Are "Bricking machines" the best method for installing refractory in rotary kilns?

Masons around the world are a proud lot and take great pride in their workmanship and knowledge of how best to install refractory. Typically a mason will defend the method of installation he is most familiar with. For example a mason who has used pogo sticks all of his career will say he can brick faster and better with pogo sticks than another mason can with a bricking machine. Another mason will tell you that the glue method will produce the highest quality installation. The problem is that due to varying conditions such as planning, organization, accessibility, kiln condition, size of kiln, ability to feed brick to the mason in a timely manner, type of installation, type and size of refractory, etc., it is hard to prove one method over another. Also in some situations one system may be better than another.

Bricking Solutions (Division of Pneumat O Ring International) has built and supplied over 650 bricking machines to 60 plus countries and feels that in most cases the use of a bricking machine is the superior way to install refractory in a rotary kiln. We also know that it is the complete system of planning, organization, with modern equipment and skilled craftsmen, not just the bricking machine, that produces the best installation results. The machine, like pogo sticks, is just a tool.

The bricking machine was designed and refined by masons and manufactured by skilled craftsmen. It is the most modern tool for the installation of refractory on the market today. The following is a description of how a bricking machine operates in a kiln, followed by a success story from Chile. You can argue

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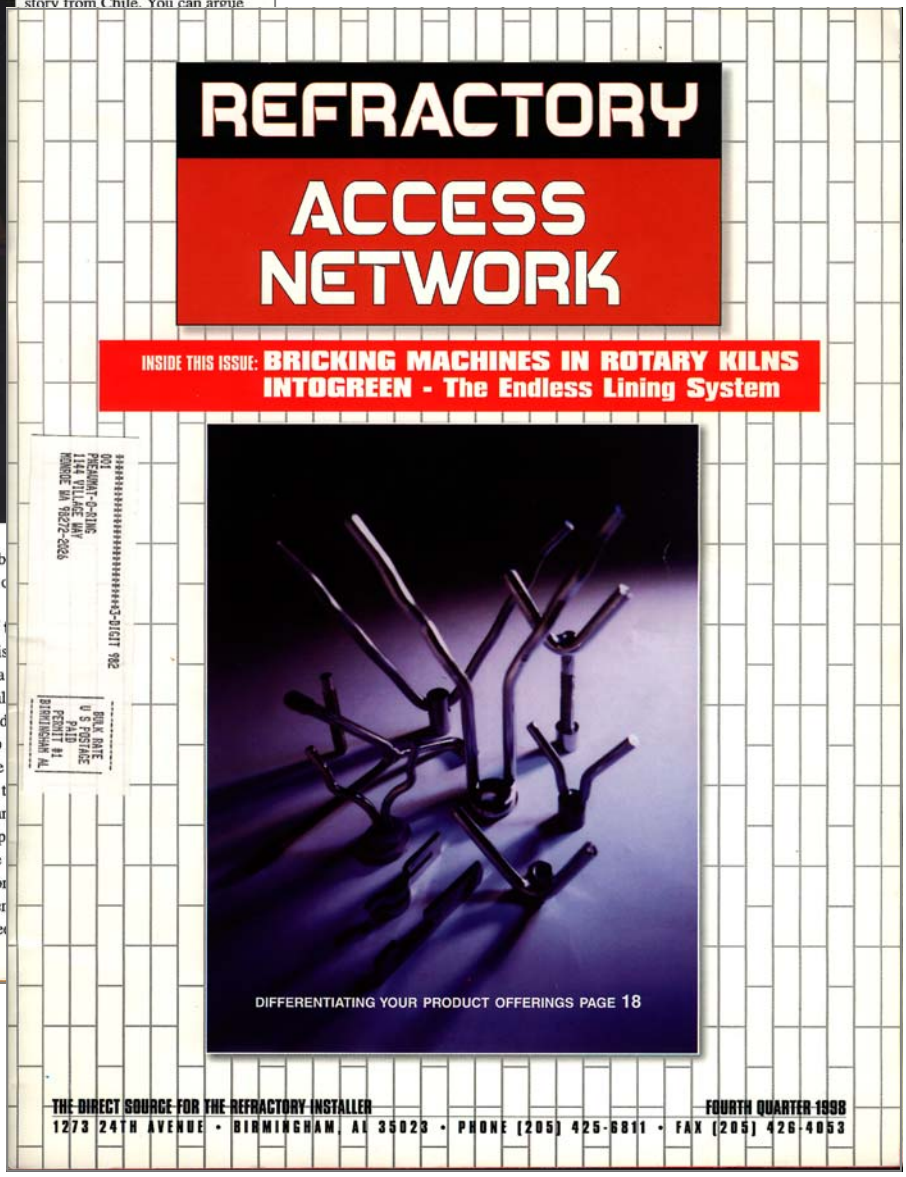

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You can argue that your results would be better, but until someone can determine a fair way to compare one method to the next, we will stand by hundreds of satisfied customers who have tried more than one method and will still choose the bricking machine.

The bricking machine

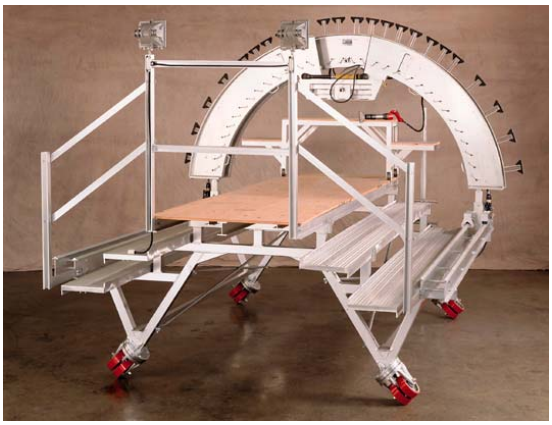
The principal

The Pneumat-O-Ring bricking machine was designed to reduce downtime cost through ease and speed of operation, safety, and quality of work. The machine is constructed of strong yet light weight, aluminum modular components with each component of reasonable size and weight so that in the event of restricted access, one or two men can transport it into the kiln for assembly. The machine can typically be assembled in less than one hour.

Construction of the machine

The machine consists of a mobile working platform capable of supporting a pallet of bricks, the men working on it and a half circle aluminum center. The platform has ergonomically designed steps so the men can work comfortably around the top half circumference of the kiln. The platform wheels can be turned through 90 degrees allowing the machine to stay inside the kiln should it be necessary to turn the kiln for mechanical reasons. The half circle aluminum center is equipped with pneumatic cylinder lifters, which are used to raise the bricks into place against the kiln shell, and is supported by carts and a rails system to allow the aluminum center to move along the length of the platform scaffold. Three types of centers are available, one which enables a

single brick ring to be installed at any one time, while the other two double arch machines permit a second ring of brick to be installed while the first one is being completed. The difference in the two double arch machines is that one is custom built for each kiln size while the other is adjustable over a 2m variance in kiln diameter. The single arch machines are recommended for kiln diameters under 3.45m due to considerations for congestion in smaller kilns.



Additional features

The machine is equipped with a finger tip control hydraulic jack assembly used to tighten each ring of bricks radially, allowing a key to be installed; a main control valve (or valves on double arch machines) releases all the cylinders simultaneously allowing the center to be advanced to the next course, pneumatic shim driver; cutaway front ring design on the double arch machines for ease of access to the rear bricking ring; adjustable spacer assembly allowing the machine to adjust to various brick length; and a light ring.

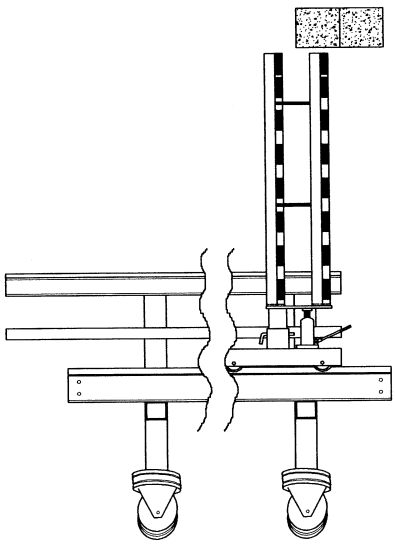


Figure 10

Advantages of the machine

The advantages of using this machine include reduced workers fatigue, faster installation, a better, more consistent and tighter installation, no unkeyed brick overhead. In addition, the machines are custom designed for the specific needs of each user.

Pre-assembly of the bricking machine

The bricking machine should be inspected prior to each use in the kiln. This should be accomplished by the people responsible for the bricking machine and the installation of the brick.

The machine is prepared for assembly inside the kiln by staging the bricking machine on the burn floor. It is important to stage the machine in the proper order to ensure the components enter the kiln in sequence and facing the correct direction.

Once the top machine has been assembled on to the freshly bedded floor and adjusted to the kiln dimensions and brick being installed, it is rolled into position (figure 10) to brick the first row of brick.

Now that the method for transporting the brick to the machine crew and the bedding floor crew has been determined and the machine has been set into position, the brick can be installed onto the intake arch. It is important to have enough brick on the platform at all times and to make sure the proper types of brick are supplied on the platform. The space on the platform is at a premium.

The first few rings may need to be cut in accordance with how far out radial alignment the rings are. Before starting, the bedded out rings are examined closely and the findings discussed with the bedding crew, these rings will take some extra time if they

need to be cut in. The bricking machine can be adjusted to accommodate the process. Eventually the rings will be brought back into radial alignment and the machine will be used with standard adjustments and in its most efficient form.

Standard operation

For optimum performance, a double arch machine is employed (approximately 40% faster than a single arch machine). Both sides of the arch are worked at the same time installing bricks from the centerline towards the top-keying void. Both 'wing' masons should reach the keying void at approximately the same time. The key mason should also be finished keying the mason then installs the hydraulic jack and uses the

master valve to release all of the up kiln arch's cylinders, freeing the arches to move forward one row. The down kiln master cylinder is then activated to support the previous ring so the jack can be released and the keying process can began while the wing masons begin installing the next row of bricks. Once the travel distance on the scaffold is used up, the whole scaffold is moved up kiln until the arches are positioned at the front of the scaffold and under the last row of brick, and the process starts all over again.

The closing out process is as important as beginning the first row, as this ensures a quality lineal installation. As with the first row, it is a good idea for the masons on the bricking machine to confer with the bedding crew since they have already bedded out the last row. Again, the machine can be adjusted and used with special close out straps to facilitate the closing out process.

Use of the machine in problem areas (conical sections and kiln distortions)

Special attachments to the custom single arch and double arch machines, such as lifter kits and caster extensions, area available to help the machine brick through conical or taper sections, oval shells, outward blisters and inward blisters. The adjustable machine ahs these variations built in and is the most versatile of all the machines to handle these abnormalities.

Documented performances

Performances vary according to the type of kiln shell, the size of the kiln shell, installation type (dry or jointed) and the number of men employed to carry out the work.. It has been found that the maximum requirements to work the machine efficiently in larger kilns (above 4m) are one foreman, size brick setters, six helpers, and one fork-truck driver. This represents 14 men per shift. (Documentation on installations using this machine in a kiln sized from 3.9m to 5.5m is available on request). Productivity in these kilns ranged from an average of 20.00 rings per shift to 28.56 rings per shift (4.98 M@ to 7.98 MS per hour) with varying conditions and situations.

Following is a letter from Anders Karlgren, Refrak Bricking concerning use of bricking machines:

Cemento Melon, located in LaCalera, Chile, and part of the Large Blue Circle Group, operates two dry process kilns. The oldest of the tow kilns, erected in 1961, is 135m long and 3.6m diameter, whilst the second is a 50m kiln with precalcinator built in 1981, also with a 3.6m diameter.

A few years ago, Cemento Melon suffered sever problems with repeated refractory failures in the to kilns, it was not uncommon that the kilns were in services only three months between brick failures, and it happened a few bricks fell out after only a couple of weeks in service.
I was asked inspect the precalcinator kiln in July 1995, when yet another emergency shutdown was made.

My conclusions by then were that Melon used adequate refractory materials, but the installations were worse the poorly made. Additionally, the kilns suffered sever mechanical defects, especially the older kiln, where a greater number of red spots over the years had severely deformed the shell.

Together with Melon, I started up an ambitious program to improve things. First step was to fire the contractor, and start training plant workers in

refractory installation jobs. We built a wood model of the kiln and installed, disassembled, installed and disassembled, and combined this with refractory theory.

In January 1996, we tried this concept for the first time and for the first time in a Chilean cement kiln; we used a Brokk robot for the demolition. The Brokk saved an estimated 72 hours of demolition time, and the brickwork, installed by the plant workers we had trained, was also made more speedily than earlier, whilst the contractor lined 4m per 24 hours, we reached 6m, by then using the lock pin method and rotating the kiln during the installation.

Shortly after the 1996 January outage, we started discussing to further improve installation quality by employing a Pneumat-O-Ring bricking machine, and a year later we made the first installation with a double-arch P-O-R rig.

I have worked 25 years with refractories, first as a helper during summer holidays, as bricklayer, supervisor and since twelve years running my own company, which specialize in rotary kilns. In fact, I do nothing but rotary kilns and have by now installed approximately 7000m of brickwork in 78 kilns. I have used all existing methods, but none of them can beat what the P-O-R rig can make when a good team of bricklayers operate the rig.

And nothing can beat the combination Brokk robot and a bricking rig in decreasing down time and at the same time improve installation quality.

When the Melon bricking machine was delivered we used once again the same concept. We assembled and disassembled the rig several times until the bricklayer team was able to do it in less than 30 minutes (record in the kiln is 26). A 12m piece of shell was used as training ground, and we trained installing and closure jobs there, and when we used the rig for a real installation the first time, time was cut to far less than half of what we made earlier. The money invested in the rig was thereby recovered only by the time saving the first time we used it.

This installation was made March 1997 and the plant expected by then to reach December or maybe January 1998 before shutting down again. The kiln worked until May 25, 1998 and when it finally was shut down, it was not caused by a refractory failure, but for mechanical jobs that could not wait. Refractories were in such good condition that instead of replacing far over 20m, which we expected, only 16m were relined.

Service factors for the kilns were 1997 94.4% in the old kiln and 96.9% in the precalcinator kiln. Personally, I believe the tow kilns will reach +97% 1998.

We have over a period of less than three years decreased the number of outages near 75% to average 2.5 per year. This has been done principally without changing refractory materials and the shells are in the same poor conditions (or worse) than three years ago. Earlier almost all stops were type emergencies, now all stops are planned and prepared, and when a kiln is stopped downtime has been reduced to a third since we earlier the kilns normally gave bad surprises, i.e., the repairs were larger than we estimated, lately with improved installation quality following the employment of the P-O-R bricking machine, we have got nice surprises as the last two outages. The number of meters replaced have been less than expected.

And maybe the most remarkable of all is that we have done this with people who work with refractories just two or three times per year. But they reline, in spite of this, over 14m per 24 hours and in total time for removal of a normally heavy coating, brick removal; and relining we are now able to make a 30m repair in less than a week, cooling and heating included.

Best regards,
Anders K.

Conclusions

Down production costs for today's kilns are increasing rapidly. Kiln maintenance, including refractory lining, can no longer be approached in a fragmented manner. Kiln maintenance must be approached as a system, and all phases, disciplines and tools of that system must be of the latest technology and perform their parts efficiently and safely. This article discussed modern techniques for the relining phase of the kiln maintenance system. The heart of this phase is the bricking machine and the supporting disciplines and equipment (access, alignment devices, transport systems, skilled masons, etc.) keep this heart pumping.

In the past 32 years, Pneumat-O-Ring International has delivered over 650 bricking machines and support equipment to more than 61 countries. Similar machines delivered by other companies would bring the number of machines to over 900. Feedback from the users of these machines has not only brought about improved versions of the machine, but has confirmed that the pneumatic cylinder bricking machine method is the most efficient and safe way of installing refractory in today's kilns.