SwissSteel Fire Kft.

Spheres of application the technology ShPR (ШПР) (daisy-chain blow-down of metal melt)

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1. External treatment of cast-iron

1.1. Desulfurization

Ladle desulfurization of pig iron allows to:

- decrease coke and flux consumption at the blast furnace process
- use cheaper coke with the high content on sulfur
- decrease the temperature of cast- iron upon the production
- cut the time of fusion down in the steel-making vessel due to reducing the period of desulfurization.

1.2. Desilication

Desiliconize of cast-iron allows to solve the following problems:

- increase the efficiency of reagents used in desulfurization and dephosphorization
- do alloying in steel furnace with minimum slag quantity
- increase the cast-iron temperature before pouring to steel furnace.

2. Out-of-furnace steel refining

2.1. Degassing

Unlike traditional cork's using, the blow-down of liquid steel (used ShPR technology) in the ladle allows to:

- do the blow-down in fine-bubble mode
- increase the area of interaction a thousandfold
- reduce the contents of hydrogen, oxygen and nitrogen
- reduce the melting loss of deoxidizer.

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2.2. Homogenizing

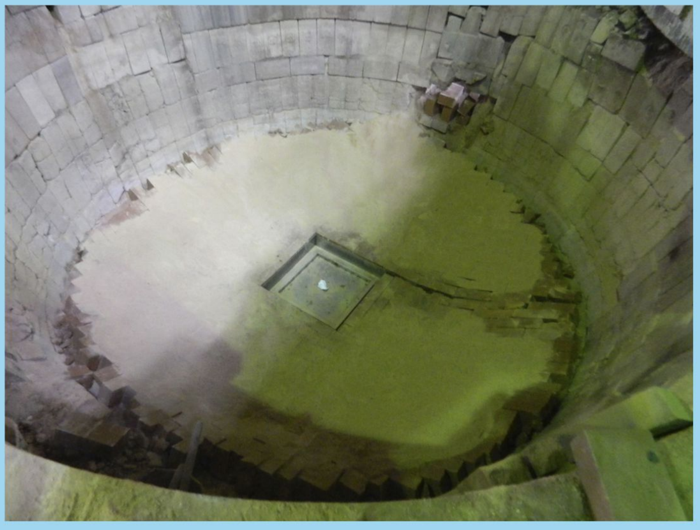
The efficiency of ShPR technology provides:

- on the square of gas supply the blocks surpass corks in 20-80 times
- in comparison with corks, the mixing force (Buoyancy force of melt ascending flows) is above 40-80 times
- the homogenizing time for chemical contents and temperature is about 2-5 min. (In comparison with corks it will be about 10-20 min.).

2.3. Refining

The ShPR process runs in the fine-bubble double-stage mode. There is the process of coagulation minor and subminor inclusions to larger ones on the first stage. There is flotation on the second stage. In other words, carrying-out inclusions by bubbles and assimilation by slag.

Depends on the chemical contents of metal inclusions and container lining's type, the metal inclusions content decreases in 2-5 times. With this technology, the refining allows to decrease the viscosity of the melt and as a result to decrease the metal temperature on 20-40 C before pouring.



3. The ShPR technology application in melting units allows to:

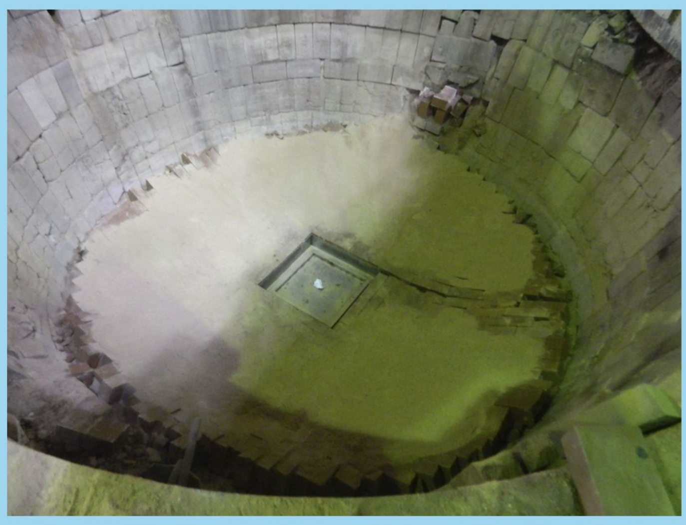
- reduce the alloying duration for 5-25%
- decrease the content of hydrogen, nitrogen and oxygen
- accelerate the process of interaction between liquid metal and slag.

EAF (Electric arc furnace)

In spite of the electric arc furnace is the most ecological in comparison of converters and open-hearth furnaces, the level of pollution is quite high.

According to many analysis the average number of dust in the outgoing gases equals 8,1 kg/t, CO – 1,5 kg/t and nitrogen oxides NO_x 0.29 kg/t. At the same time, emissions of pollution substances and the chemical content of dust are different. It depends on the content of metal scrap, the level of its pollution, the condition of lining in the furnace and the technology of melting.

To provide high environmental requirements, modern large-capacity electric arc furnaces have cleaning and output of gas systems differing by extensive range of purified gases. The productivity of such systems is about 15000 m^3 of purified gases per 1 ton of meltable steel that exceeds the gassing in such furnaces in tens times and   it is connected with considerable fundamental costs and waste of energy for purification. Power inputs just for the transportation of purified gases can be 40-60 kwt h/t, which equals 15-20% and more from general waste of energy for melting of steel in the furnace. All of these actions are related with considerable costs.



EAF (Electric arc furnace)

We have developed a really new course of solution the environmental problems of working the electric arc furnace. It consists in installation the blocks of daisy-chain blow-down of melt into the bottom of furnace in the area of electrodes steaming. Block dimensions provide covering the area of burning of arc from air intake. It has prevented the iron burning and formation of nitric oxide. Moreover, owing to airlift effect it is held the continuous feeding of cold lower capacity of melt directly to the hot area and it is held a removal of overheat melt to the colder periphery. This process prevents the overheat and iron evaporation. Using ShPR technology, the arrangement of volumetric circulation encourages increasing the efficiency of heat-exchange processes and mass-exchange processes, reducing the time of fusion and consequently reducing the quantity of discharges for a fusion. The results of the work of electric arc furnace using ShPR technology evinced absolutely absence of discharges of red fume and reduction of duration of fusions not less than 25%. Setting the block it will be easy to check. The result is obvious.

The Ladle

The technology of daisy-chain blow-down of melt is based on the effect of passing melt in the mainstream without confluence of gas bubbles .

To realize such effect is possible just during volumetric expulsion of liquid by bubble in the motion.

In case of chaotic disposition of capillary (porous corks) or locally disposition of slit capillary (slit blowing corks) the ejection by bubble flow is going on his periphery. At the same time, the internal dimension doesn’t participate in mass-exchange processes.

Hence, on purpose of effective process of mass-exchange, there is need to provide the volumetric ejection process with the bubble flow of liquid.

We have made the special blow-down device to fully satisfy all the technological (process) requirements of hydrodynamics and mass-exchanging.

The Ladle

Blow-down device is a rectangle with a width of 100-200 mm. The pores are arranged linearly (stitched), parallel to each other. The distance between lines provides the sufficient liquid volume for ejection and free pass between them. Such kind of blowing element is called like blowing section. Thus, upon sectional using the mass-exchange process is maximum developed.

Gas bubbles leave capillary as separate loops (stub lines). Upon the enough distance between stub lines, there is completely no mutual shading. That means there is no competition between gas stub line bubbles.

The technology of blow-down of melt with stitched-capillary section used is called “daisy-chain blow-down of melt” or ShPR.

Depends on the bottom area of metallurgy’s   container, the area of blow-down device has to be bigger. We have found that the area of blow-down device has to equal 0.1-0.5 of bottom’s area. For providing such area, the blow-down device consists of sections. Such device is called “the ShPR block”.

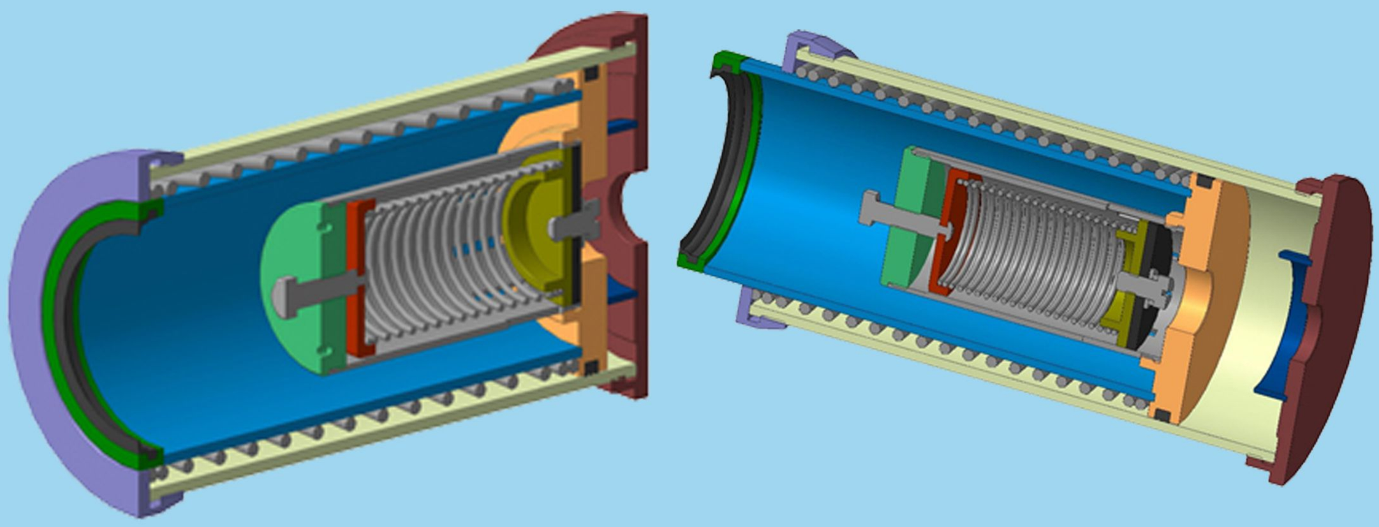
Adapter

Nowadays at the iron-and-steel works, used devices for attachment of ladle gas system are highly unreliable and need the man's participation in connection and disconnection processes. In respect to safety measures, when the metal container is full of molten metal the disconnection will be unacceptable.

We offer an automatic adapter. Offered equipment works just upon gas feeding to blowing device and comes to a stop by itself after the termination of gas feeding.

This device has the following advantages:

a) closed from metal and slag spray
b) upon the metal and slag splashing from the ladle, the device is shielded (screened) by construct unit (connection stands under the trunnions on the level of steel teeming ladle car or another storage and construct)
c) connection of device becomes independently , in automatic mode
d) the connection to department gas system is on connection either to steel teeming ladle car or to stand, so the flexible tubing is located under more comfortable conditions
e) the device is safety and operating
f) it is available for service, adjustment; change of device for preventive inspection is going fast and doesn't need some special facilities.



An equipment for lead-in ultrafine metal powders into the melt

Effective using of dispersed powders prevents the absence of reliable methods of lead-in them into the melt. The earliest methods of lead-in the ultrafine metal powders are based on lead-in them with the gas through the false stopper, which is installed in the ladle or in the special stand with lined tuyere.

Submerged tuyere's defect is low resistance of castables because of an intensive blurring of them by high velocity flows of molten metal, and also high price of high-quality castable for tuyere. Here can be added expenses for preparing a stand for blowing-down the metal by argon, the necessity of personnel, electricity expenses. Lead-in the powder through the tuyeres with nozzles because of the breakers on the surface of metal, a lot of unpredicted fine powders are thrown out in the mode of large bubbles and the process of second oxidation becomes during the break of slag covering .

From the viewpoint of hydrodynamics and service comfort, more technical is the installation of blowing devices in the bottom of ladle. In the same time when the gas-powdered flow climbs from the bottom surface it interacts with other objects on the bottom more effective.

At the time of use the blowing pipe it is impossible an additional blowing-down. Moreover, such method is effective only for coarse powders. Fine powder and especially ultrafine powder is allocated on the whole volume of bubble and is taken out to the environment. Hence, from all given powder only large ones transfer to the melt. It is too difficult to forecast the level of adoption and the consumption of lead-in powder.

We had developed a unit for continuously preparation of ultrafine powders with an active surface and also the technology of dozen lead-in it by special doser with inert gas in the mode of SHPR. The proposed technology provides increasing of predictability and efficiency of lead in ultrafine powders, an equal allocation of them in the volume of melt, more time for mass-exchange processes. Fine unmerging bubbles permit to increase maximum the speed of powder's transfer to melt. Powder's supply through the stitch capillaries allows to increase the area of mass-transfer in hundreds times.