

SHINAGAWA TECHNICAL REPORT

From Tap Hole Mud to MgO-C Bricks:
The History of a Successful 23-Year
Partnership between Saint-Gobain Ceramics
and Shinagawa Refractories

Eric SAKO

Douglas GALESI

Vladnilson RAMOS

Marcos FADEL

Carlos LEÃO

Toshio HORIUCHI

Osamu NOMURA

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“SPECIAL THEME”

From Tap Hole Mud to MgO-C Bricks: The History of a Successful 23-Year Partnership between Saint-Gobain Ceramics and Shinagawa Refractories

Eric SAKO^{*1}Douglas GALESI^{*1}Vladnilson RAMOS^{*1}Marcos FADEL^{*1}Carlos LEÃO^{*1}Toshio HORIUCHI^{*2}Osamu NOMURA^{*2}

Abstract

Due to an increasing demand for high performance refractories from Brazilian market in the 80's, Saint-Gobain Ceramics and Shinagawa Refractories decided in 1990 to start a partnership that lasts more than twenty years and has proved its success year by year. From an improved tap hole mud technology to high-quality MgO-C bricks, Shinagawa and Saint-Gobain developed a strong brand in Brazil, contemplating what it takes to grow even more in the promising coming future.

United by Tap Hole Mud

Established in France in 1665 by request of Louis XIV in order to supply the mirrors and glass pieces during the construction of Versailles Palace, the Compagnie de Saint-Gobain has diversified its business throughout the years, becoming nowadays a strong player at different markets around the world. In Brazil, an important example of Saint-Gobain strength is represented by the activities of Saint-Gobain Ceramics, which is nestled in the pleasant Vinhedo city and has historically been involved in the supply of traditional and innovative solutions for ironmaking refractories since 1976.

As can be seen in Fig. 1, at that time Brazil used to produce roughly 9,000,000 ton of steel per year, covered mainly by three big steel producers: Usiminas (Ipatinga/MG), Cosipa (Cubatão/SP) and CSN (Volta Redonda/RJ). In the 80's, the Brazilian steel production increased significantly, reaching values twice higher than the ones attained in the previous decade. This result is strictly related to the beginning of CST (Companhia Siderúrgica do Tubarão) operations in Serra/ES, in 1983, which was born from the merge of three other companies (Siderbrás, Kawasaki and Itali Pianti). This novel steelmaking producer brought to Brazil the first high capacity blast furnace, delivering up to 10,000 t pig iron/day.

^{*1} Saint-Gobain do Brasil-High Performance Refractories-Vinhedo-SP – Brazil

^{*2} SHINAGAWA REFRACTORIES CO., LTD. – Tokyo, Japan

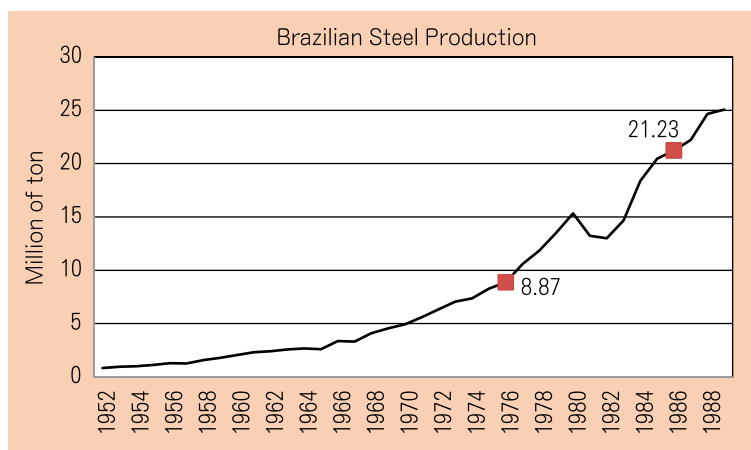


Fig. 1 Brazilian steel production during the first years of Saint-Gobain Ceramics activities in Brazil.

This changed scenario made steel producers look more carefully to the market, focusing on higher performance refractories in order to ensure conditions for a constant metal production. The operation of larger blast furnaces, for instance, was very unstable due to the unsatisfying quality of the existing tap hole clay, which could barely attain proper values of tap hole length and tapping time. Therefore, one of the main concerns to be dealt with during this period was the development of high technology for tap hole clays in order to improve the blast furnace operation with long and stable campaigns.

After more than 10 years supplying to the Brazilian metallurgy market, Saint-Gobain Ceramics saw the new requirements for refractories as a unique opportunity to expand its share in the ironmaking market. Hence, motivated by such steel market situation, Saint-Gobain Ceramics started to build a strong relationship with Shinagawa Refractories Company, a Japanese leader in refractory technology and one of the biggest worldwide refractory producers. Supplying a variety of refractory solutions (materials, kilns, furnaces and equipment) for over 130 year, Shinagawa Refractories shares with Saint-Gobain Ceramics a common philosophy to provide high quality materials, mainly for metallurgy applications, which has proved to be a key factor for a healthy and long term relationship.

On March 1990, the companies signed the first know-how transfer agreement, allowing Saint-Gobain Ceramics to bring to Brazil the technology to produce and supply Shinagawa's high quality tap hole clays. The first year of agreement was essential for the Brazilian company to implement all the know-how information after a series of technical visit to Shinagawa's manufacturing plants and research center (Fig. 2). In 1991, Saint-Gobain Ceramics built a new plant (Fig. 3) to produce tap hole mud in Vinhedo, comprising new and state-of-art technology.



Fig. 2 Saint-Gobain Ceramics and Shinagawa Refractories teams during technical visit in Japan in 1990 for know-how implementation.



Fig. 3 Saint-Gobain Ceramics' tap hole clay plant under construction in 1991.

The Progress of a Successful Partnership

Owing to a close relationship with its Japanese partner, Saint-Gobain has gained market share through the years, resulted from a continuous improvement of the products portfolio, and, as a consequence, the ability to respond instantaneously to the customers' needs. Nowadays, it owns half of the tap hole clay market in Brazil, being the leader supplier at least in three large steel companies, as illustrated in Fig. 4. In addition, Saint-Gobain Ceramics has also increased its activities in Latin America and become a key player in this region (Fig. 5). Recently, the supply of tap hole mud reached North-American market as well, resulting in a monthly deliver of roughly 57.0 t/month.

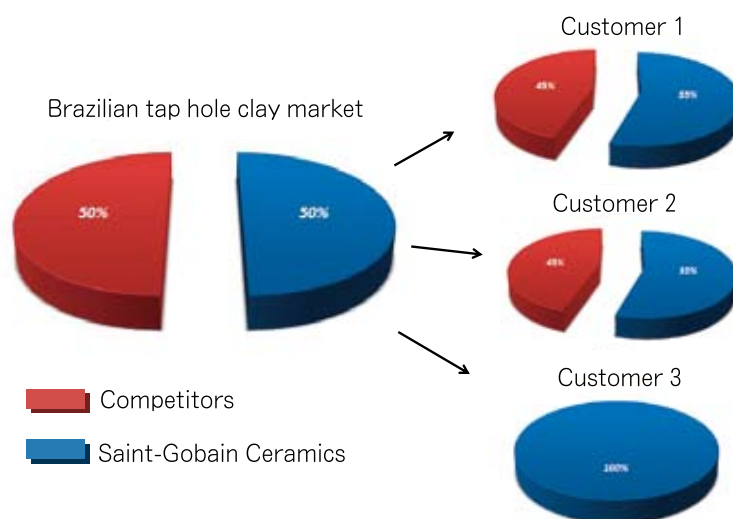


Fig. 4 Saint-Gobain Ceramics' share in Brazilian tap hole clay market in 2012 and in three large steel companies.

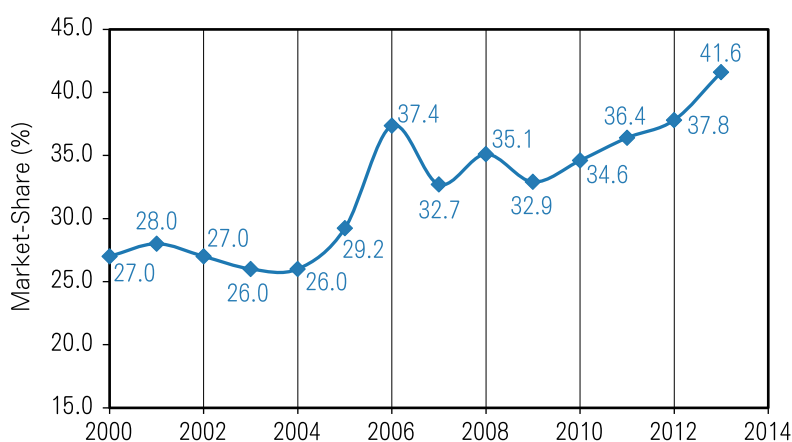


Fig. 5 Saint-Gobain Ceramics' share evolution in Latin America during the last years, highlighting its consistent growth and high potential for the future.

The relationship between Shinagawa Refractories and Saint-Gobain Ceramics did not remain restricted to tap hole mud. Due to the success attained with the first agreement, the two refractory suppliers decided to bring Brazil and Japan even closer, by signing a second contract in 1993, contemplating the technology transfer for blast furnace trough and runners monolithics. Within the new contract, Shinagawa transferred know-how not only for conventional castables, but also for the production and application of gunning materials for hot repairs, strengthening even more Saint-Gobain's position in Brazilian ironmaking market.

Having positioned itself as a strong and reliable refractory supplier for blast furnaces and cast houses, Saint-Gobain Ceramics started conversations with Shinagawa Refractories in 1994 (Fig. 6) in order to extend its activities to the steel shops. Thus, the companies evaluated the development of a new agreement to transfer to Brazil the technology for producing MgO-C bricks, which was presenting excellent results in Japanese BOFs and steel ladles. Nonetheless, the situation of Brazilian steelmaking market at that time hampered the agreement evolution and it remained in a stand-by status until 2008.



Fig. 6 Meeting between Saint-Gobain Ceramics and Shinagawa Refractories in Japan in 1994, during the evaluation of know-how transfer agreement for MgO-C bricks.

It is Time for MgO-C Bricks

The Brazilian steelmaking refractories market had always been very conservative and concentrated in very few suppliers. This condition has changed since 2008, when the steel plants decided to change the way to purchase refractories, opening the market for new players, but still keeping a conservative and strong demand of experienced suppliers and high level support in terms of technical assistance.

Mindful to the direction that the steel market was leaning to, Saint-Gobain, which has been worldwide renowned by its strong and focused technical assistance, quick answers

to customers' needs and continuous improvement, re-started in the same year the MgO-C project with Shinagawa Refractories (Fig. 7). In the meantime that the companies were formalizing the contract and carrying out the technical steps to implement the new technology in Vinhedo, Saint-Gobain initiated its participation in the steel market by performing trials at some customers steel ladles with bricks imported from Japan. The customers' acceptance of Saint-Gobain / Shinagawa agreement was excellent and the tests presented more than satisfactory results.



Fig. 7 Saint-Gobain Ceramics' visit in Japan in 2010 as part of know-how transfer of MgO-C bricks technology.

Similar to what happened during the first know-how transfer in 1991, the new agreement also required the construction of a new plant to produce the high-quality MgO-C shaped refractories. Saint-Gobain started to build the new factory on October 2010 (Fig. 8) and, during that year, it simultaneously got orders for steel ladles in 3 different customers. Saint-Gobain supplied four complete linings for each customer and no more trials were necessary to be approved in all of those mills.



Fig. 8 Saint-Gobain Ceramics' MgO-C plant under construction in 2010.

In one of these customers (Fig. 9), the refractories supplied by Saint-Gobain reached average steel ladle campaigns of 102 heats. At the second customer, the attained working life was 115 heats, limited due to trial conditions, but presenting good residual thickness. And at the third one, the steel ladle campaign reached 100 heats without any exchange brick repair and the results obtained after four linings trial became a record in 2010 for that customer.



Fig. 9 Steel ladle lined with Saint-Gobain / Shinagawa MgO-C bricks before and after campaign.

New Plant, Excellent Results

In September 2011 the new MgO-C plant was inaugurated in Vinhedo (Fig. 10) and, from that moment on, Saint-Gobain was able to produce high performance bricks in accordance with Shinagawa Refractories know-how. Right after the plant inauguration, the first contract for steel ladle supply was signed, providing 20% share of an important steel plant ladles. Two other major companies continued to regularly purchase Saint-Gobain products and other customers around Latin America placed orders in order to perform trials with Saint-Gobain products. In one of them, Saint-Gobain negotiated trials with four ladles imported from Japan plus four ladles produced in Saint-Gobain plant. The excellent results attained after those trials enabled Saint-Gobain to gain 100% share of steel ladles on the first semester of 2013.



Fig. 10 Inauguration of Saint-Gobain MgO-C bricks plant in 2011.

These results regarding steel ladles refractories helped to confirm the strength of Shinagawa and Saint-Gobain partnership at this new market. At a different client, after finishing the first ladle campaigns with 115 heats, coupling with the trial conditions, Saint-Gobain progressively showed its high quality solutions by suppressing the average life in 25%. Additionally, the campaigns with more than 125 heats, highlighted in red in the chart in Fig. 11, had never been attained before, providing a new life record.



Fig. 11 Evolution of Saint-Gobain refractories working life at one of its customer steel ladles, highlighting the excellent results never attained before there.

Regarding BOF materials, the first impression of Shinagawa technology in Brazil dates from the 90's, when it supplied a complete lining set for two companies. At that time, a record of campaign was achieved for both costumers, with 3500 heats and 5686 heats without any repair (with potential for over 6500 heats). Shinagawa was not able to keep supplying due to the existing purchase policies, as already described. However, with the changes in the market after 2008, Shinagawa and Saint-Gobain supplied the first BOF after the MgO-C know-how agreement. In order to make this deal possible, Saint-Gobain accepted all terms, which included: full technical and commercial support, purchase based on performance and a life guarantee. The complete lining set was then produced in Japan, as the new plant in Brazil was not entirely built, and the installation and operation was supervised by both Saint-Gobain and Shinagawa. Fig. 12 presents the BOF during its assembling.



Fig. 12 First BOF supplied by Saint-Gobain and Shinagawa after the MgO-C technology transfer agreement.

This first campaign begun to operate in 2011 and reached 4100 heats with good remaining lining in several areas, pointing out good perspectives for future BOF supplies to the steelmaking market. In fact, in April 2013 Saint-Gobain delivered its first lining set produced in Vinhedo. After operating under very aggressive conditions, including high average temperature, high Si content and a series of unexpected interruptions, it finished campaign in September due to a customer decision, who did not want to have two middle-life furnaces simultaneously operating. The good residual thickness measured after demolition indicated again the excellent performance of Saint-Gobain / Shinagawa bricks, confirming once more the benefits of a relationship which has been growing year by year.

Perspectives for the Coming Future

From a macroeconomic standpoint, Brazil has recently received special attention from developing countries, which resulted in an increasing input of foreign capital. As a consequence, the perspectives of Brazilian metallurgy market for next few years are very prosperous. This future scenario is totally in tune with Saint-Gobain strategy to be a strong new player in steelmaking area with a wide technology background and high performance products for South and North America.

For such target, it is of utmost importance to keep the laces which unite Saint-Gobain and Shinagawa even more tied. The unquestionable success achieved by this 23-year partnership over the years is a direct consequence of three main factors: high quality and reliable products provided by Shinagawa technology; consistent and fast technical assistance; and a flexible commercial policy provided by Saint-Gobain. Moreover, it is also relevant to extend the transparent behavior, reliable relationship and high technical formation, main characteristics of both companies, to the young professionals who are beginning to be part of this important partnership. This process has already begun with the most recent visit of Saint-Gobain technical and application team to Shinagawa's facilities on July 2013, for a complete training period on tap hole mud, trough castables properties and MgO-C bricks updates (Fig. 13).



Fig. 13 Saint-Gobain and Shinagawa teams at Shinagawa Research Center, in Japan, during technical visit in 2013.