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Reducing Refractory Costs

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REDUCING REFRACTORY COSTS

Anders Karlgren, of refrAK Bricking Systems S.A., who has installed over 7000 m of brick in over 79 kilns since 1974, provides insights into how modern refractory installation systems and equipment can significantly reduce refractory expenses.

Introduction

Looking back at nearly 30 years of installing refractories in rotary kilns, is to look back at a very turbulent period, with technological development as never seen before. Thirty years ago, people filled bags with cement, today production managers fill the airports on their way to company seminars on bagging technology or meet their colleagues in airport lounges to discuss a seminar on, for example, energy saving technology or milling technology.

However, company seminars on refractory installation technology are unheard of. Refractories together with energy represent the main cost of clinker production, and although the cement industry is good at following up the performance of different refractory qualities, it pays very little attention to how the refractories are installed. Refractory materials have enjoyed an enormous development over the years, as has installation technology, but while no cement plant should consider using yesterday's refractory material, 90% of them stick to outdated methods of installation.

Outdated methods

The main reason is that very few people in the industry are aware of the benefits in improved quality and saved downtime that can be obtained using a top of the line bricking system. Another reason is the resistance to change in the corporations. Since the cement kiln was invented, it has consumed refractories, and a production engineer might be very well aware that investing US$ 100 000 in a bricking system will pay back the first time it is used. However, corporate supervisors without a twinkling of an eye, will sign a purchase order for a million dollars of refractory materials, and then demand that the cheapest way (on short sight) be used to install the refractories. To waste money on refractory materials is as natural as snow in winter and sun in summer, purchase managers might shed tears over the prices at which bricks are sold, but they will continue opting for the road of least resistance. No plant manager in the world would dream of hiring a plumber to maintain the electrical system, or try to save money by contracting a bus driver to check the computers. But at many, many plants the heart of the production system, the kiln, is bricked by the cheapest contractor, or by plant masons without any professional training or modern equipment. This modern equipment can not only save downtime but also give immediate return in savings on refractory materials. Modern technology might have entered the cement industry at many plants, unfortunately it still has not entered the kiln. It reached the burner floor and halted.

Refractory performance

Refractory performance depends on three factors: the quality of the refractory materials, the kiln operation and the quality of installation. It is intended here to discuss the impact of installation quality on the total consumption of refractories in rotary kilns and the further impact on the kiln service factor that can be obtained by the reduction of downtime and putting a top of the line bricking system into service.

With a bricking system, a system working 365 days a year is referred to. Modern computer programs permit kiln operators to gather exact data regarding historical brickwork performance to plan for the maintenance needs.

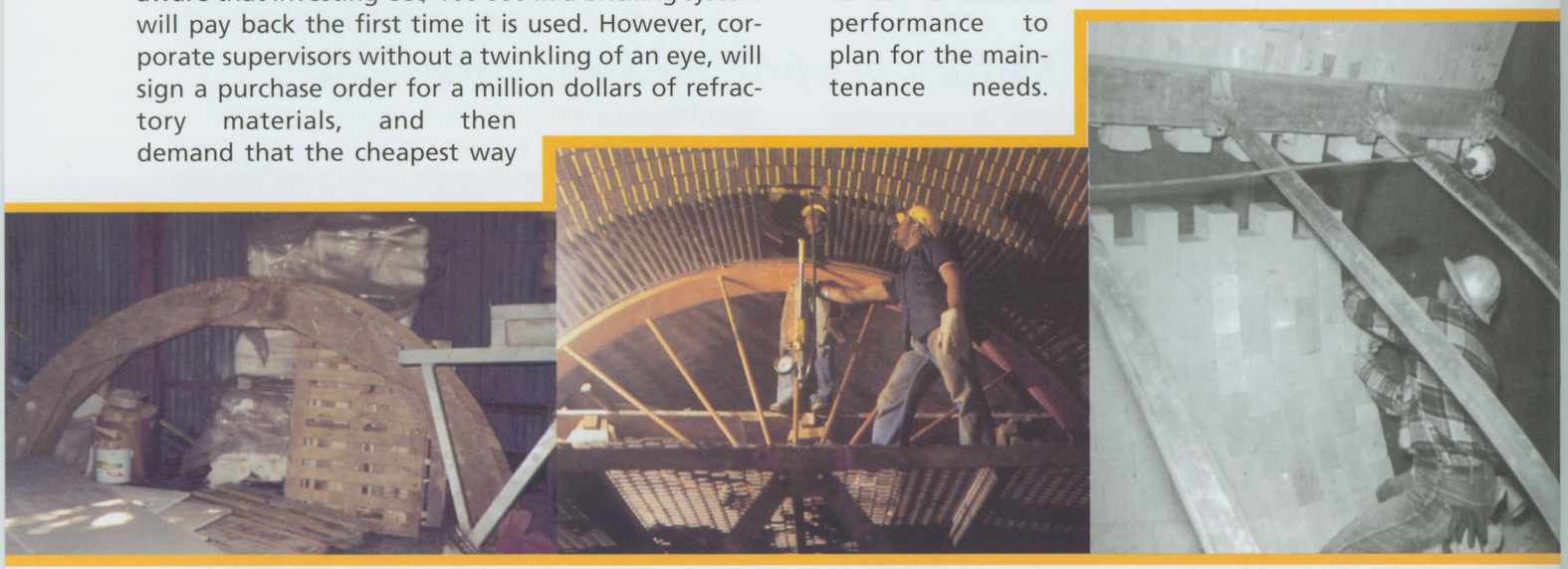

Figure 1. Outdated methods still in use. From left: Wood centre and wedges; pogo sticks; jack and timber.

Figure 2. Kiln access ramp.

Properly used, these programs can be used to foresee the magnitude of upcoming kiln stops and to maintain a minimum of stock over the periods when little or no refractory maintenance is expected. Scanning of kiln temperature will further help to foresee eventual kiln emergencies. Too many plants still run their kilns until the refractories break down, i.e. the kiln itself decides the date and hour of a shut down. This is a stone age method to get the maximum out of the kiln brickwork and comparable to running a car until the oil deposit is empty before changing the oil. With modern technology available no kiln stoppage should be of an emergency nature, unless severe process disturbances occur.

Once the kiln is shut down, the time factor is of upmost importance. A remote controlled debricking robot can start removing coating after approximately only 16 hours of cooling time. At most plants further time is lost because of problems with access to the kiln. A lightweight, but strong aluminium kiln access ramp can be put in place with for example a forklift, in less than five minutes and no time is lost before starting the demolition. Later on, the same ramp will contribute to quick outmucking and distribution of new bricks up into the kiln. When the job is finished, more time is saved as the removal of the ramp is as easy as its setup.

A remote controlled demolition robot, preferably, in combination with a skid steer loader for outmucking and the safe and quick removal of coating and old brickwork. Few plants have good statistics on time used for demolition, however in one of the few cases where demolition time by using a robot and that of the traditional method have been able to be compared the average time saving has been 72 hours per kiln stop. No accidents have occurred since the robot was taken into service. Average demolition rate should be approximately eight lineal metres per hour, depending on the characteristics of the kiln coating and its thickness.

Once the kiln is cleared of the old lining it is important to mark up the area that is to be relined. Radial alignment of the brickwork is most important for the final lining quality. The use of an alignment laser insures the masons have the references necessary to erect the brickwork perpendicular to the kiln axis.

At this point the bedding process can start with bedding the kiln floor approximately one quarter of the circumference before assembling the bedding cart. The bedding cart can be designed so complete pallets can be transported to enable two masons to work the floor bedding uphills, two masons working on each side of the bedding cart would complete the bedding and a third crew of masons on the bricking rig would start keying as soon as the bedding out has reached five meters uphills. This gives enough space necessary to assemble the bricking rig.

The bricking rig is the heart of any bricking system. A double arch pneumatic bricking rig, fixed or adjustable, is the outstanding machine for rapid and high quality installation jobs. It consists of a mobile working platform with sufficient space and strength to support two tons of bricks plus the staff working the rig. The staff would usually include one mason on each side bricking the wings, one mason keying plus two helpers. Two half arches on top of the rig, one with a cut out section at the top with pneumatic cylinders to support the bricks, permit the masons to work simultaneously in two rings. It was designed to combine job safety, reduce workers fatigue and to shorten installation time. Compared to other traditional installation methods the bricking rates normally increase at least 150% with the bricking rig and installation quality improves. It is constructed of aluminium and a trained crew will need approximately half an hour to assemble the rig in the kiln.

Working with the organisation described above, which require 9 masons per shift and good logistics for the distribution of bricks into the kiln, average bricking rates of 60 to 80 rings per 24 hours or more can be obtained (12 to 16 m). This requires a good professional job crew, professional supervision, and good preparative jobs. Payback will begin immediately with minimised downtime and improved installation quality. A plant that knows how to use a bricking system can manage a repair of 30 to 50 running metres within seven days, cooling and heating time included.

Figure 3. 'Radialign' alignment device.

Many plant engineers doubt that investing in a bricking machine would pay back in improved brick service life , this might be difficult to determine as plants work on improving their kiln supervision, processing and raw material on an on going basis. The following experiences below might help to contradict these doubts.

- A pulp mill operating an 80-m x 3.35 m lime recovery kiln, invested in a bricking rig for a complete kiln overhaul. Due to the bricking rig, it was possible to co-ordinate mechanical and bricking jobs which meant valuable downtime saved. Bricking rates were improved and the money invested in the rig was recovered the first time it was used. Staff were trained beforehand and the installation job was carefully monitored by an experienced supervisor.

  No changes were made in refractory design. For the first time since the kiln was put into service in 1990, the plant was able to run the kiln for twelve months without any emergency shut down for premature refractory failures.

- A cement plant operating two kilns, invested in a demolition robot, bricking rig and the necessary training of the plant masons. Nearly 80 hours were saved in demolition time and bricking rates increased from 6 m per 24 hours to 14 m per 24 hours. Shortened downtime gave immediate payback, and this is of much more importance, the kiln was run for a 14 month campaign without kiln stops for refractories. The money invested was recovered a second time.

  One of the kilns suffered several meters of severely deformed shell, and this deformation produced premature brick failures. It was considered necessary to shut down the kiln for a long period to change two pieces of shell. Thanks to proper installation methods, the plant has shelved the shell change as the deformed shell no longer affects refractory service life. In fact, no difference can be seen at all in the deformed area or adjacent areas. The investment in the bricking rig was thereby recovered a third time. Kiln service factor is up from 89% to a 96.9% record. Over five years refractory consumption has gone down to below 330 g per t of clinker and no unplanned outage for brickwork failure has occurred for three years.

  Refractory design has not been changed over the years; installation quality, installation methods and installation supervision has.

- During 18 years a plant had never reached more than 90 days of operation without refractory failures. For a recent shut down, a double arch adjustable bricking rig was taken into service for a repair of approximately 60 running metres. There is as yet, no indication of failures in the sections where the bricking rig was used and we expect to reach a 240 day campaign. However, a few rings were installed using the lock pin method with rotation of the kiln, this to support a mould while casting the concrete in the kiln mouth. These bricks fell out, adjacent bricks installed with bricking rig did not.

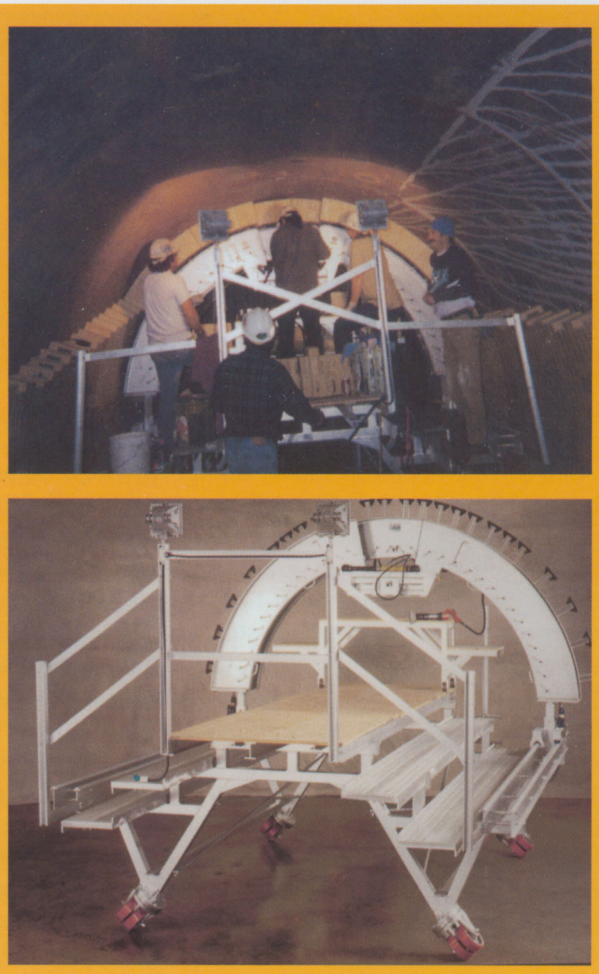

Figure 4. The bricking machine.

Conclusion

The peculiarities of the cement industry are often difficult to understand. Nobody questions millions of dollars, year after year for refractory materials. After all, kilns have always consumed refractories and many plants accept ridiculous levels of refractory usage. It has always been like that is a common argument. None of the large cement corporations have a pronounced policy or a corporate programme to decrease refractory consumption, which is incredible, considering the enormous costs that are involved.

This article has demonstrated the benefits that can be obtained with an approach to refractory installation as it is described above. Any plant can decrease downtime, and its expenses for refractory materials thanks to improved installation quality. Based on experience, as in the instances above, with these bricking systems, refractory consumption has decreased, the number of emergency outages have decreased and service factors have improved. Furthermore in the cases of all of the kilns that have been improved, the plants have reported that their investments have been recovered in the first usage of this bricking system.

Bibliography

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