CORROSION AND FOULING RESISTANCE IN HIGH TEMPERATURE ENVIRONMENTS TEMPERATURE > 450ºC (850ºF)
Application fields: • Power generation boilers (Coal, Biomass, Urban garbage): water walls ,steam re-heaters, super heaters and heat recovery bundles • Tubular systems of Molten salt solar power plants • Ash corrosion and fouling in the Oil and Gas Industry (Visbreaker, Coke Unit, Coke Calciner, Heat Recovery Units…) • Overhead Sulphur Condensers • Metal dusting avoidance (Syngas, Supercritical CO2, ETC…) • Nitric Acid Condensers

POWER GENERATION BOILERS

A new ceramic coating (K-100) with high thermal resistance and anti-clogging properties has been developed in KERA-COAT/IK4-IK4-CIDETEC.

Figure 1. Tubes with RT-100 ceramic coating in green (biscuit) state

Figure 2. RT-100 ceramic coating sintered in normal conditions

The coat thickness was around 75 microns; a second batch will be produced at 140 microns just to test behaviours in very abrasive and hot environments (biomass boilers with high amount of ashes and particles).

As it can be seen in the Figure 7 the coating RT-100 has an excellent adhesion.

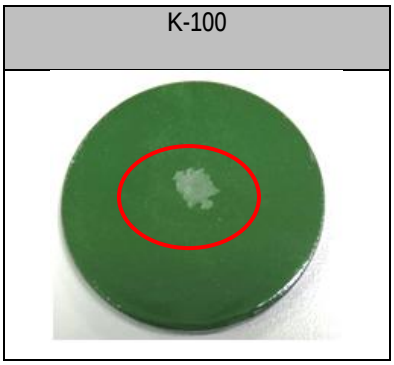
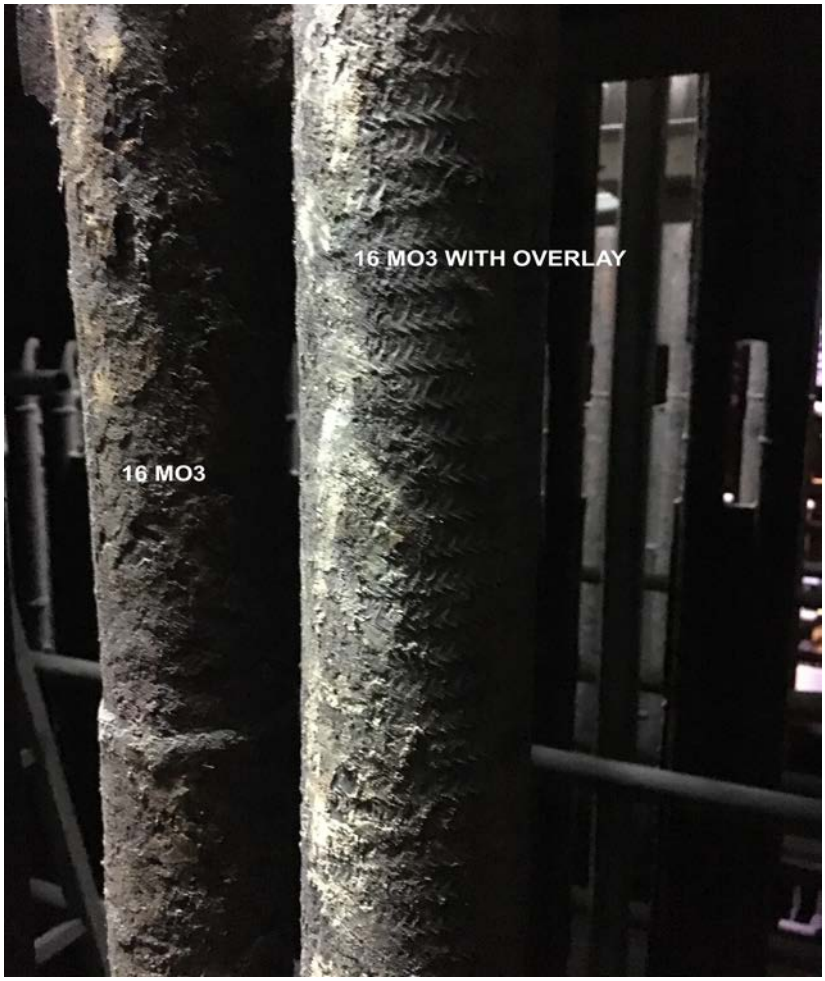


Figure 3. Track produced after the adherence test for K-100 ceramic coating

Kera-Coat has installed ceramic coated tubes in the steam reheater of an Urban Garbage Power plant.

State of the art in March 2014



1 - Installed 10th March 2014

Figure 4. Tubes in the steam reheater (2014)

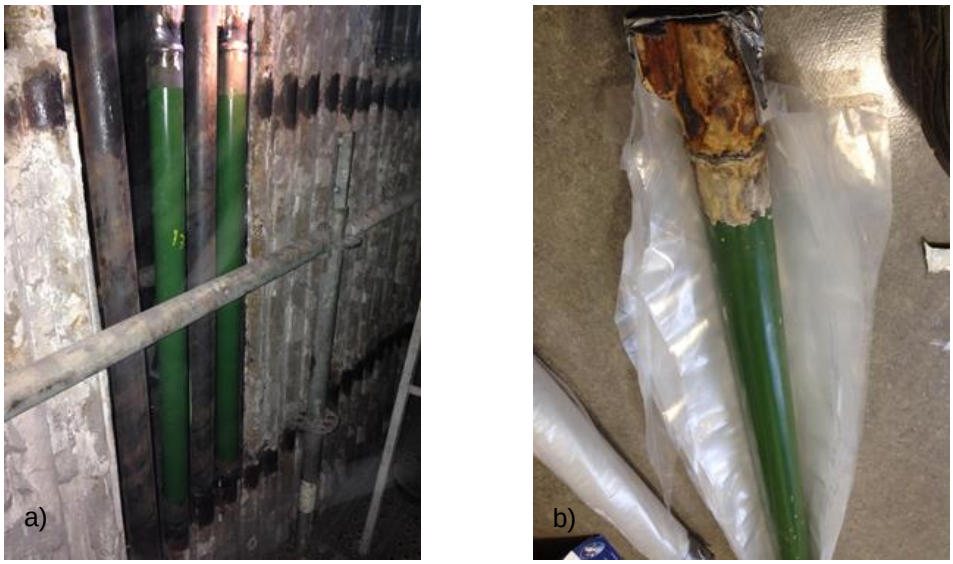
Fume temperatures in the boiler at this point are measured at 650ºC (1200º F), steam at 300ºC (572ºF) and metal surface is estimated to be at almost 500ºC (932ºF)

2 – April 2015

The tubes were in service during 13 months. In the next figure, it can be seen the same tubes untouched without any cleaning

Figure 5. Tubes after 13 months working (2015)

This ceramic coating has quite good properties in general. One of the most interesting properties is the excellent chemical resistance in comparison with vitreous conventional coatings sintered at low temperatures, as well as a high thermal resistance.



Figures 6.

a) Location tubes in the steam reheater before 13 months working

b) Tubes after 13 months working

After 13 months working tubes have not lost even one micron of its original thickness, still keeping its shine.

Next step; to continue with some old tubes (2nd year working) and news samples testing in the steam reheater:

Figure 7. Tubes working in Urban Garbage Power plant. Installed 27th April 2015

3 – April 2016

The tubes were in service during 25 months. In the next figure, it can be seen the tubes untouched without any cleaning (the ash were very easy to clean) and the 2nd year tube cleaned.

Figure 12; a) Tubes untouched without any cleaning

b) 1 - 2nd year tube cleaned b) 2 – 1st year tube cleaned

After 25 months working tubes have not lost even one micron of its original thickness, still keeping its shine.

Next step; to continue with some old tubes (2nd year working) and news samples testing in the steam reheater:

Figure 13. Tubes working in Urban Garbage Power plant. Installed April 2016

New improvement opportunities opened by these results *in the boiler operational efficiency*:

- Much longer life expectation for the tubing
- As ashes *do not stick to the tubes*: cleaning “shakes” can be reduced if not avoided
- As ashes *do not stick to the tubes*: Thermal efficiency will remain more constant as ash insulation will not grow, at least not as per today
- As ashes *do not stick to the tubes*: It might become possible to increase the steam temperature thus increasing the Turbine efficiency.

Kera-Coat has developed ancillary systems for "on site tube assembly":

- Tube Protection.

Kera-Coat has developed ancillary systems for "on site tube assembly":
Tube protection covers made on hard but flexibleplastic, easy to clamp and withdraw

Tube surface protection is IMPORTANT during different shop operations (transport, welding, sandblasting,

Sand blasted plastic cover intact protected tube after blasting

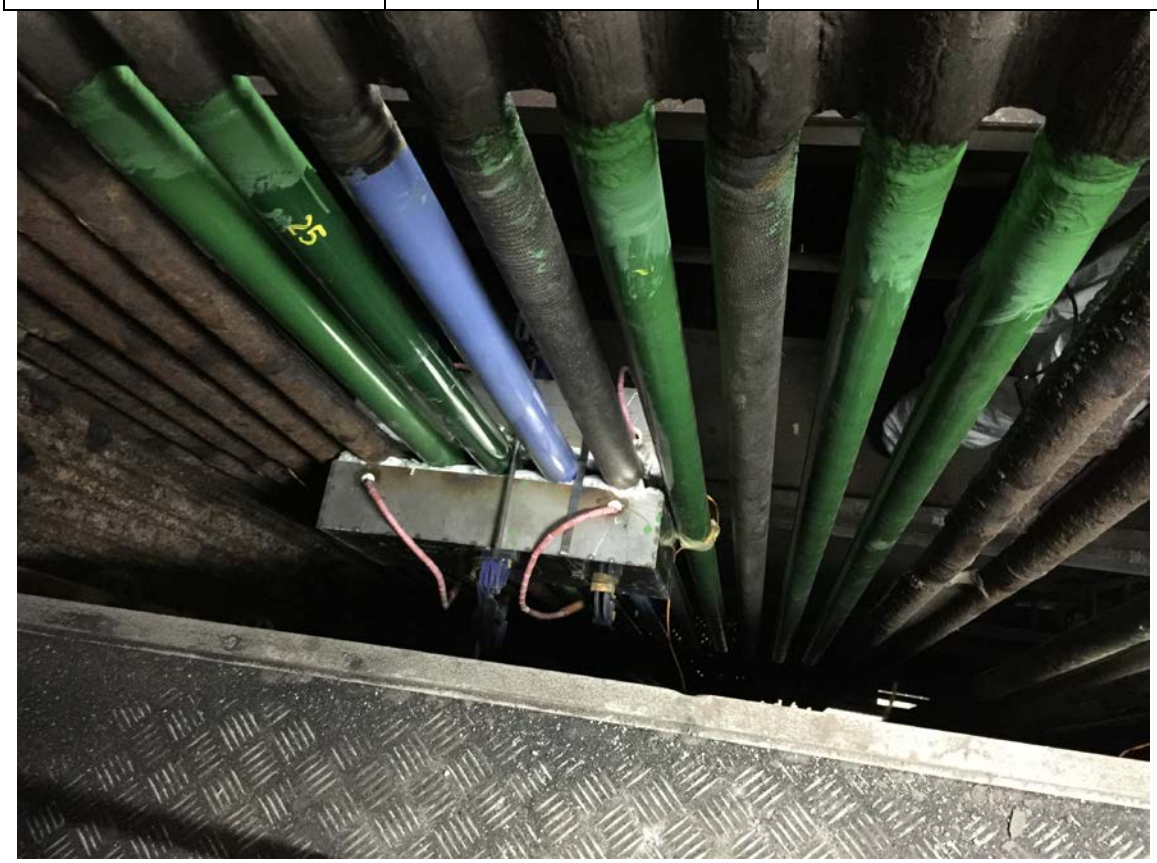
inside or outside the boiler

The plastic protection covers can be supplied with the coated tuve
Thse protections can be purcjased from companies like:

: *http://www.improfort.com/index.php?main_page/lang=1#.WCXzJ9zq9gM*

- Operations in situ for coated and sintered welded areas

		
Welds without coating	Coated Weld	Coated welds after 12 months operation



Actual in situ sintering device- new process under development