

巻頭言

“PREFACE”

品川技報から見た技術の変遷

Changes in Refractory Technology Seen in
“Shinagawa Technical Report”

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品川技報は、耐火物の研究成果および耐火物の実際の使用の記録や使用者側の意見を発表し、耐火物を通じて関連産業の生産技術の向上に貢献したいとの精神の下、1954年に第1号が発刊され、半世紀以上発行し続けてきました。関連産業に貢献すべく、これまでどのような技術を紹介してきたのか、品川技報の歴史を辿ってみました。

1. 戦後復興から高度経済成長期

Fig. 1に示すように、高度成長が始まろうとする昭和29年、1954年に第1号が発刊されました。粗鋼生産量は現在の12分の1以下の775万t、その8割が平炉鋼でした。耐火物生産はピーク時の約6分の1でした。第1号では、平炉やセメントキルンで高耐用が期待され、広く使用されるようになってきた塩基性れん

Shinagawa Technical Report was first published in 1954 in the spirit of contributing to the improvement of refractory related industries manufacturing technology. It contained articles on the achievements of research in refractories and actual use results of refractory products, as well as users' opinions. Since then, it has been issued for more than half a century. I looked back over the history of Shinagawa Technical Report to see what kinds of technology have been introduced.

1. From Postwar Reconstruction Period to High Economic Growth Period

As Fig. 1 shows, the first issue was published in 1954 when the high economic growth period was about to start. Crude steel production was 7.75 million tons that year, less than one-twelfth of the present level. Open-hearth-furnace-steels accounted for 80% of the market at that time. Meanwhile, refractory production was about one-sixth of the peak production period. Basic bricks called RITEX, which had become widely used due to their expected high durability were reported on in the first issue. The second issue was published

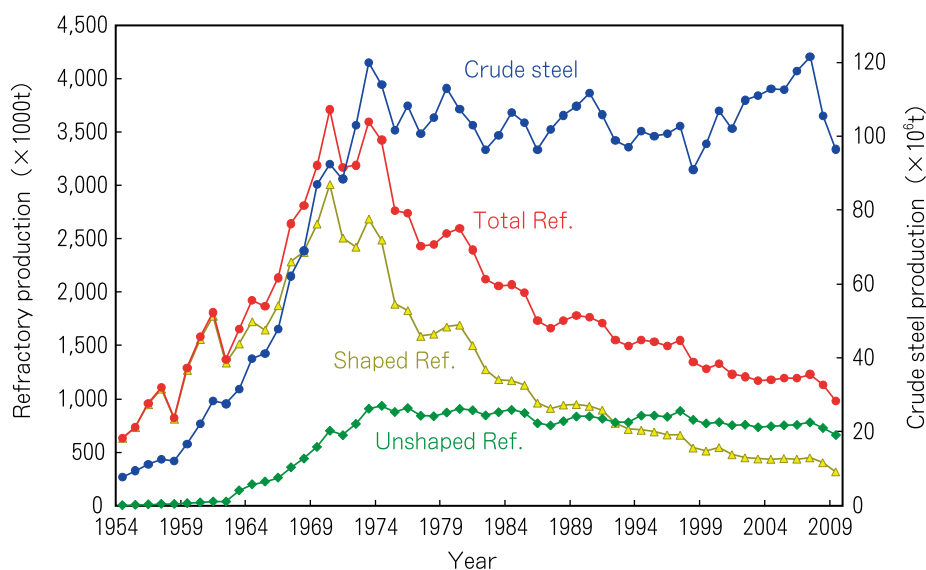


Fig. 1 Production of crude steel and refractories in Japan.

がRITEXを発表しています。1955年の第2号では、不定形耐火物の生産はまだ年間3500t、耐火物全体の0.5%でしたが、早くも不定形耐火材料として、キャストブルやプラスチックの性能と施工要領を報告しています。1957年には2～3年前からアメリカ、ドイツで増加しはじめてきた炭化珪素質れんがの特性や用途を紹介しています。1963年には日本で初めてキャストブルによる高炉吹付補修実績と米国の実績を、1965年にはダイレクトボンド塩基性れんがの海外レポートを紹介してきました。1967年は第1回の不定形耐火物特集として、キャストブル、プラスチック、ラミング材を広く紹介しています。不定形は1963年から増加してきましたが、まだ全体の生産量の8%程度でした。製鋼法を大きく変えた純酸素上吹転炉は、1958年頃から導入され、1961年から1965年にかけて数多く新設されましたが、1968年の技報には転炉の操業や耐火物の損傷機構を報告しています。

in 1955. The production of monolithic refractories was only 3500 tons this year. This accounted for merely 0.5% of the total refractory production. However, the performance of castable and plastic refractories, and the methods of installing them were already reported in this issue. In 1957, the properties and applications of silicon carbide bricks, which had started to increase two or three years before in the U.S. and Germany, were introduced in the Report. The 1963 Report showed the performance of castable gunning repair for blast furnace linings which was carried out for the first time in Japan, and also, application of this method in the U.S. In 1965, overseas studies on direct bonded basic bricks were reported. The 1967 Report introduced castable and plastic refractories and ramming mixes widely as the first special issue on monolithic refractories. At that time, monolithic refractories accounted for about 8 % of the total refractory production, although they had started to increase since 1963. The oxygen top blowing converters, which drastically changed the steelmaking method, had been adopted since around 1958 and newly built in large numbers from 1961 through 1965. Operation of converters and the erosion mechanism of their refractories were reported in the 1968 issue.

2. 安定成長期

1970年には、普及しはじめた取鍋のスライドバルブ方式を発表し、1971年には急速に進展しはじめた連続鑄造用耐火物について初めて紹介しています。1972年には、公衆衛生問題として重要視されるようになってきた生活系および産業系廃棄物の焼却炉用耐火物を発表しています。1973年からは連続鑄造用モールドパウダーの紹介も始まっています。取鍋の不定形化としては、1971年に報告されたスリンガープロセスがありましたが、1979年に肉盛り補修によるエンドレスライニングの可能性や施工・設備面の簡素化、作業環境の改善を求めて、流し込み施工の開発を報告しています。また、セメントキルン用耐火物として、現在環境問題も含めて主流となっている合成スピネルを使ったスピネルレンガが出現しています。1970年代の技報を見ると、3600t大型プレスや大型乾式ISOSTATIC PRESS, Max.1900℃焼成が可能な超高温トンネルキルン等の導入によるレンガの高品質化も進んでいます。転炉ライニング装置や各種自動吹付装置等の施工機械の開発も進められました。1980年、昭和55年にはレンガの特性を大きく進化させることになる黒鉛含有不焼成レンガの開発や、当時盛んに開発されたキャストブルの高耐用化をもたらしたローセメントキャストブルの紹介を発表しています。また、連鑄比率向上や高級鋼対策として増加傾向にあったRH脱ガス用耐火物も初めて紹介されています。1982年号では、耐用を大幅に向上することになる連鑄用カーボン含有機能性耐火物を初めて紹介しています。コンピューターによる熱応力解析やX線透視法による非破壊検査も報告されまし

2. Stable Growth Period

In 1970, the ladle slide valve system, which had just started to be used, was published in the Report. The 1971 Report introduced refractories for continuous casting, which had just begun spreading rapidly, for the first time. In 1972, refractories for household and industrial waste incinerators were reported on. They had begun to attract attention as a public health issue. In 1974, the reports on mold powder for continuous casting first appeared. As for monolithic refractories for ladles, the slinger process was reported on in 1971. In 1979, reports were made on the possibility of infinite life linings by repeating repair with castable and the development of ladle lining with castable to simplify installation, equipment and improve the working environment. Meanwhile, spinel bricks containing synthetic spinel clinkers appeared as refractories for cement rotary kilns. They have now become mainstream from the view point of environment. Reports in the 1970's showed that the improvement in quality of refractory bricks had progressed by the introduction of equipment such as a 3600t oil-hydraulic press, a large isostatic press with dry-bag system and a super-high temperature tunnel kiln that is able to fire bricks at 1900 degree C at the maximum. The development of installation equipment such as lining equipment for LD converters and various automatic gunning systems was also carried forward. In 1980, reports were made on unburned carbon containing bricks, which were to evolve the properties of bricks dramatically from then on, as well as low cement castables, which provided high durability to the castables that had been developed actively at that time. Furthermore rise of the CC ratio in crude steel was described and refractories for RH degassing vessels, which had been increasing for high grade steel making, were also reported on for the first time. In 1982, the first report was made on carbon containing refractories with elaborated function for continuous steel casting, which were to improve the durability drastically. Thermal analysis by computer and non destructive inspection by X-ray inspection method were also reported. In 1984, the Report started to introduce ceramic fiber. It had been increasingly used because energy

た。1984年には、1973年秋のオイルショック以来省エネルギー化が注目され、高品質化とともに増加してきたセラミックファイバーの紹介が始まり、1985年には、転炉の耐用を大きく向上したマグカーボンレンガの進展を報告しています。また、この当時炉外精錬として多面的に活用できるLFが増加しており、安定操業のための耐火物も紹介しました。1986年には、現在コークス炉延命用耐火物として実績を挙げている熱間補修用レンガHRSの開発や、吹付キャスタブルの性能を大幅に向上した高密度吹付システムの開発が報告され、また、本格的稼働に入った溶銑予備処理用耐火物も紹介しています。1988年号で初めて連続鑄造特集が組まれました。連続鑄造法は1970年代初めのエネルギーショックにより普及に拍車がかかり、この当時は日本の鉄鋼生産の90%以上が連続鑄造法で生産されるようになっていました。この特集では、欧米の連続鑄造技術動向や日本の連続鑄造用耐火物の現状や新技術を紹介しています。1989年、平成元年には不定形耐火物の生産は年間84万t弱と耐火物全体の47%まで増加しており、第2回目の不定形耐火物特集が組まれました。高炉用から製鋼用、セメント用や焼却炉用、また施工機械まで幅広い開発品を紹介しています。製鋼用耐火物は、転炉複合吹錬や二次精錬技術等の製鋼技術の進展とともに技術的な発展の道を歩んできましたが、1990年に初めての製鋼用耐火物特集を発行し、新しい技術や開発品を紹介しています。また、ファインセラミックス等耐火物以外の開発品についても紹介を開始しています。

3. バブル崩壊と低成長期

1991年には、現在の生産量の約2倍の8千

saving had been attracting attention since the oil shock in autumn 1973 and higher-quality products had become available. In 1985, magnesia-carbon bricks which greatly helped improve the life of converters were reported on. At that time, ladle furnaces which can be used in various ways as a secondary refining system had been increasing and the refractories to operate them stably were also reported on. In 1986, reports were made on the development of HRS, hot repair silica bricks, which has now achieved satisfactory results for prolonging the life of coke ovens and that of the gunning system for high density, which substantially improved the performance of gunning mixes. Refractories for hot metal pre-treatment which had just started full-fledged operation were also reported on. In 1988, the first special issue on refractories for continuous casting was published.

The first oil shock in the beginning of the 1970's accelerated the spread of the continuous casting method, which helped increase the CC ratio of Japan's steel production to more than 90%. This special feature described the trends of continuous casting technology in the U.S. and Europe, and the situation and new technology of the refractories for continuous casting in Japan at that time. In 1989, the annual monolithic refractory production was about to reach 840,000 tons, accounting for 47% of the total refractory production. Thus compiled was the second special issue on monolithic refractories. It widely introduced newly developed products from refractories for blast furnaces, steelmaking, cement, and waste incinerators to installation equipment. Refractories for steelmaking showed technical development along with the progress in the steelmaking technology such as BOF combination blowing and secondary steelmaking. In 1990, we published the first special issue on refractories for steelmaking, introducing new technologies and products. Newly developed products other than refractories such as fine ceramics also started to be included.

3. Collapse of the Bubble Economy and Low Growth Period

In 1991, a special issue on refractories for the cement industry was issued. About 80 million tons of cement was produced at that time, which was about double the amount produced today.

万t程度を生産していたセメント工業の耐火物特集、1993年には第2回連続鑄造用耐火物特集を発行しました。この頃から不定形耐火物の生産比率は50%を超えるようになり、2000年にかけてミキサーレス流し込み材、レジン系マッド材、セルフフローキャストブル、高炉シャフト熱間補修用自動吹付機等の使用現場の環境対策や省力化対策を考えた不定形新技術や、耐用を向上したショットクリートと一般に呼ばれている新湿式緻密質吹付キャストブルCLS、転炉熱間補修用カーボンボンド吹付材・焼付材の開発を報告してきました。2002年には社会問題化してきた環境対策特集としてクロムフリーやピッチフリー、焼却炉ダイオキシン対策等を紹介し、2005年には大きく躍進してきた中国の鉄鋼用耐火物の現状を紹介しています。その後も、当社のグループ会社も含めた新商品を中心に新しい技術を報告してきました。

以上のように、あらためて品川技報から見た技術の変遷を振り返ってきましたが、先達たちによって、その時代時代に応じた常に新しい技術・製品の情報を提供してきました。1954年の品川技報の発刊の精神通り、関連産業の生産技術向上に基礎のところで少なからず貢献できてきたのではないかと自負しております。

耐火物産業では最近、経済成長の鈍化、耐火物生産量の減少に伴って新技術の展開も減少しているように思えます。イノベーションの提唱者である経済学者シュンペーターは、経済発展のためには、新しい財貨の生産、新しい生産方法の導入、新しい販売先の開拓、新しい仕入先の獲得、新しい組織の実現の五つが重要であると言っております。技術研究所としても、新しい財貨すなわち価値の高い新商品や新しい生産

In 1993, the second special issue on continuous casting refractories was published. Since around that time, the amount of monolithic refractories accounted for over 50% of the total refractory production. This issue was followed until 2000 by reports on the development of various technologies. These included new monolithic refractory technologies involving environmental and energy saving measures on site such as mixerless casting materials, resin bonded taphole mud, self-flow type catables and automatic gunning equipment for the hot repair of blast furnace shafts. Also reports about a new wet type of high density gunning castable with high durability which is generally called shotcreting and we call “CLS”, as well as carbon bonded gunning mixes for hot repair of BOFs which we had developed were provided. In 2002, when the environment had become a serious social issue, such topics as chrome-free or pitch-free refractories and dioxin exposure preventive measures for incinerator repair work were reported on as a special environmental issue. The 2005 issue described the situations of the refractories for steelmaking in China which had shown rapid progress. After that, we have been reporting on new technologies focusing on new products of the Shinagawa Group.

As described above, taking this opportunity, I have looked back over the history of refractory technology through Shinagawa Technical Report, showing that our predecessors have always provided information on new technologies and products which met the needs of the times. We believe that we have contributed unbiasedly to the improvement of manufacturing technology of the refractory related industries at the basic stage, observing the spirit of the first issue in 1954.

It seems that the development of new technologies has diminished recently in the refractory industry with the slowdown in economic growth and decrease in refractory production. Joseph Schumpeter, an economist who advocated innovation, distinguished five types of innovation which are important for economic growth: “the introduction of a new good(product)”, “the introduction of a new method of production”, “the opening of a new market”, “the conquest of a new source of supply of raw materials or half-manufactured goods”, and “the carrying out of the new organization

方法の開発を目指して、弛みない努力をしていく所存であります。そして、その新しい成果をタイムリーに品川技報で紹介し、関連産業の皆様方のお役にたてるようにしていきます。今後ともご愛読いただきたくお願い申し上げます。

of any industry". We, the Research Center, will make every effort to produce a new good, that is, new products and new manufacturing methods of high value and will introduce these achievements in Shinagawa Technical Report timely so that we can contribute to every industry related to refractories. We would appreciate your continued patronage.