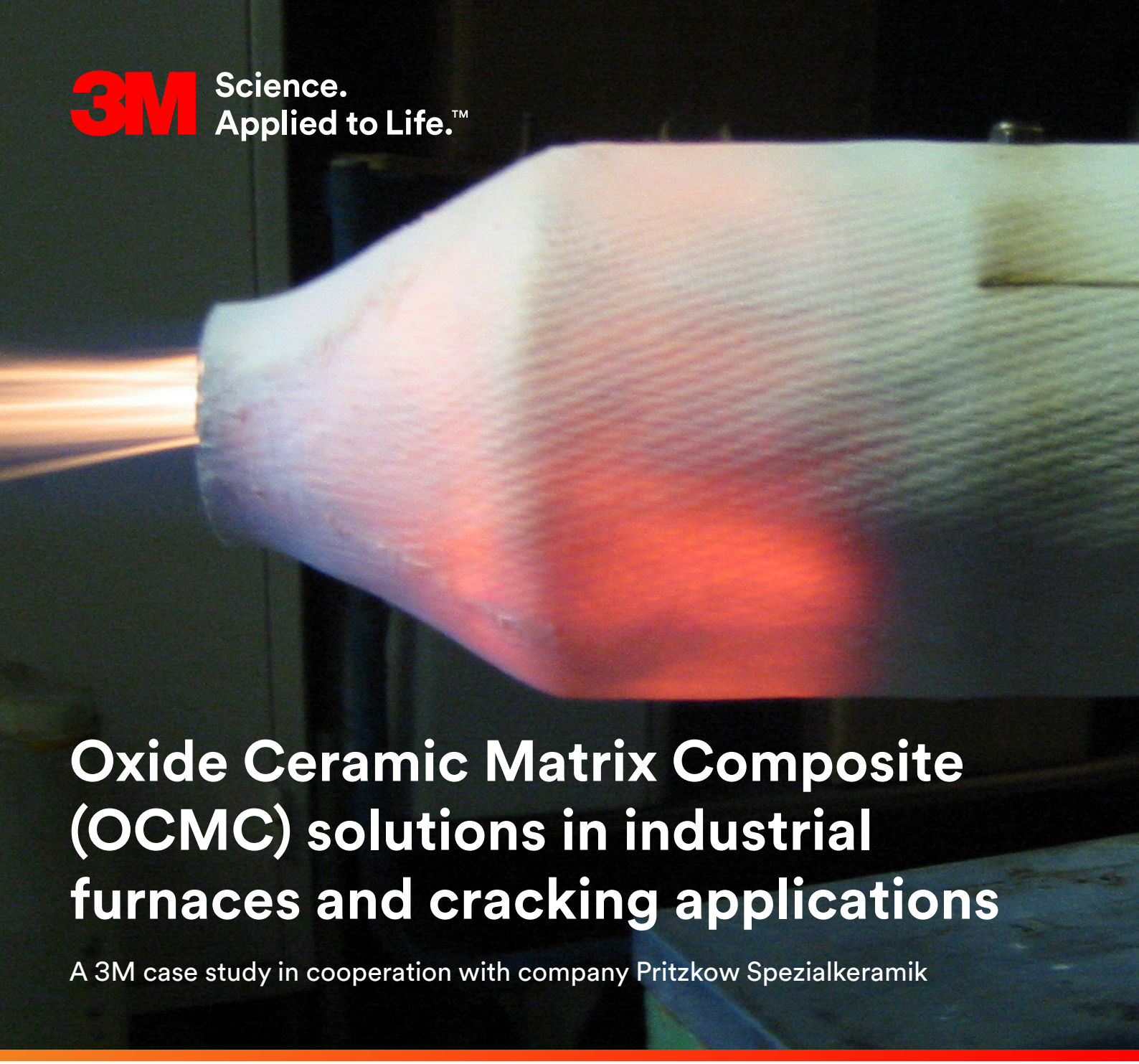


3M Science. Applied to Life.™

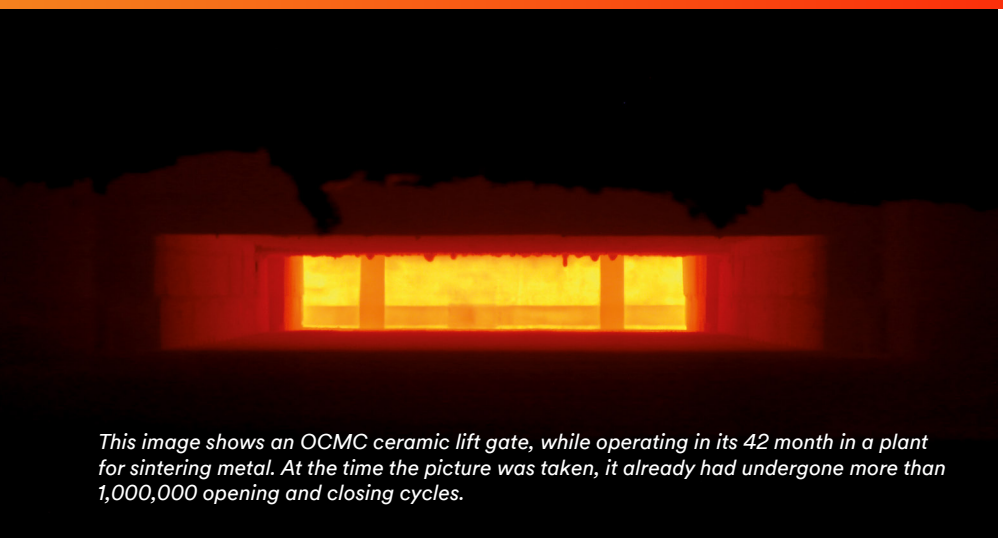
Oxide Ceramic Matrix Composite (OCMC) solutions in industrial furnaces and cracking applications

A 3M case study in cooperation with company Pritzkow Spezialkeramik

Performing in and withstanding severe environments.

Managing high-temperature environments, such as in and around industrial furnaces, presents a significant challenge. Not only is there intense heat to contend with, but the materials used to generate, control, and contain the heat are subjected to thermal shock, corrosive environments, and the potential of responding with unintended catalytic reactions. Flame tubes, burner lances, rotary kiln seals and industrial furnace linings are just a few examples of components facing these challenges. By replacing these materials with components from Pritzkow Spezialkeramik made with 3M™ Nextel™ Ceramic Fibers and Textiles from 3M, thermal performance can be enhanced, energy consumption reduced, and functional lifespan significantly extended.

Keramikblech®
Walter E. C. Pritzkow Spezialkeramik



This image shows an OCMC ceramic lift gate, while operating in its 42 month in a plant for sintering metal. At the time the picture was taken, it already had undergone more than 1,000,000 opening and closing cycles.

The need to beat the heat

Industrial furnaces and crackers operate continuously, 24/7, in challenging (corrosive) atmospheres at elevated temperatures far beyond what is typically considered hot.

what is hot and challenging

250 °C (480 °F)

A **standard household oven** can usually reach temperatures of approx. **250 °C (480 °F)**.

500 °C (930 °F)

Pizza ovens, or **household ovens** with a pyro-cleaning function, may become as hot as **500 °C (930 °F)**.

reach up to 800 °C (1,470 °F)

Charcoal, like in your BBQ, will ignite at **350 to 400 °C (660 to 750 °F)** and can **reach up to 800 °C (1,470 °F)** in optimal conditions.

800 to 1,200 °C (1,470 to 2,190 °F)

Lava erupting from a volcano usually reaches temperatures from **800 to 1,200 °C (1,470 to 2,190 °F)**.

> 1,200°C (> 2,190 °F)

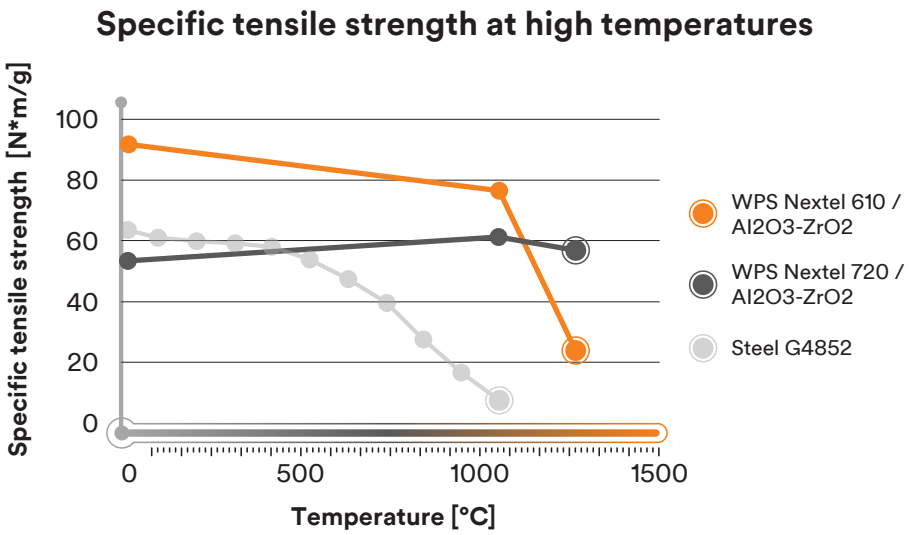
Furnaces for metal tempering and cracking furnaces can reach continuous operating temperatures of **> 1,200°C (> 2,190 °F)** and will stress all components and parts.

The challenges extend beyond just high temperatures in industrial furnaces and crackers. The heating and rapid cooling processes, sometimes involving liquid nitrogen, create a thermo-shock effect. This shock can cause fractures and even catastrophic failure when the materials used are unable to withstand this stress.

"In general, the issue is that parts deform, warp, or scale over time. Customers frequently get in touch with us, searching for solutions to that problem."

> Metals starts to creep massively from 600 to 800 degrees Celsius, which means parts can deform under their own weight or deform under a load.

says Walter Pritzkow, owner and product developer of Pritzkow Spezialkeramik, Germany, since 1990.



But not only creeping and deformation are stressing the parts in furnaces and crackers, unwanted catalytic reactions can negatively influence processes and yield. Corrosion can also distort and harm some of the metal parts in a furnace. A much more durable solution can be manufactured by creating identical OCMC (Oxide Ceramic Matrix Composite) parts that can withstand the challenges much better. They also can last, depending on the individual parameters/application, 10 - 20 times longer.

From left: Flame tubes made with Nextel ceramic sheets new and after 20,000 hours in use; metal flame tubes, type 1.4541, new and after 1,000 hours in use. Images courtesy of Walter Pritzkow.

The use of Nextel ceramic fibers and textiles in Ceramic Matrix Composite (CMC) parts allows for more durable, shock resistant and light-weight components. At first glance, the weight of a component in industrial applications seems to be of little importance, but in fact a low weight is also an enormous advantage in industry applications.

If large parts must be replaced, a lighter weight part is easier to install and de-install and may not need heavy equipment.

When it comes to carriers, boxes, and trays, devices intended to hold other precious parts during a tempering process or even heat shock treatment, parts made with Nextel ceramic fibers and textiles provide numerous advantages for the goods and the process.

These carriers are lightweight, don´t bend or deform under load and reduce the risk of unwanted catalytic reactions that may contaminate or impurify of the parts within the process, as the oxide ceramic has no catalytic effect at all.

Oxide ceramic parts also show significantly less tendency to coking. Coking and catalytic reactions will quickly block and destroy parts such as burner-lances, so that lances made from metal may therefore need to be replaced rather quickly.

Example Burner lances 6 months in use in a steam cracker.
[1] *Ceramic Burner lances before and after 6-month use.*
[2] *Steel Burner lances after 6 month use.*
Images courtesy of Walter Pritzkow.

We also observe something comparable in chemical plants, where simply due to corrosive processes at high temperatures within a very short time, metal parts of long pipes are quickly burned away by a third and corroded.

I think the main problem is the reoccurring quick coking of cracker burner lances that requires continuous cleaning and frequent exchange.

When using ceramics with 3M™ Nextel™ Ceramic Roving 610 or 720, none of this degradation happens.

says Walter Pritzkow,
Pritzkow Spezialkeramik, Germany

The Application

Creating CMC parts for furnaces and crackers that can withstand extreme temperatures and corrosive conditions.

Challenge

Find a better performing, long-lasting alternative to metal parts that does not degrade, coke, bend, or deform in hot and corrosive environments.

Solution

OCMC parts made with 3M™ Nextel™ Ceramic Fibers and Textiles can perfectly cope with the challenges, resisting corrosion and continuous operating temperatures of up to 1250°C (2282°F).

Why 3M™ Nextel™ Ceramic Fibers and Textiles?

With the potential to expand the lifetime of valuable assets like burner lances or flame tubes by a factor of 10 to 20 depending on the application parameters, Nextel ceramic fibers and textiles are made of continuous polycrystalline metal oxide fibres. They offer low shrinkage, excellent dimensional stability, and low thermal conductivity, as well as non-porous and non-hygroscopic characteristics.

Supporting reduced energy consumption

CMC parts made with Nextel ceramic fibers and textiles provide finished parts and devices that are more lightweight than geometrically identical metal parts. They have less thermal inertia, which means they require less energy to be repeatedly heated up, especially in circular charging processes with high temperatures in heat treatment and tempering processes.

Want to learn more about OCMC parts with **3M™ Nextel™ Ceramic Fibers and Textiles replacing metal?**

Get in touch with us

Technical information: Technical information, recommendations, and other statements contained in this document or provided by 3M personnel are based on tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed. Such information is intended for persons with knowledge and technical skills sufficient to assess and apply their own informed judgment to the information. No license under any 3M or third-party intellectual property rights is granted or implied with this information.

Warranty and limitation of liability: Many factors beyond 3M's control and uniquely within user's knowledge and control can affect the use and performance of a 3M product in a particular application. User is solely responsible for evaluating the 3M product and determining whether it is fit for a particular purpose and suitable for user's method of application.

All questions of warranty and liability relating to a product are governed by the terms of the sale, subject, where applicable, to the prevailing applicable law.