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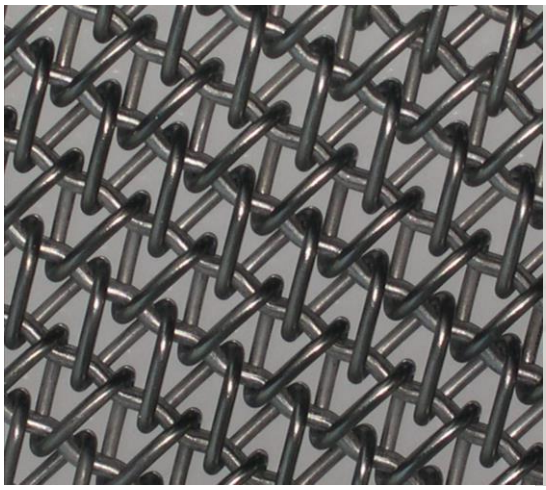


Protecting Furnace Components with

Minimox® Alloy Treatment

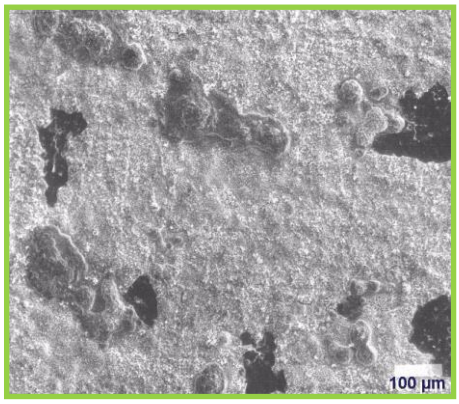
Material Interface, Inc.

Minimox® Self-Protective Alloy Treatment is a new, patented product that minimizes oxidation of alloys at high temperatures. Corrosion resistance is often improved as well.

When applied before oxidation, Minimox® treatment changes the structure and/or chemistry of the subsequent thermal oxide. The new thermal oxide is more dense and adherent than the oxide would be without Minimox solution. Corrosion resistance is also provided.

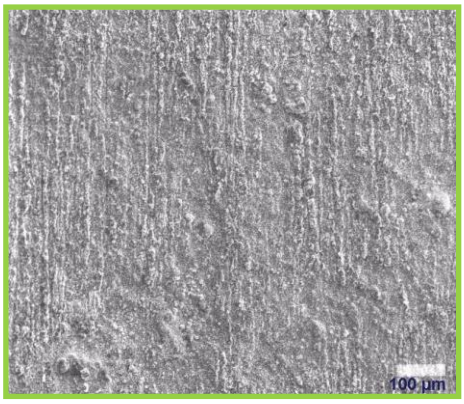
The dense thermal oxide protects the sample.

Ni 600 Thermal Oxide, 1000°C, 500 Hr



Thermal oxide without Minimox coating:

- Flakes
- Protrusions
- Microvoids for corrosion nucleation



Thermal oxide with Minimox coating:

- Dense
- Adherent
- Smooth

Material Interface, Inc. / N73W22301 Willowview Drive / Sussex, WI 53089-2244 USA
ph: 262-246-9610 fax: 262-246-9670 info@materialinterface.com

Possible Heat Treat Furnace applications include:

- Thermocouple covers
- Belts
- Fans
- Radiant Tubes & Supports
- Baskets
- Curtains

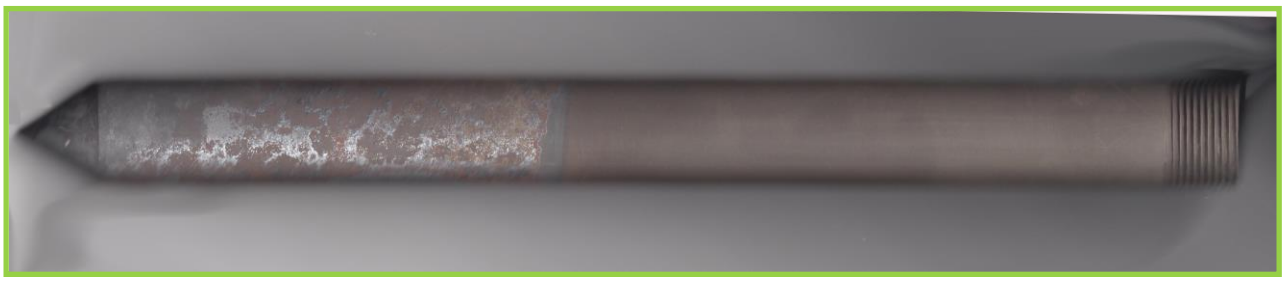
Potentially improve component lifetime for pennies/square foot!

Oxidation improvement

This is a straightforward application for Minimox® Self-Protective Alloy Treatment. The components need to be thoroughly cleaned and free of debris. Because blasting leaves embedded media, detergent and/or solvent washing is recommended. A machined finish works best.

Clean, spray or dip into Minimox® solution, air dry, and install. Depending upon the specific application, redipping or respraying may be necessary.

304 Thermocouple protection tube;
815°C, 200 hours, air.



Untreated, spalling | *Treated, stable oxide*

Thin protective oxide on Minimox-coated surface. Spalling, unstable oxide on untreated portion.

Decrease carbon uptake

Laboratory tests have demonstrated:

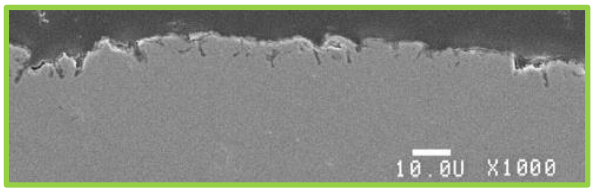
1. **Reduced carbon pick up in pack carburization experiments**
2. **Metal dusting reduction**

Keep in mind, the sample must be cleaned, coated with Minimox, and preoxidized to form an oxide that is at least 1 µm thick.

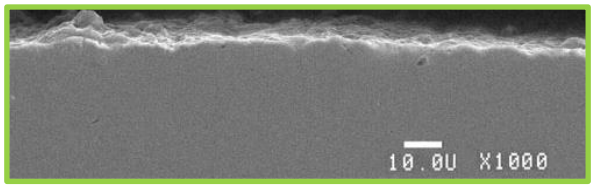
The oxide protects the sample and reduces carbon uptake.

1. Pack Carburization

330 furnace belt; coated with Minimox, oxidized 850°C, 100 hours. Exposed to pack carburization at 593°C, 450 hours.



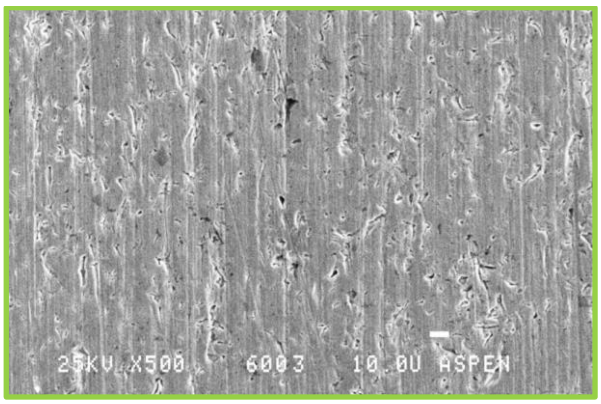
Untreated belt showing carbon ingress on cross section.



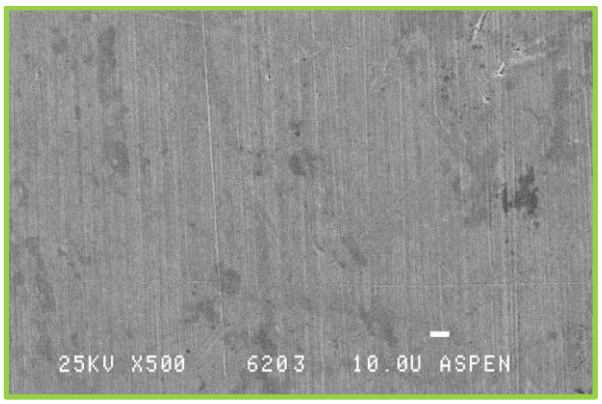
Treated belt showing no degradation during graphite exposure.

2. Metal Dusting Reduction

Testing at Argonne National Labs, Alloy 601, 600°C, 4286 hrs.



Untreated



Minimox-treated and preoxidized
Substantially improved surface integrity

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How do I get started with Minimox?
Call or email our office to discuss your application.

If samples go into a high temperature, oxygen-containing environment, do they need preoxidation?
No. Clean, coat and put into service.

Do I have to preoxidize the sample to prevent carbon ingress or metal dusting?
Yes.

How long and at what temperature do I need to preoxidize?
This is different for all alloys and systems. Generally, better results are obtained when done at the highest temperature and longest time that is metallurgically valid and economically reasonable.

How do I know how thick the oxide may be?
Material Interface, Inc. has been conducting metallurgical analysis for over 20 years. We will work with you to measure thickness and determine surface integrity if necessary.

Do I need to recoat periodically? How often?
For applications like furnace belts that may stretch over time, reapplication is recommended. Unfortunately, the most economical frequency is currently unknown. A reasonable time may be once/week.

Can the efficacy of Minimox be guaranteed?
Not at this time. Minimox is a new product and is transitioning from laboratory tests to field use. Production quantities are ready for delivery.

Material Interface, Inc.

About Us
Material Interface, Inc. is a contract laboratory that specializes in failure analysis and product R&D using surface analysis techniques, coating design, and consulting. We are dedicated to the development of superior products through improved surfaces, interfaces, and coatings.

Founded in 1993, Material Interface offers state-of-the art materials analysis with personalized service, including full reports with all projects.

The development of Minimox® Self-Protective Alloy Treatment grew out of years of stainless steel surface analysis. The patent was received in 2012.

Contact Us
Phone: 262-246-9610 Email: info@materialinterface.com
Web: www.minimox.com and www.materialinterface.com

Turbine blades

Samples on left are untreated; those on the right were dipped in Minimox Self-Protective Alloy Treatment before heat treating.