

2020

SOLUTIONS

THE TECHNICAL NEWSLETTER from CASTOLIN EUTECTIC

IRON AND STEEL

PRECISE ANALYSIS



CORRECT SOLUTION



SOLUTIONS – IRON & STEEL 2020

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Front cover:
"Iron and Steel Industry"



Dear Customer,

We would like to present you a new issue of our technical magazine dedicated to Iron & Steel industry, one of the oldest in Europe. Steel is the most used material in the world, 100% recyclable, therefore it is fundamental for the Circular Economy Action Plan adopted by the European Commission in 2015. This covers the whole cycle from production and consumption to waste management.

Since the 19th century, Iron & Steel Industry has been concerned about re-using and recycling (e.g: using the gas from melting iron ore in blast furnaces, EAF or BOF to produce energy for other production steps). Additionally, the environmental footprint of material is best estimated through the Life Cycle Analysis which takes into account three phases: the production, the use and the end of life including its recycling. Moreover, it is important to mention that on average, 1.83 tonnes of CO₂ were emitted for every tonne of steel produced.

Our mission statement is in line with the above facts, as we are improving the lifetime of many different parts along every step of the Iron & Steel process, from the

raw material extraction up to the semi-finished or finished product. Many years ago, we started working very closely with maintenance and R&D departments, to analyze in detail the wear phenomena and providing the best tailored-made solution for every situation. Due to our old tradition in the Iron & Steel Industry, we have a large database with proven applications that can be reproduced in other Steel Plants with similar cost reduction. Additionally, we will all be contributing to reducing CO₂ emissions.

To share our experience and transmit our working philosophy, we have created a SteelTec Team in Europe that is allowing us to put in practice all the successful stories emerged in every single country. Castolin Eutectic production plants all around the world for developing and manufacturing the bespoke products such as welding and brazing consumables, powders, CastoDur Diamond Plates, CastoTubes and welding equipment.

We hope this release will be appreciated and achieve its targets: inform and cooperate.

Victor Sánchez
Coordinator SteelTec Europe

Our working method for cost savings

Since a very long time we are successfully applying a partnership program, focused on cost reduction. This smart Maintenance and Repair program can be summarized in six steps:

1. Analysis: The first step for a good solution is correct analysis. To facilitate this, we have created a document that can be easily completed in collaboration with our local application specialist, which reflects the most important parameters to be considered when developing in-house solutions to wear problems. This document will allow our Technical Department to prepare a proposal for a professional solution tailored to the client's real needs. Only a thorough analysis can generate a professional solution.

2. Technical Report: With the information provided, our Technical Department prepares a report. In this document, the base material is analyzed, the wear-causing factors are carefully considered for optimal prevention and the most suitable materials/procedures are defined. Finally, a basic operating procedure is indicated. The information is delivered to the technician responsible for study and evaluation.

3. Job development: Once the client considers the job to be feasible Castolin Eutectic puts at at your service

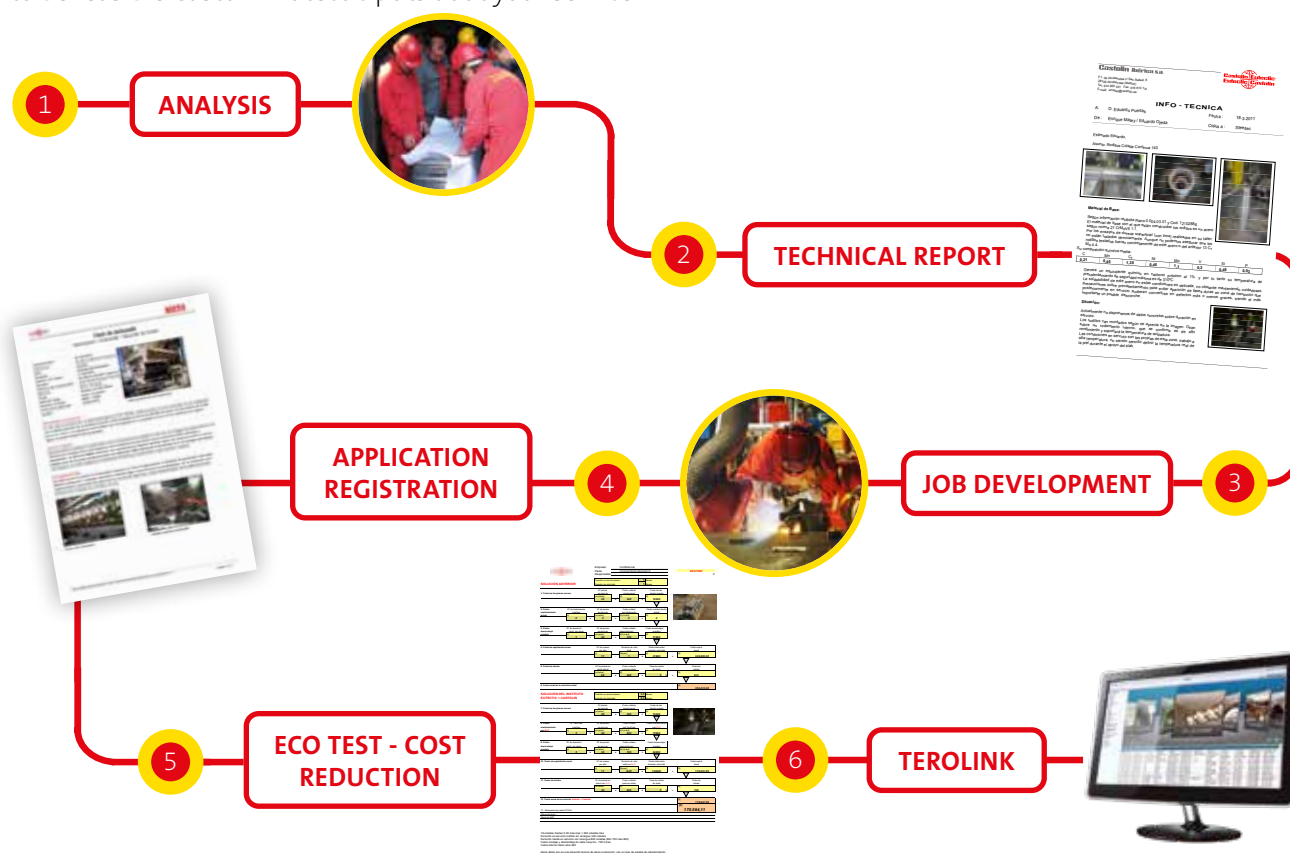
our Technical Department to develop the procedure:

1. Local Technical Specialists;
2. Castolin Service Workshops;
3. Training and Qualification of staff or subcontractors.

4. App registration: Always subject to the customer's approval, we first propose to register the job done in our confidential "FAR" database where the short application summary remains on hold until confirmation of service results.

5. EcoTest: At the end of the part service life, we are ready to establish a detailed cost analysis to evaluate practical direct savings achieved through mutual collaboration. This will show the real value of our teamwork and the important savings made by the maintenance department. This is the ultimate goal of our "Cost reduction" proposal.

6. Terolink: Finally we propose to submit the complete application as verified in our Terolink Database. This database allows both the customer and Castolin Eutectic to take advantage of the existing proven solution, update it, include further information and use it for future confidential promotion of the solution.



Scrap shredding

EnDOtec DO*05 + TeroMatec 4923TM

● The best combination against impact, pressure and abrasion

The Electric Arc Furnaces in Steel Plants use ferrous scrap among other raw materials. This ferrous scrap has to be shredded before feeding the EAF. There are two main components in the scrap shredder: discs and hammers between the discs. The scrap is fed from a conveyor belt so these discs are exposed to impact and considerable pressure onto their surfaces exerted by contaminated scrap.

In M&R, it is not always possible to carry out a proper preparation of the welding surface and edges, to select the more comfortable welding position or properly clean the surface. These conditioning factors were found when rebuilding the rotor's discs in this scrap shredding machine. In this case, the biggest difficulty was to clean the surface from a thick layer of dust and to have a regular profile without the previously damaged hardfacing.



General view of the discs



Aspect of DO*05

Based on these preliminary conditions, the wear phenomena affecting the discs and our know-how, **EnDOtec DO*05** was selected as a buffer layer and **TeroMatec 4923** as a hard layer.

DO*05 has been successful in many other applications as buffer layer without any porosity and cracks. **TeroMatec 4923** has resulted in a well bonded surface resistant against impact, pressure and abrasion.

The previous solution lifetime was 2 days and we achieved 3 weeks with our solution.
[FAR 31129]



Wearfacing with TeroMatec 4923

Increase of lifetime: 2 days to 3 weeks

EnDOtec DO*02 + DO*11

● Perfect solution for fans in sinter plants

DO*11 provides a superior solution for protecting fan blades of ventilators in the sinter plant (2 layers). The fan is used for taking out the dust from the plant so the erosion and heat are the main wear phenomena. This metal-cored wire features a high density of hard, cast tungsten carbide particles evenly distributed in a nickel alloy matrix which is further reinforced with very fine precipitates formed by recrystallization. The crack-resistant deposit gives exceptional resistance to abrasive erosive particles with moderate impact and is specifically intended for service in hot and/or corrosive environments.

Deeply damaged zones and worn areas were rebuilt with **DO*02**, which is appropriate for joining dissimilar martensitic or austenitic stainless steel and as a buffer layer due to its high elongation.



FAR 30645 – Fan blades of a ventilator in a sinter plant

**Increase of lifetime:
11 to 75 weeks**

TeroMatec 4666

● Protecting the delivery drum for the sinter mixture onto the sinter belt

TeroMatec 4666 was used on the drum of the sinter, which constantly delivers the right mixture of materials onto the sinter belt. This self-shielded flux-cored wire was applied in one layer onto the new part made of low alloy steel. Due to its high content of primary chrome and niobium carboborides in a

hard and tough austenitic-martensitic matrix, the abrasion resistance of the drum increased its service life in the range of 1,6 to 2,0 compared to standard chrome carbide weld overlay.

[FAR 30646]



Drum before wearfacing



Drum after wearfacing with TeroMatec 4666

LD converter BOF / EAF

CastoMag 45640 Ti + CastoMag 45612



Copper cooled plate before repairing



While repairing

FAR 31288 – Copper cooling plate for removing the slag before discharging the pig iron into the converter

After obtaining the pig iron in the blast furnace, it is transported within the torpedoes until discharging in the ladles. Just before discharging the pig iron into the converter, the ladle is partially tilted to place the slag into the slag pots. Once the pig iron is free of slag, it is discharged into the converter at around 1300°C.

To facilitate the discharging of slag, a copper plate (internally water-cooled) is used for this purpose. These

pieces suffer high wear due to the thermal fatigue and corrosion that might cause punctures with the consequent loss of water.

Following the right welding procedure, **CastoMag 45640 Ti** and **CastoMag 45612** are the right combination to rebuilt these copper plates and increase the lifetime against temperature, cracking, thermal fatigue and corrosion.

CastoTubes for discharging EAF

Olivine is a refractory material manufactured from magnesium silicate. Nowadays, the tapping of the Electric Arc Furnace is carried out through the Eccentric Bottom Tap Hole (EBT) that is placed in its lowest part to avoid inclusions of Ni and slag in the liquid steel.

The first step before starting the tapping is to fill out

the olivine used in the EBT. This refractory material runs out along steel conduits causing extreme abrasion, especially in the direction changes such as elbows.

The use of **CastoTubes** for these pipes is the perfect solution due to the increase of life and the ease for assembly-disassembly.



Unsuccessful old solution



CastoTubes ready for assembly

CastoDur Diamond Plates and CastoTubes



Transitions square to circle

CastoDur Diamond Plate is a bimetallic plate composed by a wear-resistant coating and a steel substrate.

Inside a CDP wear-resistant coating, we usually have extremely hard carbides correctly formed and a tough matrix that firmly keeps carbides together.

The production is critical for getting the right microstructure. We have different types of CDP depending on the wear phenomena.



Fan's shell

CDP can be cut, rolled or used as a structural part. We also have **CastoTubes** that are seamless pipes with an internal wear-resistant coating.

They can be used as a straight pipe, with or without flanges, as well as any kind of complex shape. Both CDP and CastoTube are used in different parts of the Steel Plants with very good cost savings.



Aditives chute for the EAF



LD pipeline for limestone



Blast furnace elbows



Laser Cladding CDP LC8

Continuous Casting

TeroMatec 3205

TeroMatec 3205 is a high chromium manganese austenitic alloy for wear coating of carbon steels, low or high alloy steels and 14% manganese steels.

This alloy has maximum resistance to heavy impact and compression with low metal/metal friction coefficient, high resistance to cracking and plastic deformation with rapid work hardening characteristics, but machinable.

Given the characteristics of this alloy, it becomes an optimal technical/economic commitment for iron and steel applications where a medium hardness, machinable, with resistance to pressure and metal/metal friction, is required at temperatures up to 450 °C.

Continuous casting rollers

These ConCast rolls guide and shape the billets progressively in the continuous casting ramp.

At the beginning, the molten iron is poured down at approximately 1.100 °C and it starts to solidify and to decrease the temperature along the process.

It is estimated that the skin temperature of the rollers reaches 700-400 °C (these rolls are cooled internally) depending on its position.

The wear phenomena involved in this situation are pressure, thermal fatigue, metal-metal friction and temperature.



Worn ConCast rollers



Disassembly rollers before repaired



Rollers after wearfacing and machining

FAR 30938 – Continuous Casting cooled rollers recovered with TeroMatec 3205

Continuous Casting

Eutalloy RW 12999

● Coating of rolls for middle fine rolling mill

Eutalloy RW 12999 is a nickel-base powder alloy with fine-grain Diamax particles and other spheroids particles (Ni Cr Fe B Si) of controlled granulometry.

It is ideal for abrasion and erosion resistance coatings, as well as for protection against corrosion by a wide range of aggressive media.

It is applied by spraying with subsequent fusion process, using CastoDyn DS 8000 torches. Eutalloy RW PE 3307 was applied as a buffer layer.

Eutalloy RW 12999 can also be used with successful results on fan blades.



Rollers coated with 2-step hot flame spraying process



Coated rollers before getting back in service

FAR 31028 – Middle fine rollers coated with Eutalloy technology

LaserClad

● Maxium protection for Steel Rolls

The powerful laser installed in our facilities enables high deposition rates that can reduce the cost of the cladding operation.

Compared to standard welding techniques, the dissolution of the carbides and the dilution of the

cladding material are the lowest that can be achieved. As a result, the wear-resistance is maximized and the useful life is longer. The unique broad beam (up to 23mm wide) produces a flat-coated surface that minimizes subsequent machining or grinding.

Rolls can often be used as welded without further processing. The low heat input of the laser process means the lowest distortion of large and/or thin wall parts that can easily be coated.



Slag recycling

The slag produced both in the blast furnace and EAF / BOF is considered a valuable product since the early 20th century. Producers are aware of that and even several national associations have been formed around the world on this topic.

Slag is the highest volume industry solid co-product. On average, for the blast furnace route, approximately 400kg of slag are produced per ton of crude steel. In the EAF, around 170kg of slag are produced per ton of crude steel.

Each year an average of 45 million tonnes of ferrous slags are generated from steelmaking in Europe.

The slags can be classified in different types depending on how they are cooled. There are three types of slags produced in the blast furnace: crystallized, vitrified (granulated or pelletized) and expanded. The main uses of final products are additives for concrete, cement, roads, fertilizers etc.

The slag from the EAF/BOF furnace can be divided into black and white slag. The black slag comes from the EAF and is transformed into a valuable product by impact crushing. The white slag comes from the refining ladle, it is very abrasive and it is normally treated in a vertical roller mill. The main uses are additives for roads and cement.

As mentioned before this is a contribution to the Circular Economy Action Plan 2015 in Europe. We have experience in several applications related with slag recycling, so we can collaborate with the waste management of this product in the steel plants, and bring benefits for both the environment and the economy.

EnDOTec DO*390N

● *The perfect solution for hot slag bucket accessories*

When handling the slag from the blast furnace or EAF / BOF, it is still between the liquidus and solidus state so that the temperature is very high.

The high temperature of the slag and its abrasive nature cause damage of the bucket accessories such as teeth, blades and side cutters.

After several field tests carried out with different products, our **EnDOTec DO*390N** has achieved the requirements set by the customer. Despite the cost of the spare parts wearfaced with DO*390N being initially higher than the original OEM spare parts, the lifetime has doubled. The cost reduction benefits for the customer have been demonstrated with our EcoTest.



*FAR 30974 – High alloyed bucket accessories wearfaced with EnDOTec DO*390N. EcoTest available*

Fume ducts - Whertec

The fume conduits in the steel plants are exposed to high erosion wear and/or corrosion. The internal walls are subjected to the impact of erosive particles transported at high speed by the ventilation gas at high temperatures.

In some applications, ventilation gas is also corrosive.

Since decades, Castolin Eutectic and Whertec™ have been the providers of choice for service,

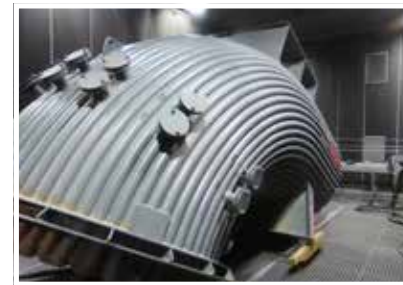
repair and preventive maintenance of heavy-duty and industrial process equipment.

In Iron & Steel, protecting your industrial process equipment, fume ducts, tubes and walls from future corrosion and erosion, while also extending your tubes' useful life is vital to your operation's bottom line.

Eutronic Arc is the highest productivity and lowest running

cost thermal spraying process. Due to the low heat input, there is a very low dilution during the process with limited distortion or metallurgical modification of the substrate without any dilution.

This technology can be applied both in the workshop or in the field. It does not require the use of oxygen, kerosene or a combustible gas which means more economic coatings.





*Stronger, with
Castolin Eutectic*



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