

帝国窯業株式会社
機能性塗料
「黒鉛電極用酸化防止剤と溶鋼付着防止剤」



Teikoku Yogyo Co., Ltd.
Functional Paints
“An Inorganic Agent for Preventing Carbon Electrode Oxidation and
an Inorganic Agent for Preventing Hot Metal Adhesion”

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Abstract

An Inorganic Agent for Preventing Carbon Electrode Oxidation :

We developed an oxidization prevention agent which suppresses surface oxidization of carbon electrodes.

By applying it to an electrode with a spray gun, excellent performance is demonstrated in reducing its unit consumption.

An Inorganic Agent for Preventing Hot Metal Adhesion :

We also developed a paint which suppresses the adhesion of hot metal to refractories by coating their surface. Prevention of hot metal adhesion and growth are anticipated.

Inorganic Paint & Adhesive Section of Teikoku Yogyo acquired
ISO9001 : 2008 certification in February, 2010.

1. 黒鉛電極用酸化防止剤 品質名 : SIM#303WN

1. 1 背景

製鋼用電気炉やLF炉で使用されている黒鉛電極は、その先端から飛ばすアークによって黒鉛が焼失し短くなる。ところが実際は炉蓋より下の赤熱している電極表層部分で酸化が進み、電極下端から徐々に細くなってしまいうのが実情であ

1. Inorganic Agent for Preventing Carbon Electrode Oxidation

Product Name : SIM#303WN

1. 1 Background

Carbon electrodes currently used in electric arc furnaces or ladle furnaces in steel mills are burned down by the arc generated at the tip and become shorter.

Along with this, the red-hot surface of the

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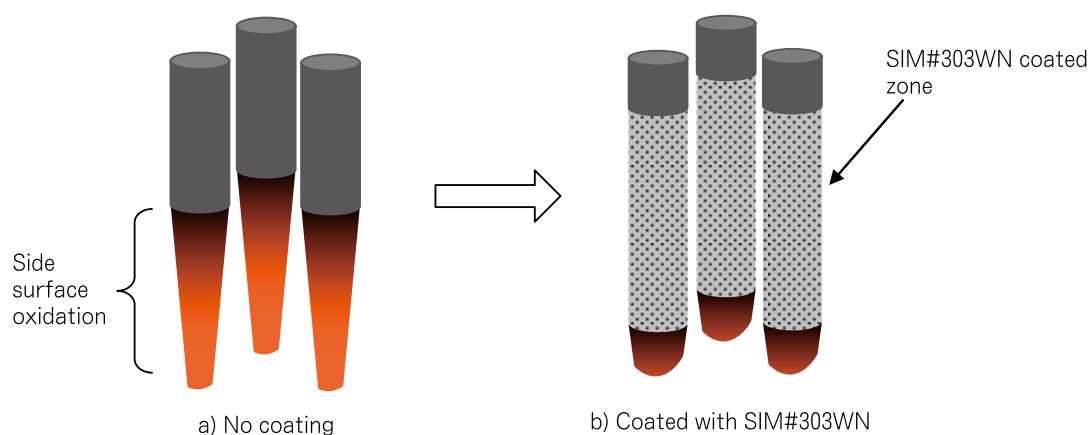


Fig. 1 Images of side surface oxidation prevention of carbon electrode by SIM#303WN.

る (Fig. 1-a)。この電極表面の酸化損失量は黒鉛電極全体のその4割以上を占めるとも言われ、場合によってはアークによる焼失量を超えてしまう。

電気炉で使用される電極は、その側面に水をかけて酸化しない温度まで冷却することが可能だが、水を使用できないLF炉では、簡単に酸化を抑える手段が望まれている。

一方で黒鉛電極はその原料事情から近年価格の高騰が続いており、鉄鋼業を主とする電極ユーザーは原単位の低減を志向している。

弊社では20年以上にわたる耐熱無機塗料の販売実績を活かして黒鉛電極用酸化防止剤を開発し、LF炉等の冷却が困難な電極の側面酸化を抑えることにより (Fig. 1-b)、一部のユーザーで好評を得ているのでここで紹介したい。

1. 2 品質

SIM#303WNは電極の側面酸化を防止するために、黒鉛が酸化しやすい800℃前後でガラス質の

electrode beneath the furnace cover will be oxidized and the electrode will become thin gradually from the bottom end.

(Fig. 1-a)

An estimated 40% of the carbon electrode is lost through oxidation. This can exceed the amount of loss of the arc at the tip of the electrode depending on conditions.

It is possible to reduce the surface temperature by pouring water down to the non-oxidizing temperature in the case of the electrodes used in electric arc furnaces. But a simple method is required to suppress oxidation in ladle furnaces where water cannot be used.

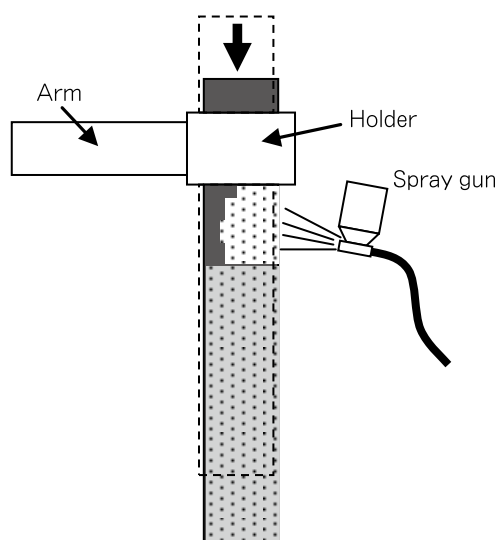
On the other hand, the price of carbon electrodes has been continuously increasing due to the raw material situation in recent years.

Electrode consumers who are mainly concerned with the steel industries are aiming to reduce the unit consumption of electrodes.

We developed an inorganic agent to prevent the oxidation of carbon electrodes by taking advantage of the experiences in heat-resistant inorganic paints we have acquired more than

Table 1 Material properties of SIM#303WN

	SIM#303WN
Appearance	Off white liquid
Main ingredients	SiO ₂ , Al ₂ O ₃
pH	6 ~ 7
Viscosity	2,000 mPa·s
Nonvolatile content	72 %
Density	2,000 kg/m ³

**Fig. 2** Coating method of SIM#303WN.

皮膜を形成するシリカ系成分と、1000℃以上の温度領域でも耐熱性を有する耐火粉末およびバインダーを用いている (Table 1)。

1. 3 使用方法及び実績

使用方法としては、電極の継ぎ足し時にホルダー部分から降ろした部位に、SIM#303WNを塗装ガン、またはハケ等で塗布する (Fig. 2)。塗膜は操業中に受ける熱で硬化するので、乾燥工程の必要がない。LF炉の電極に塗布した電極の操業後の写真をFig. 3に示す。

20 years.

We want to introduce the good performance that this agent has exhibited at some ladle furnaces where cooling by water pouring is difficult. (Fig. 1-b)

1. 2 Quality

In order to prevent side surface oxidization of the electrode, SIM#303WN contains silica which forms a glass film at around 800℃ at which temperature much of the carbon tends to be oxidized, and the refractory powder which is heat resistant to 1000℃ or more, and a binder. (Table 1)

1. 3 Application method and practical results

SIM#303WN is applied by spray gun or by brush to the part where the electrode is pushed down from the holder. (Fig. 2)

Since the film of SIM#303WN is hardened by the heat received during operation, the drying process is not necessary.

A photograph of an electrode which had been used in an actual ladle furnace is shown in Fig. 3.

Moreover, it was proven at a special steel producer that breakage of the knot of the electrodes caused by the oxidization during operation was suppressed by painting SIM#303W by brush only to the nipple parts of the electrodes before installation.

2. Inorganic Agent for Preventing Adhesion of Hot Metal

2. 1 Background

When hot metal adheres to the refractory surfaces from splashing, and grows and disturbs

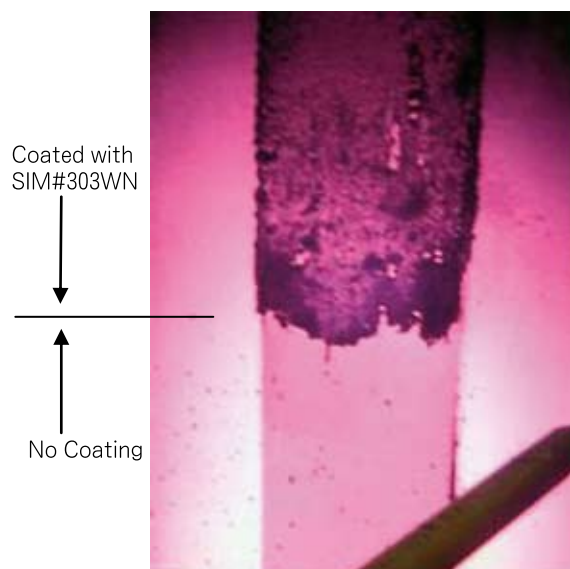


Fig. 3 SIM#303WN coated electrode in use at a ladle furnace.

また、電極をセットする前にハケ等で電極のニップル部のみを塗装しておくことにより、操業中の酸化による電極脱落を抑えられることが、特殊鋼メーカーで実績として上がっている。

2. 溶鋼付着防止剤 品質名：SIM#311W

2. 1 背景

溶鋼がスプラッシュとして耐火物表面に付着、その後それが成長して溶鋼のフローを妨げる場合に、耐火物の表面に塗布するだけでその付着を抑制し、あるいは成長する前に脱落を促す塗布剤である。

2. 2 品質

SIM#311Wはジルコン系耐火粉末を用い、特殊バインダーにより、室温乾燥のみで1600℃の耐熱性を持つ塗膜を形成する (Table 2)。

本品を塗布した断熱キャスタブルに溶鋼をかけ

Table 2 Material properties of SIM#311W

	SIM#311W
Appearance	Light brown paste
Main ingredients	ZrO ₂ , SiO ₂ , Al ₂ O ₃
pH	2
Viscosity	3,000 mPa・s
Nonvolatile content	70 %
Density	2,100 kg/m ³



Fig. 4 Hot metal dropping test.

the flow of hot metal, this paint is applied on the surface of refractories in order to inhibit adhesion and growth of hot metal, and to accelerate defoliation.

2. 2 Quality

Since SIM#311W contains zircon refractory powder and a special binder, its film can resist up to 1600℃ with only room temperature drying. (Table 2)

The experimental results of applying hot metal to the SIM#311W coated samples which were heat insulation unshaped refractories is shown in Figs. 4, 5 and 6.

Although metal adhered strongly to the non-applied sample, metal on the SIM #311W coated sample easily defoliated and the refractories



Fig. 5 Samples of insulating unshaped refractory after hot metal dropping test.



Fig. 6 Prevention effect of SIM#311W on adhesion of hot metal.

る滴下試験結果をFig. 4, Fig. 5, Fig. 6に示す。
未塗布品には溶鋼が強力に付着しているのに対し、SIM#311W塗布品は簡単に剥離し、耐火物に損傷を与えていない。

2. 3 使用方法と実績

塗布方法としては、耐火物稼動面へのコテ塗り、

were not damaged at all.

2. 3 Application method and practical results

It can be applied to the refractory working surface using a trowel or brush.

Although we have a few actual applications until now, it can be easily coated to the bottom side of the tundish lid, or the inside of the pouring pipe. Therefore the restraint of metal

ハケ塗りが使用できる。実績としてはまだ少ないが、タンディッシュ蓋の裏や注入管の内面へ塗布し、地金の成長を抑えて耐火物の保護延命が期待できる。

3 おわりに

無機塗料部門では、耐火物の技術を活かし特徴のある耐熱塗料、耐熱接着剤を開発し、主に電機メーカーへの供給を行ってきた。今後は本稿で紹介した機能性塗料についても、耐火物部門と協力し、鉄鋼、非鉄分野でニーズに対応できるよう開発を続けていきたい。

growth and the extension of refractory life can be anticipated.

3. Conclusion

The inorganic paint unit of Teikoku Yogyo Co., Ltd. developed a characteristic heat-resistant paint and heat-resistant adhesives by taking advantage of refractory technology. They have mainly been supplied to electrical equipment manufacturers.

We also want to continue to develop the functional paints introduced in this paper in cooperation with our refractory unit so that we can respond to requirements from steel and non-iron industries.