd, respectively. Lafarge Exshaw operates on 100% natural gas and is working towards using low

carbon alternative fuels in the future. Its updated facilities operate the latest cement production technology. As a member of LafargeHolcim, the plant is continually seeking solutions to operate more efficiently and sustainably.

### **Solving short lining lifetime in the Riser Duct**

Responding to Western Canada's significant cement demands, Lafarge Exshaw seeks to increase capacity and minimise stoppages. However, in 2017, the plant faced abrasion and chemical challenges in its refractory lining in Riser Duct K#6. The lifetime of the company's

# A LIFETIME ACHIEVEMENT



existing refractory lining was no more than six to 12 months. Needing a long-life, sustainable alternative, Plant Manager, Kate Strachan, contacted HASLE Refractories with a recommendation from another cement plant within the LafargeHolcim Group, which was already using HASLE's precast Modular Lining. "We needed to achieve a significantly longer lifetime", said Kate. "When the Modular Lining was already showing excellent performance at another plant within the group, we didn't hesitate to install it here at our Canadian plant."

Upon receiving the technical drawings from Lafarge Exshaw, HASLE's team of

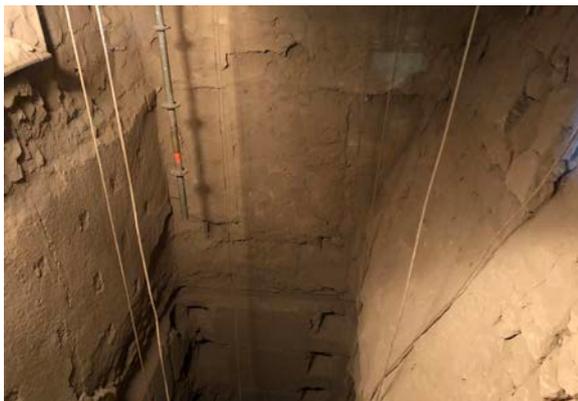
engineers designed a tailor-made solution for line K#6, based on the standard precast element design. Detailed drawings of all 138 m<sup>2</sup> of the riser duct were made, and once they were approved by Lafarge Exshaw, the installation was scheduled for mid-March to mid-April 2018. To ensure that the optimal installation technique is used, a team of HASLE supervisors always participates on site whenever the precast Modular Lining is installed – in this case, they had the pleasure of cooperating with the Canadian installation company, Alliance, who undertook the installation at Lafarge Exshaw.

## A worthwhile recommendation

By September of 2020, the precast Modular Lining installation had been in operation for more than two and a half years. The Lafarge Exshaw Cement Plant has achieved an excellent lining lifetime in its riser duct, with no re-linings or repairs needed to keep it running. This has lowered its use of natural resources per produced unit and resulted in an overall more stable production. When Lafarge Exshaw implements the use of low carbon alternative fuels in the future, the precast Modular Lining will remain a beneficial lining choice for the riser duct, as its low, open porosity and smooth impact surface makes it highly resistant to alkali attack and build-up – even in extremely hostile environments.

“Currently, the precast Modular Lining has achieved a lifetime of +30 months”, said Plant Manager, Kate Strachan, and adds, “We estimate it will have an additional lifetime of up to 24 months, so we are very satisfied with it. It certainly proved to be a worthwhile recommendation.”

Although HASLE's pre-cast Modular Lining has been installed at more than 100 plants worldwide, this instance was the first in which the company supplied the lining to a Canadian company; the future might



**Earlier refractory lining in K#6 riser duct with a lifetime of only 6 – 12 months.**



**Steel rails are welded onto the casing and HASLE's console lining is installed with mortar between the elements. It is now ready for installation of the precast Modular Lining elements.**

hold more precast Modular Lining installations for the North American country, whose cement industry in the year of the installation generated around CA\$10.5 billion in revenue.

## The design

The HASLE precast Modular Lining was designed almost 20 years ago. The goal was to create a hot face refractory lining for the critical areas of high temperature industries, which was durable and resistant to abrasion, chemical attack and coating, resulting in a significantly longer lifetime than the existing alternatives on the market. Since its creation, it has stood the test of time and can last twice or even three times as long as a traditional cast lining, and sometimes even longer.

Whereas traditional in-situ cast solutions typically have an open porosity of 18 – 20% or more, HASLE's precast Modular Lining was designed to have a low open porosity of only 8 – 10%. This quality is achieved through a combination of selecting raw materials with an optimal corn distribution curve and adding only a very small amount of water (as little as 4.5%) when mixing the castable. The result is a refractory lining which has a longer lifetime, is abrasion- and alkali-resistant, and even when installed in plants operating on 100% RDFs, build-up is almost eliminated.

With the precast Modular Lining, it is also possible to achieve a lining thickness as low as 185 mm. This is often less than the thickness of a traditional cast lining, and presents two options; the plant can either decide to go for a reduction in heat loss by applying more back-up lining, or it can decide to increase the cross sectional volume, which will give additional space in the given area. In many cases, an increased production capacity has been achieved by removing a process bottle neck through the installation of the precast Modular Lining, thus increasing the volume of the given area.

In order to secure the highest quality of the Modular Lining elements, all elements are cast and pre-fired under strictly controlled conditions in HASLE's plant in Denmark. Casting the elements at the plant using specialised equipment such as vibration tables, special moulds and dry-out ovens and employing skilled workers secures a strong focus on each step of the casting process and ensures a consistent optimal quality. The process includes dry mixing for 60 seconds, adding water, wet mixing for 4 – 5 minutes., casting it into the moulds and covering the elements in plastic immediately after. The elements are then left to cure for 24 hours and are subsequently pre-fired for five days up to a peak temperature of 500°C. All these steps are carefully monitored in order to secure the highest possible consistent quality of all pre-cast elements. However, even in this carefully monitored production environment, small deviations in quality can occur, and therefore each

element is both visually inspected and subjected to a strict quality control procedure prior to leaving the production facility.

## Installation

Installing the precast Modular Lining is both fast and easy. Due to a smart element design combining steel anchors with a tongue-and-groove system, the installation of the pre-cast Modular Lining often takes about 50% less time than the installation of a traditional in-situ cast solution. Once preparations are completed, the time required for a typical lining is 80 min/m<sup>2</sup>, depending on the condition of the area to be lined i.e. number of air blasters, inspection holes, manholes etc. After the welding of the rails and steel plates holding the elements, the console elements are easily installed. Upon these, the square modular elements (250 x 250 mm) with a tongue and groove system are installed. The precast elements weigh only about 15 – 16 kg each, so no special lifting equipment is required.

All elements are pre-fired at HASLE's production facility in Denmark, so no dry out of the lining is required, which allows for a faster restart of production. To ensure the successful



**Precast elements are installed on the steel rails, on top of the console elements, with vermiculite back-up insulation between the rails. Ceramic fibres are installed between every four elements (every 1 m) to allow thermal expansion. Now, the system is only missing the pouring of the insulating castable behind the pre-cast lining.**



**After 1.5 years of operation, HASLE's logo embedded on the elements is still visible.**

completion of each individual installation project, HASLE Refractories always supplies approximately 5% more elements than needed, and if a surplus of elements remains after completed installation, these can be stored and kept for many years as there is no limited shelf life. Compared to the limited shelf life of castables, this is another valuable advantage.

## Applications

Now, the precast Modular Lining at Lafarge Exshaw has been in operation for +36 months, and the cement plant is looking into the possibilities of the use of the precast Modular Lining in other areas of their production.

Depending on the lifetime achieved from traditional castable or brick linings, there are many other areas in which the precast Modular Lining could be applied. HASLE's Modular Lining has shown good performance when installed in a variety of applications throughout the world, i.e. feed pipes, coolers, cooler bull noses, smoke chambers, cyclone roofs as well as cyclone bull noses. All areas are lined with the same type of elements and can also be adapted for curved and cylindrical structures.

As long as there is a steel casing the rails can be welded to, the precast Modular Lining can be applied, and has even been installed in a number of boilers and incineration plants.

## A sustainability perspective

Driven by climate policies and a desire to run a sustainable production, more and more cement plants are implementing sustainability goals. To reach these goals, efficiency improvements are necessary and using HASLE's precast Modular Lining could be a step towards running a more sustainable operation.

Not only does it require less material per installation to create a HASLE precast Modular Lining compared to an in-situ castable solution, but the Modular Lining also has the potential to last longer. Consequently, plants can lower their use of natural resources per produced unit, as using the Modular Lining reduces the number of re-linings and repairs needed. Contrary to a stocked monolithic castable, which can become unfit for use over time, HASLE's precast Modular Lining has an unlimited shelf-life, thus reducing material waste.

The lining offers tangible efficiency improvements that companies in high temperature industries can make on their journey to becoming more sustainable. ■

## About the author

Daniel Hansted-Martin is Regional Sales Manager at HASLE Refractories. Daniel holds a Bachelor's Degree in International Management and services the European and North American cement markets. He has extensive theoretical and practical experience from on-site installations, and an in-depth understanding of refractory challenges and solutions.