Looking for the most suitable, high-performance, specific product for aluminium? We have it!

We have often told that our company is the sole proprietor of hundreds of formulae for refractory materials, which have seen the light thanks to a vast amount of work by our R&D department, led personally by the company Chairman Davide Scabini since the very creation of the company, often with input from partnerships with top research and university institutes.

But what we have not always said, or perhaps not stressed sufficiently, is that each of those products is the outcome of constant, painstaking work in support of our customers, intended to deliver just the right solution to very specific metal processing tasks. In more than 70 years in business, this has enabled Eredi Scabini to build up an immense store of knowledge that still lies at the core of its product portfolio. Yet the world does not stand still, situations change and it is essential to keep up to date.

The changes in the aluminium industry during the last few years — such as the introduction of new alloys, new equipment and new working conditions — have recently led us to reassess the performance of our specific products for this sector in the light of those sometimes extreme conditions, with the aim of coming up with the very best compromise on the basis of the alloys, temperatures and fluxes parameters involved. This project has affected 88 different Eredi Scabini products, of 4 different types:

- conventional castables
- low-melting castables
- cement-free castables
- refractory materials.

The aim of the first phase of the project was to choose every product’s performance in contact with each of the alloys considered (Aluminium 7075, 6082-T6, 6082-T651, 2024-T3), at different temperatures (950 – 1300 – 1800°C and 3000°C).

Cross-checking of all the possible combinations involved in this performance of 980 tests. The results achieved enable us in some cases to combine and in others to review the products’ strong points in relation to the various situations tested, increasing our awareness of our products’ quality and even further raising our standards in offering more and more high-performance solutions, tailored to specific needs, to meet and exceed our customers’ expectations in the first phase. We are currently at work on the creation of a database of specific information about fluxes, that will be soon used for the continuation of this task.

New investments at Eredi Scabini: constantly expanding, now even more flexible.

Eredi Scabini has a history reaching back 73 years, during which it has created, consolidated and extended its business by wearing a very close eye on the market, listening to its needs and demands — and where possible — keeping ahead of them. This has enabled the company to grow, evolve and — in spite of the many difficulties on its key market and in the economy as a whole — to face its challenges and press forward without ever flinching. The firm invested in preferred shapes, a major part of the business for about 33 years, further reinforcing Eredi Scabini’s standing, especially in the export markets, enabling it to make a name for itself all over the world. Since then, the company has grown rapidly, to meet ever-increasing demand, and has gradually extended its operations into new areas (the South West and the South East of Italy) which will yet another year which will be remembered for this reason.

A new building next door to the existing production site is now nearing completion, and a new high-temperature furnace for testing prefabricated shapes up to 15 tons is being installed alongside the one already in service for several years. All this will very soon be reflected in an impressive increase in production capacity and thus greater flexibility in responding to customers’ demands. 2016 is now drawing to a successful end, and the company is ready and waiting to face new challenges and more and more important goals!

Highlights

Eredi Scabini launches the new BEcoat® line

Looking for the most suitable, high-performance product for aluminium treatment? We have it! New investments at Eredi Scabini: constantly expanding, now even more flexible.

case histories

Cleaner, more durable washers with BEcoat®

Fluxing® number 1 solution that ensures performance.

Fluxing®, a Fluxing® make up a complete range.

Eredi Scabini: Number 1 for DCMA tool (FC9®) uses reliable and solid to apply than other conventional systems.

More durable impregns with Fluxing® Hi Al.

Once you’ve tried perfomed shapes you never step back!

Outstanding mechanical strength with Resistant®

Stronger and more reliable charging area with Fluxing® impact plates.

CSP® (Crucible preferred option): still the best solution on the market for impressive coreless induction furnace linings

Distinctive® the dry running mix that really makes the difference!

Inconvertible advantages

Distinctive® the best maredititle safety being solution.

Hearts free from wear and with reliable joints thanks to Fluxing®.

Fluxing® extends the lifetime of reheating furnaces.

Papers: including references.
Cleaner, more durable launders with BEcoat®.

BEcoat® is a line of aqueous suspensions of highly reactive nickel boride for use in the transfer of aluminum, zinc, and magnesium. BEcoat®-based products are coatings applied to metal or ceramic materials in contact with molten metals to prevent corrosion and facilitate cleaning. In addition to the excellent lubricating and non-wetting properties of nickel boride, ceramic-like surfaces provide high adhesion and good abrasion resistance.

The customer is looking for a long-term solution for molten products, primarily more than 100,000 tons of aluminum a year. To pursue the desired search for potential improvements in the production process to maintain a high-quality standard over time in this case, the customer expressed the need to reduce the metal loss by 20% to 40% in aluminium launders, as simply ensuring operation and reduced its durability over time. Eredi Scalini came forward with BEcoat® NP 500, a ready-to-use product from its line of aqueous suspensions based with high boron nickel boride, containing
and special tribology nano-additives. From the very first trials performed on the launders, the customer was immediately impressed by the uniformity and saving power of BEcoat® NP 500, the strong bonding achieved, the subsequent easy removal of aluminium bars and run-off, and the simple application and general convenience of a product which is supplied ready for use with no need for dilution. In the plant today, BEcoat® NP 300 is considered essential, and no area is standard without it.

REF 1.32

flextrong® - a solution that empowers performance

Flextrong® is a patented ceramic matrix composite reinforced with high carbon steel. The product has excellent resistance to thermal shock, impact, fretting, and oxidation as well as to corrosion with metal melts. Flextrong® is designed for the installation via both cold and welding techniques provided.

The customer is a company which produces about 200,000 tonnes/year of refined aluminium products with continuous casting machines. The launders between the melting and holding furnaces have to cope with massive flows of molten aluminium. A new 105 t high-strength steel tank furnace was installed in 2008. The number of this new furnace was limited with concrete, but its life was only short due to the extreme stresses it had to withstand.

In fact, it became necessary to replace the current launder that had every 2 to 3 months while the straight launder had to be replaced every 4 to 5 months. The furnace operates non-stop, producing about 50 t per hour of aluminium every day. 800 t are shipped from the furnace every 5 to 6 hours, in a continuous block about once hour. Eredi Scalini supplied several Flextrong® launder sections, which were installed without destroying the integral structure with dense concrete casting to create the supporting surface and using PECU® for resistance of the site walls.

This resulted in a reduction immediately provided: greatly improved performance, with an average life of about 12 months compared to the 3-4 months of the previous solutions. The customer has been using only the solution, on a regular basis, since 2008.

REF 1.31

flextrong® & Flustone® make up a complete lining.

Flextrong® is a patented ceramic matrix composite reinforced with high carbon steel. The product has excellent resistance to thermal shock, impact, fretting, and oxidation as well as to corrosion with metal melts. Flextrong® is designed for the installation via both cold and welding techniques provided. Flextrong® has been specifically developed for applications at high temperatures and in the presence of oxidizing atmospheres.

The customer is an European company which is a leading international producer of rolled products, processing more than 150,000 tons of aluminium a year and exporting it to more than 50 countries. It prioritizes the constant search for potential improvements in the production process to maintain a high-quality standard over time. In this case, the customer was about to completely rebuild a 80 t iron foundry furnace and asked to extend the life of the aluminium furnaces connected to the conventional types with steel or iron instead plates, to eliminate the furnace, the continuous maintenance costs and the risk of wear of the steel and carbon due to the charges. The customer also acquired a high-quality refractory material with strong resistance to aluminium immersion, highly reliable, stable, and with minimal expansion and contraction in the event of furnace shutdown and start-up, not to mention costs to install. The key feature of the design developed by Eredi Scalini is the Flextrong®-F1788. The wear lining of the furnace was liners, burners, and nozzles were manufactured in a variety of products from the Flextrong® line of monolithic dense materials with high resistance to abrasion and erosion by metals and slags.

More than three years after its introduction, the plant is still fully operational, with only a small amount of maintenance, and one replacement of the lining and parts are out of the frame, which is still intact. Completely satisfied with this solution to all its requirements, the customer is now working in partnership with Eredi Scalini in a continual basis, engaging more complete melting furnace rebuilding projects in our company.

REF 1.40
Eredi Scabini: Number 1 for OEMs too!

The customer is an international corporation specialized in the design and production of industrial furnaces for ferrous and non-ferrous metals. Their range also includes aluminium melting, holding and heat treatment furnaces.

Eredi Scabini has been a major player in this market for more than 50 years, providing customers with a complete, absolutely efficient service, as well as a top-quality product. In this respect, Eredi Scabini has always been at the forefront of the latest developments in technology, achieving high levels of performance and reliability for their products. Their furnaces are designed to meet the specific needs of each customer, ensuring the best possible results in terms of quality and efficiency.

IPS™ (Inductor Preformed System): more reliable and quicker to apply than other conventional systems.

The new IPS™ - Inductor Preformed System - is an innovative solution for the induction of aluminium induction furnaces. This product comprises a preformed, pre-routed wire, which is to be fed to the metal in order to improve its conductivity and minimize its wear. This makes the system more efficient and reduces wear and tear. In addition, the IPS™ system is designed to be easily integrated into existing equipment, making it a perfect solution for upgrading existing furnaces.

The IPS™ system is particularly useful for the production of aluminium alloy products, which require precise control of the melting process. The system is designed to be used in combination with the induction furnace, ensuring a smooth and efficient melting process. The IPS™ system is also ideal for the production of high-quality aluminium products, such as automotive parts, aerospace components, and electrical components.

Proud to build also customer loyalty!

Eredi Scabini is a major international corporation with plants all over the world, specializing in the production of aluminium alloy for the aerospace and other industries. In the past 50 years, the company has developed a range of furnaces suitable for the melting and holding of aluminium, copper, and stainless steel.

The IPS™ system is just one of the many successful solutions developed by Eredi Scabini. The company is committed to providing customers with the best possible product and service, and this commitment has resulted in a high level of customer satisfaction.

The IPS™ system is designed to be easily integrated into existing equipment, making it a perfect solution for upgrading existing furnaces. The system is particularly useful for the production of aluminium alloy products, which require precise control of the melting process. The IPS™ system is also ideal for the production of high-quality aluminium products, such as automotive parts, aerospace components, and electrical components.

The IPS™ system is just one of the many successful solutions developed by Eredi Scabini. The company is committed to providing customers with the best possible product and service, and this commitment has resulted in a high level of customer satisfaction.
More durable impeller with Flextrong® HT AL

Flextrong® is a preferred ceramic matrix composite reinforced with hot resistance steel. This material has excellent resistance to thermal shock, impact, abrasion and erosion as well as corrosion with molten metals. Flextrong® is designed for the installation via extra undergirding brackets provided. Flextrong® HT AL has been specifically developed for applications at high temperatures and in the presence of erosive atmospheres.

The customer is a leading international producer of forged wheels and alloy rings for the automotive industry. The mixing of alumina chips from reclaiming operations is fundamental to the production process and makes usage of furnaces using Impellers, which operate partially immersed in the bath and are constantly subjected to intense thermal and mechanical stresses.

The customer asked Edis Scabini to come up with a preferred impeller which would resist a longer lifetime than the current type, which was breaking or wearing out after a month and a half. In response, (Edis Scabini) designed an impeller in Flextrong® HT AL, a ceramic matrix composite reinforced with hot resistance steel and excellent resistance to thermal shock, impact, abrasion and erosion as well as corrosion with molten metals, generally used as a substitute for both refractory linings and metal casings. The lifespan of the Flextrong® impeller was three months, in contrast to the competitors' typically over 6 months. Today, after more than 9 months of continuous uninterrupted service, the Flextrong® HT AL Impellers are still in operation, leading over the most optimistic expectations. Without any wear for the final result, the customer has placed another order with Edis Scabini, with the aim of replacing all these installed in the various smelting plants.

REF. N.36

Once you've tried preformed shapes you never step back!

Edis Scabini has always believed in the development of preformed shapes. This conviction has now been proved right, as the market is demanding high-quality, large-sized preformed shapes to increase reliability, increase performance and cut down process times. For capability for producing preformed shapes up to 15 t in weight please Edis Scabini adapted the selected workshop solutions in the market sector. The production process takes place in a perfectly controlled environment, which reproduces the ideal conditions of a laboratory on an industrial scale. After casting, the pieces are dried, dried and fired in special furnaces, and undergo strict dimensional inspections before shipment to customers or, if required, installation on their premises.

The customer is a well-established manufacturer which produces aluminium, iron and steel castings for the automotive market. The company has a strong focus on technological innovation, and it therefore aims to continually expand its product range, as well as the equipment used to produce them. It was for this reason that the customer contacted Edis Scabini in 2014 with the intention of trying Flextrong®. The customer was very satisfied with the results, and the idea of producing preformed shapes was born. Edis Scabini decided to continue to pursue the preferred option, also extending their use in the electrically heated box-in-box furnaces. These furnaces comprise a tank containing a slag separation barrier and the charging and tapping wells, and the AL, where the electric heating elements are installed. After thorough development and design work, the first loading was produced in 2015. The load was made as a blank, with 250x250x400 mm blocks of a well-sounding version, and 250x250x400 mm blocks of a well-sounding version, and 250x250x400 mm blocks. The load was made as a blank, with 250x250x400 mm blocks of a well-sounding version, and 250x250x400 mm blocks.

The customer immediately realized how hard the metal was finding it to stick in the blank, and thus how much easier and less potentially damaging cleaning was, since it was no longer necessary to hammer the blank to break off the metal and slag, as had been the case in the past. A second complete load of the existing machine having been produced immediately afterwards. At present, these furnaces are the first installed in October 2015 and the second in February 2016, and both in operation.

This success is an indication that further development work is now underway in the new preformed lining from Edis Scabini products.

REF. N.38

Outstanding mechanical strength with Resistone™:

As well as formulating preformed and preformed shapes, the company has a full range of conductors specifically developed for industrial floors exposed to heavy mechanical and chemical stresses in the presence of heat: the Resistone™ line. Resistone™ 35 conductors are installed with procedures similar to those used for construction contractors, but with a specific attention to mechanical resistance with a single effort and can be used at a temperature of 1400°C over a period of time and any application. Resistone™ is a product of high performance, and a solution for use in industry, opens up new opportunities for the customer.

The customer is a multinational cementing on three continents, with production sites in several different continents; these include a large capacity concrete production plants having one or more sites with production lines with 30 t per 24 hours. The customer asked for a new solution to be used with a conical cone and a smooth plate, considering the weight of the mechanism and the stress imposed by the load. The solution was tested with a total weight of 3,000 kg at a temperature of 1400°C. With this solution, the plate had to be changed annually due to thermal expansion. With the new Resistone™ HT MF solution, the entire solution is now made from high-strength steel and 250x250x400 mm blocks. The customer received a 35 kg collection pan over the previous years, a significant improvement in productivity.

REF. N.32
Stronger and more reliable charging area with impact plates.

**Flexible** has been specifically developed for applications at high temperatures and in the presence of aggressive atmospheres.

This customer is an international leader in the same-finned copper product market. With a production capacity of over 600,000 tons/year in 2 production lines and more than 30 years’ experience, the company is a benchmark for all production and trading companies in the electrical engineering, electronic and system construction industries as the customer needed to solve a series of problems around the charging area of their shaft furnace, initially lined with copper impact plates. The problems involved altering of copper surfaces to the impact plates causing the formation of drippings, a very high temperature in the charging area, causing internal air cooling and uneven/abnormal impact strength and lifetime.

In response, Eredi Scabini developed a new charging chest lining using **Flexible** ST, a preferred ceramic matrix composite reinforced with high-strength steel, previously used as a substitute for both refractory linings and metal coatings. This lining was installed by simply bolting in place, in just half a day. Apart from the benefit of extremely fast installation, the solution solved all the other problems, with no more altering of surfaces or bridge formation, a dramatic fall in the metal temperature from 450°C/850°C to about 300°C and thus no more need for forced air ventilation, and excellent mechanical strength. The success of the Eredi Scabini solution encouraged the customer to assign more complex projects to us, culminating with the complete reparation at the shaft furnace, in the undertakings entirely using the innovative ART - Advanced Refractory Technology.

**CPS** ( Crucible preformed system): still the best solution on the market for coreless induction furnace linings.

Eredi Scabini is the only company which has introduced and successfully implemented the CPS® ( Crucible Preformed System), an innovative solution for various induction furnace linings. Every lining is a one-off, therefore each CPS® is customized to meet the specific customer.

The customer is a long-established European company that leads the world in the manufacature of heat exchangers in copper and copper alloys. The client is equipped with a continuous induction furnace with capacity 140T, used to smeltreturn of non-ferrous and semi-conductor products.

The original refractory lining consisted of dry ramming mix. The lining lifetime was highly variable but never satisfying. The critical point in the lining was around the hearth area of the structural rings. In fact, most stoppages and lining replacements were due to the formation of through cracks in this point.

To solve the critical problem of this dry ramming mix lining, in 2014 the customer decided to try Eredi Scabini’s CPS® solution. First test and treatment, use of the CPS® would avoid the use of the expensive copper hearths otherwise necessary for construction of the ramming mix lining.

It was also expected to solve the prior problem of the continuous furnace, since the lining consisted of a non-suitable preformed structure. After 2 months of design work, the new CPS® lining was installed in August 2014.

The first immediately obvious major difference between the previous solution and the CPS® lining was just the length of the repair time.

What’s more, this solution eliminated the metal intrusion around the output, which in the conventional design was carried in geometry, requiring it to be installed using special materials with CPS®. The second, on the other hand, it is integrated with the rest of the crucible.

Another point worth noting about the CPS® was the reduction in material duration saving, the crucible was designed and built with an integral ceramic in the upper part to prevent any overflows. The furnace with this new CPS® lining was to remain functionally for 12 months, with stoppages only for routine maintenance to check the general condition of the refractory lining. The first CPS® lining was followed by another, again with very satisfactory performance, and then another which is in operation. This customer is completely satisfied with the Eredi Scabini preformed solutions to the point where it is also considering the use of our preference for lining many of its furnaces.

**Dristone**: the dry ramming mix that really makes the difference!

Eredi Scabini has offered, and successfully conducted the in-house development of top-quality monolithic refractories since its foundation. The range now consists hundreds of different formulations, which can be used for the realization of refractory and insulating linings by a wide variety of methods. **Dristone** is a line of pure dry ramming mixes made with neutral or basic raw materials for installation by dry ramming composition. These products can be used as either safety or wear linings and with other durable or non-durable linings.

The customer is a cold metal industry with output of about 25,000 tons/year of pure (99%) and ductile (98%) cast iron. A few years ago, it began to produce steel for the automotive industry. The cast iron foundry consists of 60 coreless induction furnaces and 4 tures of pressureless coreless induction furnaces. The steel foundry is also equipped with coreless induction furnaces from 1 to 10 tons. The first linings the customer used for steel furnaces were foundry insulation and vibration problems, and furnace lifetime varied from 1 to 3 weeks at most (Photo 1-5). Eredi Scabini offered a “turnkey” solution including both supply and installation of the complete furnace lining. The lining was then cast grinding to the working lining, for which this chance was a pure Dristone®, produced with just ironpowder gives excellent 4000°C reliability. This solution solved the crucible lifetime while maintaining a high safety level, demonstrated by the fact that the same Dristone® was used to be partially remanufactured. (Photo 6 - 4 - 5 - 6). At present, all coreless induction furnaces in this batch are constructed using the Eredi Scabini solution.
**Incontrovertible savings!**

Flustone® is a line of non-cordierite castables with excellent flow ability allowing application by self-distribution. They are used mainly for working linings requiring high resistances to abrasion and/or spalling by metals and slag. They are self-bonding, allowing linings to be repaired by applying the same product to the worn surface without changing the whole lining.

The customer is a major foundry producing about 10,000 tons of cast iron a year (94% nodules and 6% gray) mainly for the construction machinery industry, with a small proportion for the automotive industry. The foundry produces 3500 and 8400 tons of iron castings annually (2 casting lines). One line is served by tilting ladles of varying capacity, already lined with Flustone® scabbards. The excellent results achieved with our products encouraged the customer to request a feasibility study on the lining of the 5 ton pressure ladles installed on the other line.

Prior to the Flustone® solution, these ladles were lined with bricks and concrete, with average lining lifetime of no more than about 5,000/5,000 tons (photo 1). With the new solution, Flustone® autolines made it possible to improve both durability and energy saving, achieving a 100% increase in lifetime and a 30% increase in productivity (photo 2). The results were immediately achieved, in fact, as of today the lining lifetime has increased from 5,000/5,000 tons to over 15,000 tons and the ladle is still in operation; since it went into service it has only required 4 re-linings, which represent a saving of very little material from the energy point of view, compared to the previous solution (photo 3). The Flustone® solution has reduced the temperature of the metal structure by about 130°C (photo 4).

This result has cut out pre-lining times and therefore consumptions and allows metal to be tapped from the melting furnaces at about 1100°C less than in the past.

From the economic point of view, the annual saving calculated by the customer is:
- about 150,000€ of electricity
- about 35,000€ of electricity, approximately
- about 8,000€ of natural gas

This has led the customer to decide to use the solution for both the ladles in the plant (Photo 5).

**Driztone**: The best monolithic safety lining solution.

Driztone® is a line of dense dry-mixing mortars made with natural or basic raw materials for installation by dry shotcreting. The products in this line can be used as either safety or working linings and with either refractory or renewable forms.

For the steel industry, Driztone® is specifically designed to be laid behind the brick working lining, creating a joint-free, monolithic back-up. At the operating temperature, this product develops a high strength and low porosity and hence maintains a dense back-up to stop molten metal from flowing.

The customer is a major European steel plant which produces about 3,000,000 tons/year of steel. The steelworks has one 105 and one 205 t coking furnaces which are the relevant ladles. The customer has already been using Driztone® for the safety lining of the 205 t ladle as an alternative to the conventional alumina bricks for a considerable period of time. In view of the consistent very satisfactory results achieved, the customer recently decided to use the same solution for the 105 t ladle. While the 205 t ladle is cylindrical in shape, the 105 t ladle is conical. The use of a dry-mixing shotcreting product meant that the safety lining was able to hug the metal structure precisely, providing the perfect supporting surface for the brick working lining, with none of the drawbacks typically linked with brick safety lining. Moreover, the use of our Driztone® by spraying has for the safety lining was combined with the use of Erediscabini® Monospor as insulating lining in the metal structure. The combination of insulating and safety linings applied as closed-loop systems provided the customer with energy savings and a joint-free structure, which was therefore able to withstand any metal infiltrations.

**Hearth free from wear and with stable joints thanks to Flustone**.

Flustone® is a line of non-cordierite castables with excellent flow ability allowing application by self-distribution. They are used mainly for working linings requiring high resistances to abrasion and/or spalling by metals and slag. They are self-bonding, allowing linings to be repaired by applying the same product to the worn surface without changing the whole lining.

The customer is a large producing steelworks for the petrochemical and energy market. The large workshops are remachining furnaces with capacities of 150-420 tons, including a rotary hearth furnace, and heat treatment furnaces from 420 to 2000 tons. Both types of furnaces are experiencing continuous problems with the hearth and outer rings. In the rotary hearth furnace, the customer was forced to perform repairs on the hearth during every annual shutdown. This operation slowed the plant shutdown times and, after the fact, that the repairs lasted a few months. This furnace was completely rebuilt after just 3 years in operation. It was decided to rearrange the hearth with a new Erediscabini® castable, with the outer ring in Flustone®. An extremely stable castable with high mechanical strength, and the hearth in another 12 months of the same line, the results kept the Flustone® mill area without changing mechanical strength and thermal shock resistance.

(Photos 1 - Photo 3) This solution solved the wear problem. After about 12 months in operation, the furnace is still in excellent condition without any repairs having been performed (Photo 3 - Photo 4). This result has persuaded the customer to use Erediscabini® Flustone® castables for the complete and partial repair of all furnaces in the plant.

**Ref. N° 38**

**Ref. N° 90**

**Ref. N° 40**
Flustone® extends the lifetime of reheating furnaces.

Flustone® is a line of monolithic dense castables with excellent flowability, allowing application by self-consistency. They are used mainly for working hearths requiring high insulation to atmosphere and/or saturation by metals and/or slag. They are self-curing, allowing linings to be erected by applying the same product to the work surface without changing the white lining.

Walking beam and pusher type furnaces are widely used for reheating, billets and slabs for rolling, and the most common problems occur in their hearths, which are exposed to both thermal shock and corrosion and then require frequent maintenance. The presence of scale, which penetrates into the porous surface of the refractory lining or cracks caused by thermal or mechanical shock, is a familiar problem, and it led Creda Scalae to draw up a refractory material specifically for this application. After a thorough assessment of operating conditions, it came up with a number of products with excellent mechanical properties and low linear expansion, withstanding mechanical stresses and thermal shocks.

The new products were introduced under the trade name Novacast® V 881 in the presence of scale (Photos 1) in order to select the material with the best performance. The outcome of the study conducted by our R&D department was Flustone® V 881, the supreme product for this application.

Flustone® V 881 has been installed on the hearths of pusher- and walking-beam furnaces as documented in the case histories below.

**Case history #1**

For more than 10 years, a European steel plant has used Flustone® V 881 as the refractory material for the walking beam hearths of its steel furnaces. The customer was looking for a product that could withstand the severe conditions of the hearth, which is subjected to high thermal stresses and mechanical shocks. The Flustone® V 881 product was chosen due to its excellent performance in terms of thermal stability and mechanical strength.

**Case history #2**

The customer at an electric steel mill which produces about 800,000 tons a year of steel slabs, which is processed in-house to some of the petrochemical, energy and Automotive markets. This plant has a number of scalding and heat treatment furnaces, including a walking-burn furnace, where the customer encountered a serious problem of the refractory lining of the hearth. The lining was pruned by cutting small segments with a crane, all the joints between them to compensate for the high level of thermal expansion of the low cement castables used. The expansion created cracks and mechanical failures in the joints (Photos 12, 13), apart from serious wear of the surface which led to the advance of sulfur for the steel grade, generating high energy consumption levels.

The customer was reaching the maximum annual scheduled shutdown, although the west was occurring a long time before this. The solution proposed by Creda Scalae involved the use of Flustone® V 881, which thanks to its stability allowed the creation of thinner sections with fewer joints. After 12 months in service, the lining was still in excellent condition, with no problems of wear, cracks and/or failures of the joints (Photos 12, 13). After two years in service, the lining is still in excellent condition, so it is about to be used for the third consecutive year. What's more, the customer has reduced the scrap reduction in reject rate during use of the furnaces.
INSULATING REFRACTORY

Insulating refractories are an extremely complex subject. When used to insulate dense refractory structures, they can totally control the engineering concept of the abutments, and as the structure as a whole is exposed to the environment as well as the specific insulating material itself. This is even more the case when the refractories are in contact with metal melts, because the use of insulating materials can modify the metal's solidification planes.

We will discuss insulating refractories from two different points of view: those of their insulating and refractory properties.

INSULATING PROPERTIES

In general terms, there are 4 main categories of insulating refractories:

- Insulating shapes (brick, calcium silicate, etc.)
- Insulating moraines (castables, ramming mixes, etc.)
- Insulating fibres (glass and ceramic)
- Microporous materials

The key feature which distinguishes insulating refractories from other types is their low thermal conductivity, which varies from product to product depending on the temperature to which they are exposed. (Figure 1)

![Figure 1: Thermal conductivity of some insulating refractories.](image)

Microporous materials are the most effective insulators, but their operating temperature does not generally exceed about 1000°C and they are used only for particular applications, or when traditional products are unable to reduce temperatures as required.

Moreover, this solution is expensive and the materials are not resistant to water or steam unless manufactured by specific methods.

At the same time, I believe that the continuous increase in energy costs will cause the use of these materials to become more and more widespread.

Microporous insulators consist mainly of monocrystals with an extremely small pore diameter (in many cases it is smaller in size than an air molecule, meaning that we are close to nanometric values).

HISTORY OF INSULATION

We all know that carbon is an excellent insulator.

In the 15th century Marco Polo reported an insulation material being used in Sibrica; this is now thought to have been asbestos.

We also know that people have always used animal pelt to protect themselves from the cold and prevent the loss of heat from their bodies. They did not know why this was the case, but it worked.

The answer is very simple; it worked by means of the capillarity of the air trapped in the hair of the pelt, which becomes an insulating agent.

Transferred into high-temperature industrial plants, this concept has encouraged people to find solutions and products to insulate furnaces or other equipment by adding them with dense refractory materials, initially natural refractory clay.

What are the main reasons why micro and more sophisticated insulating refractories are required?

- To reduce energy usage
- To reduce the thickness of ‘furnaces’ linings and thus their structures
- To achieve more control of temperatures or the process
- To reduce the loss of heat to the exterior to provide a better, safer workplace

One important principle of thermodynamic (Thermodynamic flux) is that heat tends to move from a high-temperature zone to a zone where the temperature is lower (Figure 2) before returning to the hot zone.

Heat transfer occurs in 3 different ways:

- Conduction
- Convection
- Radiation

These systems are clearly explained in the literature, and without getting too involved in mathematical formulae (inesas handled by computers), it is important to look more closely at the concept of “Thermal Flux”, because it is directly related to heat transfer. (Figure 3-4)

\[ Q = \frac{K.A.(\Delta T - \Delta I)}{L} \]

Figure 3: Thermal flux formula

Where:
- \( Q \) = Thermal flux
- \( K \) = Thermal conductivity of the insulating refractory material
- \( A \) = Cross sectional area
- \( \Delta T \) = temperature difference (hot side - cold side)
- \( L \) = Length of thermal flux

Figure 4: Heat transfer through a wall by conduction, convection and radiation.

In terms of conduction there is little that can be done to influence heat transfer for any given length and cross-section of a solid refractory substance. Once it reaches a certain point associated with heat exchange, heat transfer by conduction can be partially controlled, as can radiation, in which heat is carried by the electromagnetic waves. How? By means of the length of the thermal flux passing through the solid.

For example, if a refractory material contains large pores, convection will occur inside them as well as radiation on one side and the other. If we were able to make the thermal flux travel further between the pores, this would enable us to reduce heat transfer inside the solid. How can this be done?

The answer is: by controlling the pore diameter of the apparent porosity of the insulating refractory.

An ideal insulating refractory should have a highly porous structure consisting of areas of the unpolished possible size and with the most uniform possible shape, with the spaces between pores as narrow as possible and consisting of materials with the lowest possible thermal conductivity. (Figure 4a said through, but I’ll work)

In fact, if we apply this principle, we can make the passage of the thermal flux “C” (Figure 3) in an insulating refractory with large pores, while Figure 4a shows its path within a microporous material. In the latter case, the thermal flux, conveyed by conduction, has to travel a longer distance to pass through the solid, which will therefore be a better insulator.

It should also be noted that this does not modify the apparent porosity, and thus the apparent density of the material and therefore its other physical characteristics – such as its mechanical properties - remain unaltered.

This also means that apparently “loose” insulating materials can have thermal conductivity values similar to or even better than those of more tightly insulating materials.

REFRACTORY PROPERTIES

It is an accepted fact that the refractory properties of a solid depend directly on its analytical composition, meaning which metal oxides it contains and in what percentages.

It is equally certain that the lightest solid is the least refractory it is, meaning that it will be less able to withstand continuous operation at high temperatures without deformation than a similar, denser material. This is because it does not contain the same metal oxides but because it contains more air within its volume, so it is therefore less physically stable at high temperatures.

Hence, of two light insulating refractories with the same ~90 apparent porosity, that containing the same amount of air, the microporous material will be more refractory than the microporous one in the microporous material. The air will definitely be better, more evenly distributed through the mass, meaning that reactions within the micropores will be less pronounced and distributed, with the practical result of greater volumetric stability.

Since it is standard practice to assign an insulating refractory a maximum working temperature on the basis of its permanent linear shrinkage at that temperature, it is obvious that for any given density, a product with microporous will have better resistance to heat.

Written by Daniele Scabini