CRESS

Emisshield®

CONSERVE ENERGY. ENHANCE PRODUCTION.

HIGH EMISSIVITY COATINGS

FOR

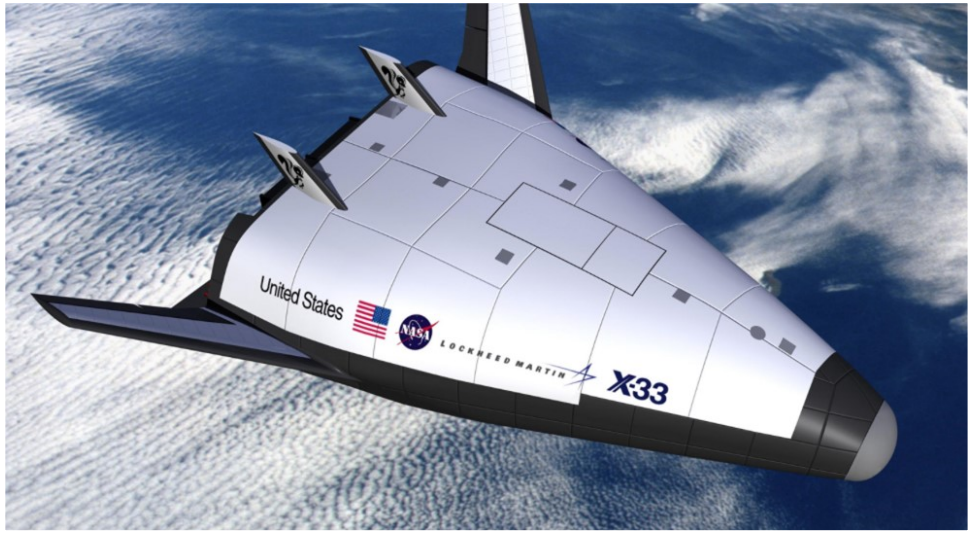
Furnaces, kilns, fired heaters and OEM parts

July 2024

ABOUT CRESS

- Located in Breskens/NL and Molenstede/BE
- Demolition of refractories
- All kinds of installations, with or without the full- or partly material package delivery
- In-shop prefabrication of refractory elements
- Project planning and supervision
- European license and strategic partner of ***Emisshield® High Emissivity Coatings***

EMISSIVITY COATING INTRODUCTION



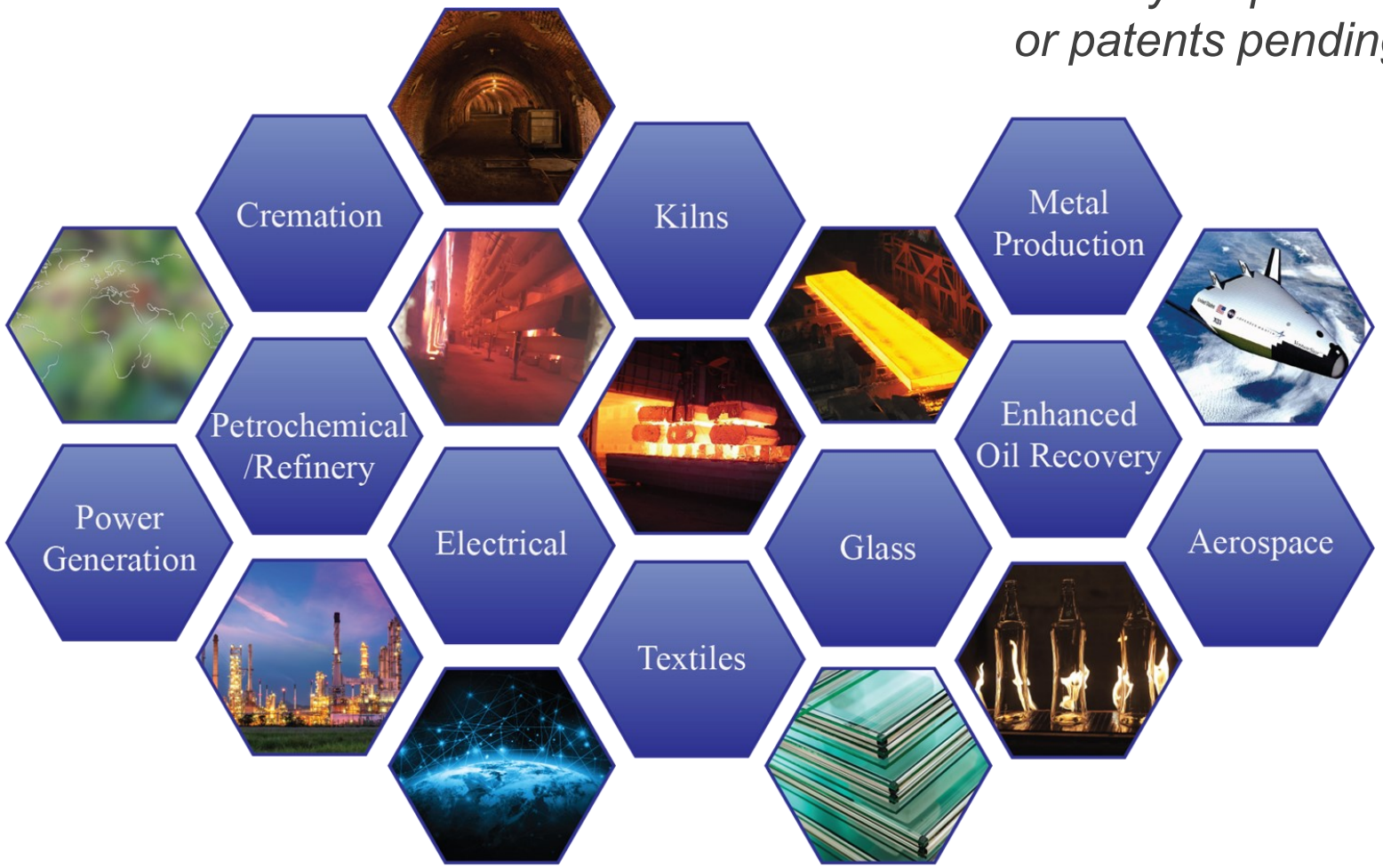
- Only NASA based technology that enhances heat, cooling, thermal shock, and life expectancy performance of most materials.
- “SPACE CERTIFIED”
- Inducted to “Space Technology Hall of Fame” by NASA in 2021
- Created to protect human life and space equipment and return them back to earth safely and intact.

EMISSIVITY COATING PROPERTIES

1. Water-based with no volatile organic components (VOC)
2. Thin film coating (< 120 microns)
3. Nano-Emissive Ceramic Structured
4. Coatings formulated for Refractory, Ceramic and Metal Substrates
5. Superior Adhesion because of unique binder system
6. No special curing times needed after coating
7. Excellent thermal shock qualities
8. Excellent anti-corrosion/ anti-erosion properties
9. High operating temperature stability, up to 1700°C

EMISSHIELD PATENTS / SECTORS

… currently 20 patents or patents pending



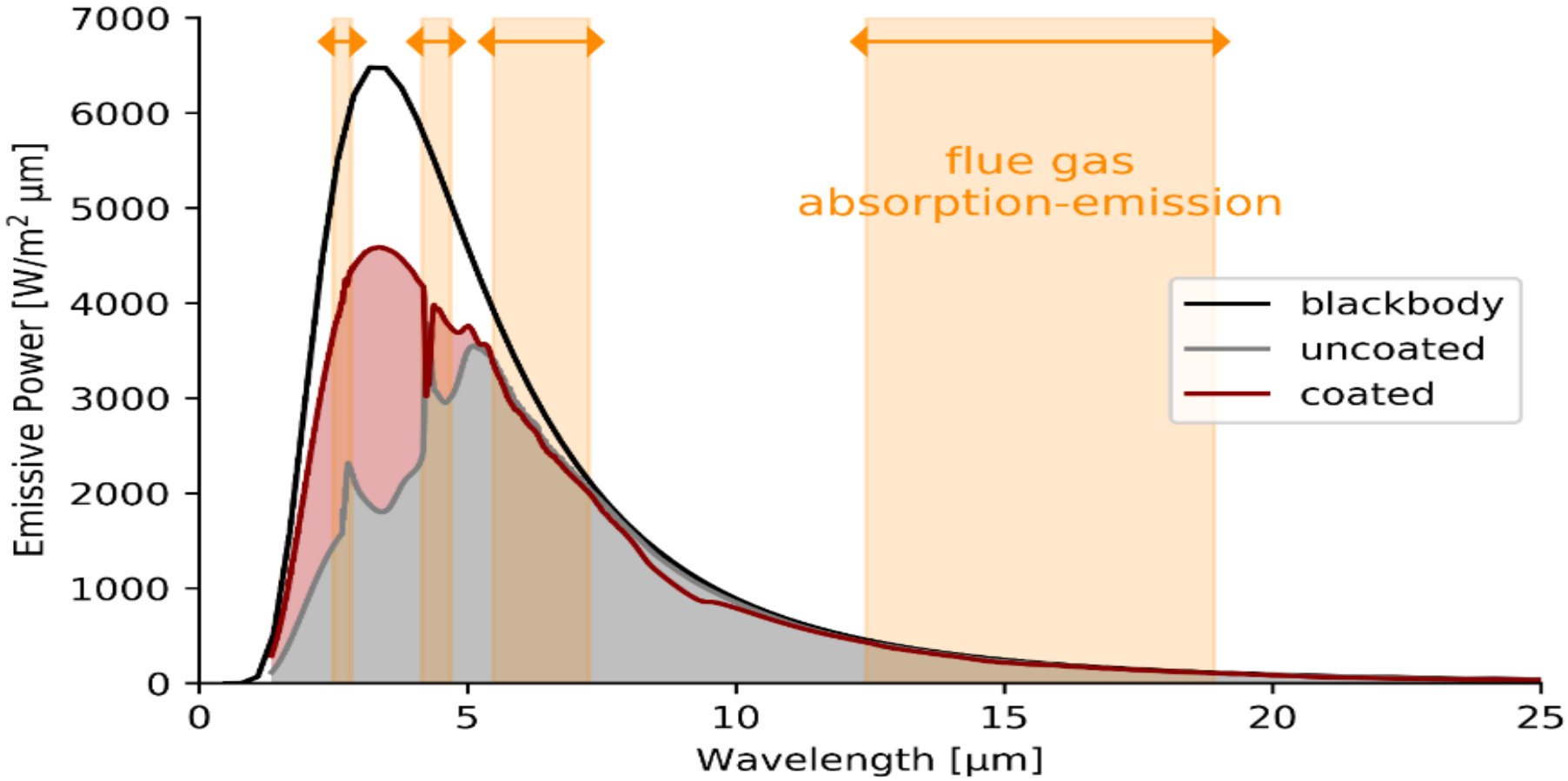
EMISSIVITY

» The measure of the ability of a body to emit or absorb energy when compared to a black body at the same temperature. «

EMISSIVITY + REFLECTIVITY = 1

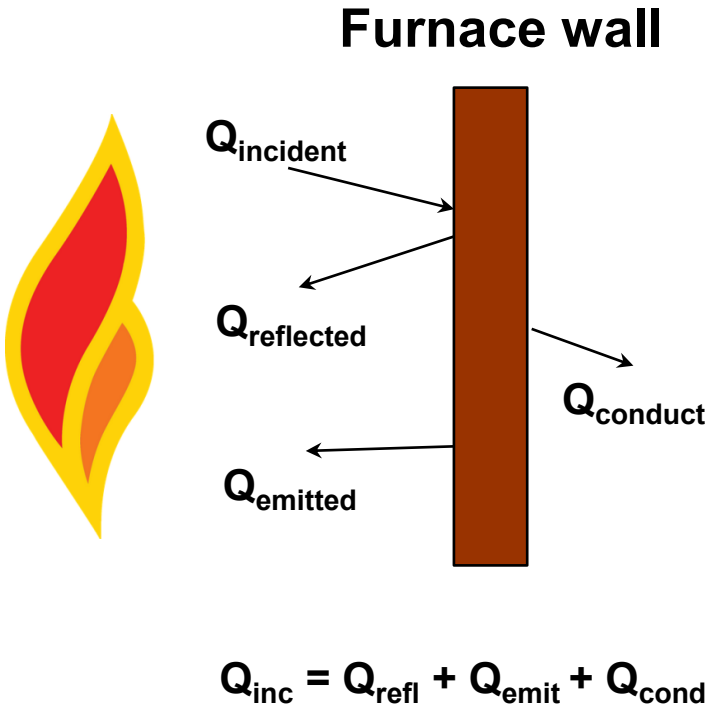
- Every object has emissivity and reflectivity values that add up to unity or 1. For example a white car has an Emissivity = 0.05 and a reflectivity = 0.95.
- With proper testing at temperature of operation by hemispherical and spectral methods you can measure the emissivity of an object. If the object surface has an emissivity of 0.9 then it will have a 0.1 reflectivity value at 1000°C.
- Emisshield is a perfect “Grey Body” with its emissivity NOT changing with temperature. 99% of materials of construction in furnaces are “Non-Grey Body” and change with temperature.

BLACKBODY / GREY BODY



FURNACE RADIATIVE HEAT TRANSFER

- Flame / heat source radiate to furnace walls
- Surfaces absorb and emit incoming radiation
  - Absorbed radiation is either reemitted or conducted into surface
  - Non-absorbed radiation is reflected back into gas



$$Q_{inc} = Q_{refl} + Q_{emit} + Q_{cond}$$

EMISSHIELD High Emissivity Coating

- ensures more radiant energy reaches the production load
- provides more uniform heating of load

Radiative Heat Transfer

Standard

$$Q_{\text{WALL TO LOAD}} = \sigma \times \varepsilon_F \left(T_1^4 - T_2^4\right)$$

With shape factor(S_F) (depending on furnace geometry)

$$Q_{\text{WALL TO LOAD}} = A \times S_F \times \sigma \times \varepsilon_F \left(T_1^4 - T_2^4\right)$$

Heat flow: Hot to Cold→ T_1 > T_2

ε_F: **emissivity factor**

- ε_F Refractory: 0,4
- ε_F Ceramic fibre: 0,2 – 0,3
- ε_F Metals: up to 0,7

Q = re-radiated energy absorbed by the kiln load [W/m²]

ε_F = emissivity factor of the coatiing

σ = Stefan-Boltzmann constant [W/m²K⁴]

T_1 = wall temperature [K]

T_2 = load temperature (e.g. bricks in a tunnel kiln) [K]

REDUCTION OF HEAT LOSS

EMISSHIELD® Application in a tunnel kiln

- side walls from bottom of kiln car
- ceiling
- preheat zone (from ~600°C)
- firing zone

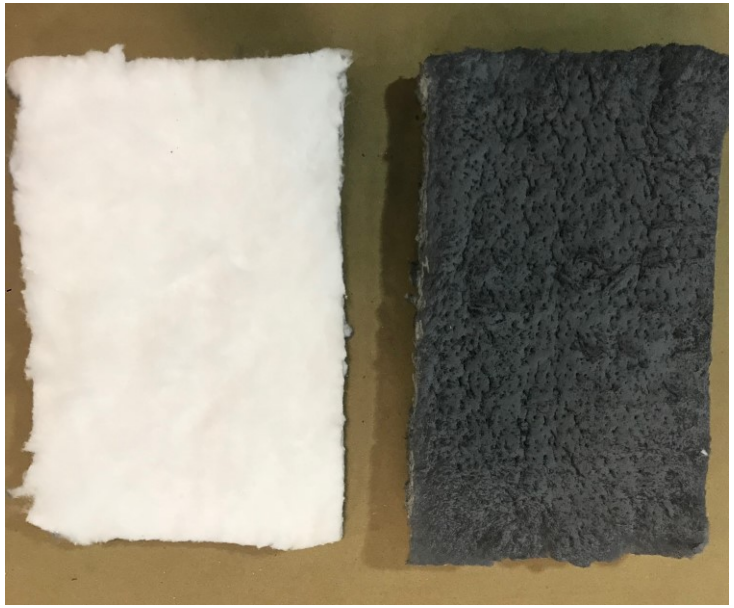
- surface preparation (cleaning, dedusting of the surfaces (vaccum cleaner)
- application by an Emisshield certified applicator
- **ca. 65m² / hour**
- drying time: **2 - 3 hours**

Ceramic Fiber Coating

CERAMIC FIBER EXAMPLE – UNCOATED VS. **COATED**

- Extends Metal and Refractory/Fiber Life
- Minimizes Devitrification and Shrinkage of Ceramic Fiber
- Increases Run Time
- Resists High-temperature Corrosion
- Emisshield adds approximately 302°F (150°C) to Operating Temperature (Continuous Duty) for Ceramic Fiber
- Reduces Maintenance and Downtime

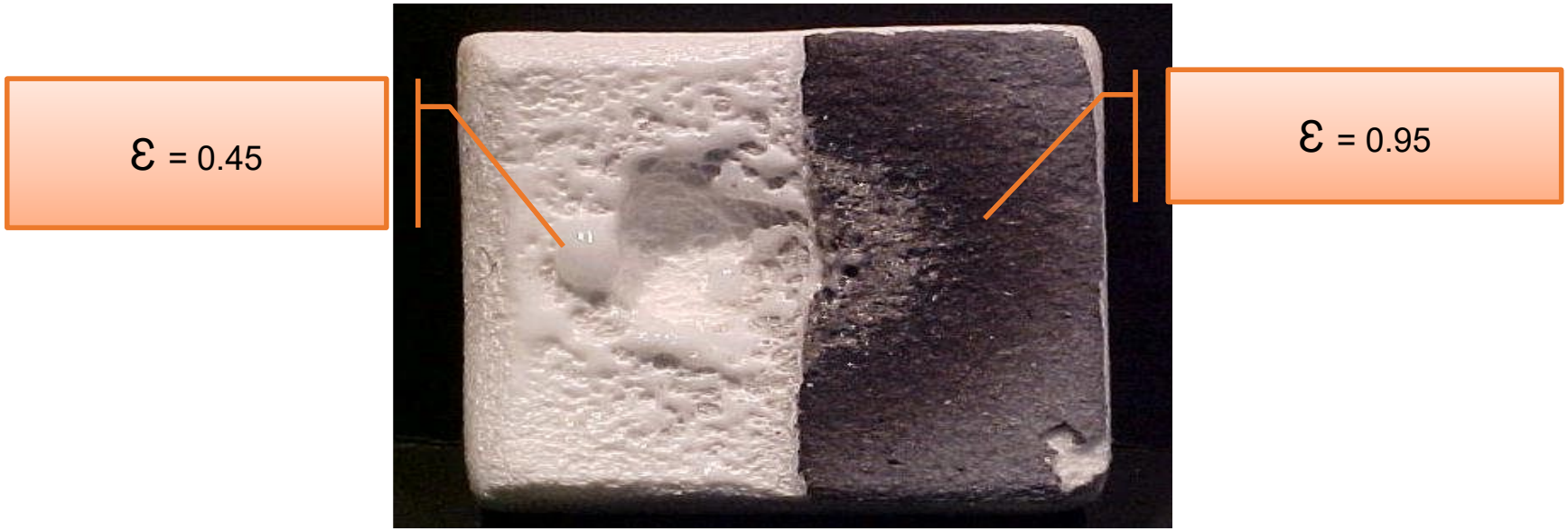
Emissivity (Ɛ): uncoated vs. coated



Uncoated:
Ɛ=0.2 - 0.3

Emisshield Coated:
Ɛ=0.85 - 0.95

Thermal Stability



2300 rated refractory fiber board - melts at 3100˚F (1700°C)

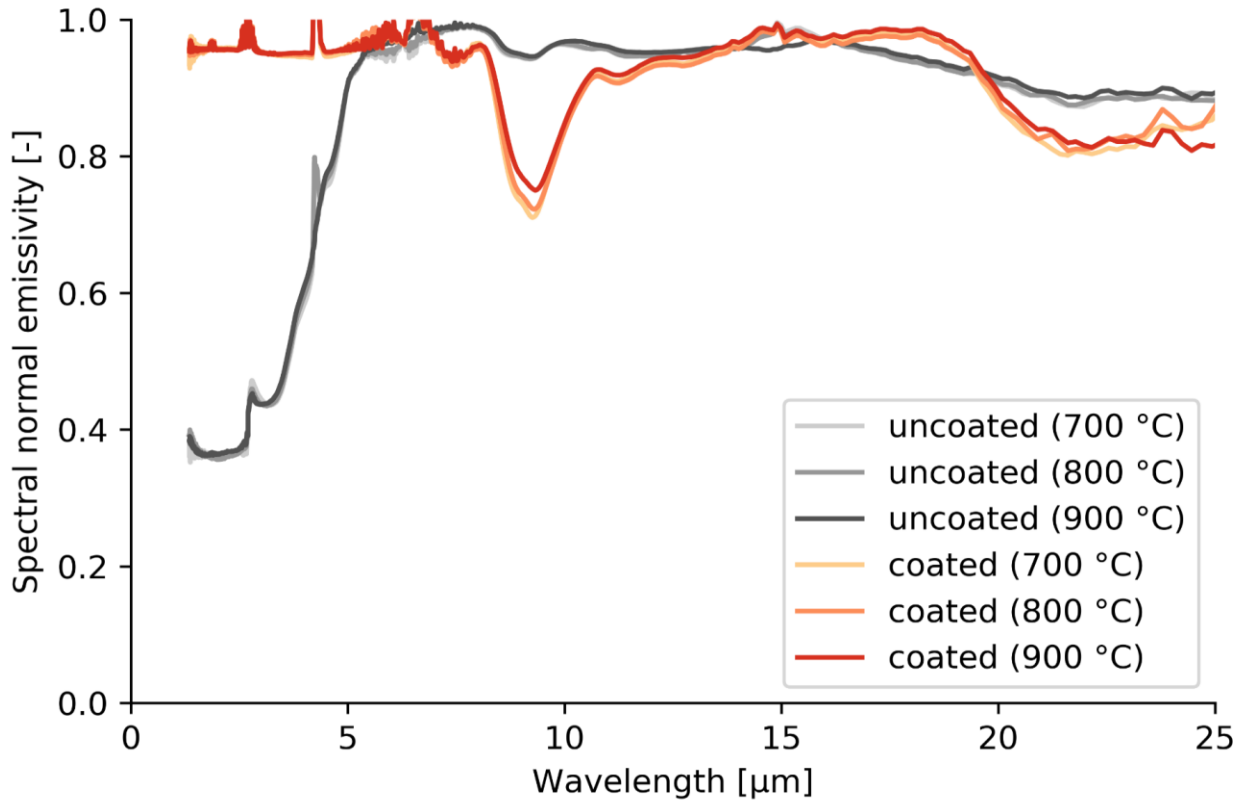
Long Term Thermal Stability:

- 7+ years at 1150°C on ceramic fiber and hard refractory
- 5+ years at 750°C on metal process tubes

Spectral EMissivity

Spectral emissivity of refractory

Measured by Western Bohemia University (WBU)



Uncoated vs
Emisshield coated
refractory

GREEN TECHNOLOGY

Reduces Carbon Footprint

Emisshield® optimizes combustion and reduces air emissions

- NO_x, CO, CO_2 Reductions
  - Air Credits / Trading

EMISSHIELD SUMMARY

DEVELOPED BY NASA

core technology was developed by NASA, improved at Virginia Tech, and licensed by Emisshield Corporation in 2001

ENERGY SAVINGS

and improved productivity in industrial processes

GREEN TECHNOLOGY

reduces carbon footprint and harmful emissions

LOWER COSTS

of maintenance and reduced downtime

LONGER LIFETIME

for substrate (ceramic fiber, metal, refractory)

REDUCED CORROSION,

wear and tear

EASY APPLICATION

quick & simple

SHORT-TERM ROI

typical return on Investment (ROI) is less than 1 year

PROVEN SUCCESSES

in multiple Industries

CASE History – Tempering Heat Treat Furnace, Tulsa, OK

Furnace Information
Furnace Type: Two Identical Heat Treat Furnaces
Location: Tulsa, OK
Fuel Type: Gas
Substrate: New Ceramic Fiber Modules
Operating Temp: 732 °C (1350°F)

Application Information
The operators of this furnace wanted to compare the effects of Emisshield® with a similar uncoated furnace so one of the two furnaces was coated with Emisshield® while the other one was left uncoated. This application was completed in June 2005.

Emisshield® Benefits
The two identical furnaces were loaded with 1200 lb loads. The Emisshield® coated furnace reached the operating temperature of 1350°F/732°C one hour faster than the uncoated. This is a 30% decrease in time to temperature which results in an increase in production. The Emisshield® furnace also cooled down faster than the uncoated furnace, reaching 600°F/316°C in only 13 minutes versus 20 minutes for the uncoated. This is a faster cool down of 35%.

Emisshield®, when applied to sintering furnaces, can increase production by allowing for decreased cycle time as detailed below:

Time	Uncoated Furnace (Temp)	Furnace Coated with Emisshield® ST-1 (Temp)	Temperature Difference
10:30 AM	200°F/93°C	200°F/93°C	**0°F/0°C**
11:00 AM	900°F/482°C	1000°F/538°C	**100°F/56°C**
11:30 AM	1050°F/566°C	1150°F/621°C	**100°F/55°C**
12:00 PM	1150°F/621°C	1250°F/677°C	**100°F/56°C**
12:30 PM	1225°F/663°C	1350°F/732°C	**125°F/69°C**
1:00 PM	1300°F/704°C	1350°F/732°C	**50°F/28°C**
1:30 p.m.	1350°F/732°C	1350°F/732°C	**0°F/0°C**

CASE History – Bell Annealing Furnace, Sandviken, Sweden

Furnace Information
Furnace Type: Ebner Bell Annealing Furnace
Location: Sandviken, Sweden
Fuel Type: H_2
Substrate: Stainless Steel
Operating Temp: 825 °C (1517°F)

Application Information
Emisshield® was applied to the external and internal surfaces of the inner bell unit. No product was applied to the outer bell unit. This application occurred in July 2007.

Emisshield® Benefits
- Increased production 10 - 15%
- Heating Bell 10 – 20% Cooler Depending upon point in heat cycle
- Increased inner bell life 1.5 to 2+ times
- Improved product uniformity
- Inert Gas Savings 1 – 2%
- Reduced System Maintenance

Annealing Bell with **Sintered** Emisshield Coating

CASE History – Radiant Tube, Oxelösund, Sweden

Furnace Information
Furnace Type: Integrated Steel Mill
Location: Sandviken, Sweden
Fuel Type: Natural Gas
Substrate: Chrom / Nickel Tube

Application Information
The tube was shipped to an Emisshield® preferred installer in Sweden for the application. The tube was cleaned with a light grit blast and then coated with Emisshield® on the outside surface. The tube was then heated to 800 °C to be sintered and then returned for installation.

Emisshield® Benefits
- Exit gas temperature was reduced from 500 °C to 430 °C
- Increased thermal flux across tube to product
- Ability to outperform more exotic radiant tube types
- Reduce hotspots and provides uniform temperature profile
- Reduction in thermal oxidation of the tube
- Reduce down time of furnace for radiant tube replacement

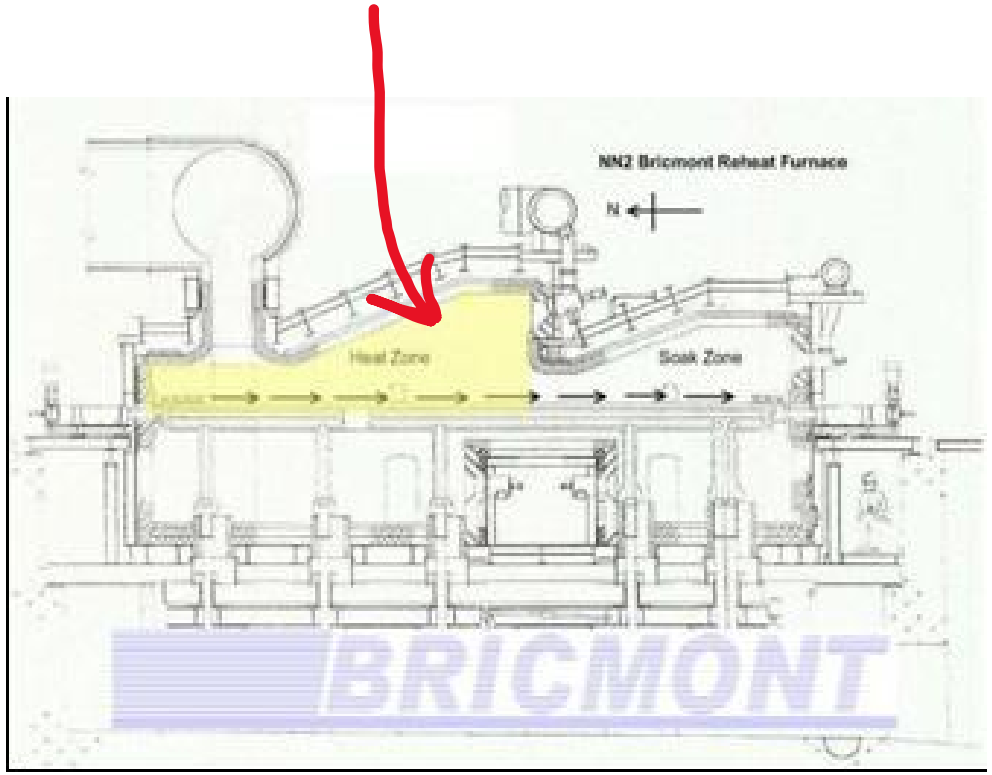
Radiant Tube with **Sintered** Emisshield® product

CASE History – Walking Beam Furnace, Norfolk, Nebraska

Furnace Information
Furnace Type: Bricmont Walking Beam Reheat
Furnace Location: Norfolk, Nebraska
Fuel Type: Natural Gas
Substrate: Hard Refractory / Castable
Operating Temperature: 774°C – 1000°C (1425°F – 1830°F)
Product: Merchant bar quality hot roll product and some special bar

Application Information
Emisshield® was applied to the top heat zone down slightly below the billet line. This total area of refractory was approximately 2000 ft^2. The customer's goal was to improve energy efficiency of the furnace.

Emisshield® Benefits
The customer was able to realize an improvement of 4.5% in energy efficiency with the utilization of Emisshield® technology across their product line. This resulted in a direct savings in their natural gas usage per ton of product produced.



CASE History – Pusher Furnace, Mo i Rana, Norway

Furnace Information
Furnace Type: Pusher furnace
Location: CELSA NORDIC Mo I Rana - Norway
Fuel Type: Gas
Substrate: Refractory
Operating Temp: 950 °C (1740°F)

Application Information
Application of Emisshield GZ-5 Coating in a pusher furnace
Coated surface: 350m²
Date: 28.December 2018

Performance analysis:
Pre-coating period Feb-Dec 2018 to Post-coating period Jan-Oct 2019, under these categories:

- Hot Charging (>500ºC), Warm Charging (150ºC to 500ºC), Cold Charging (<150ºC)
- Separate for each product

Emisshield® Benefits Statement by CELSA Nordic
"The weighted average we have got as a result of our analysis is 5.55% improvement in the post-coating period compared to the pre-coating period".

CASE History – Batch Reheat Furnace, Mexico

Furnace Information
Furnace Type: Batch Reheat Furnace
Location: FRISA, Mexico
Fuel Type: Gas
Substrate: Ceramic Fiber and Refractory brick
Operating Temp: up to 1200°C

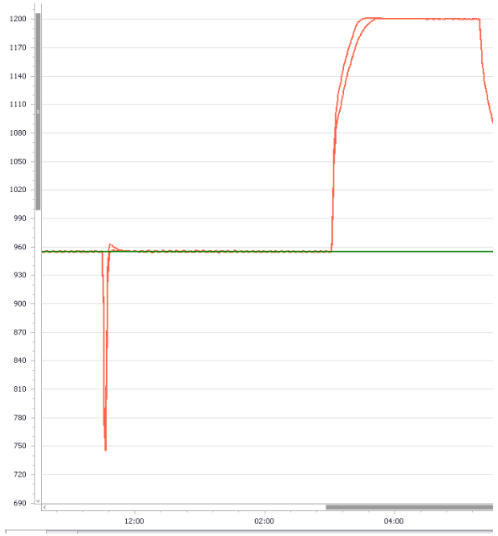
Application Information
The Plant was able to measure pre and post coating data by using the exact same load and the exact some charging temperature.

Emisshield® Benefits
By applying Emisshield to the hot face of the refractory lining, the Owner was able to obtain a **10-13% energy savings**. Additionally, a **production increase of 14%** was observed concurrently with reduced energy. **The combined overall furnace energy savings and production increase was approximately 20%. The pay back for these Emisshield furnace applications was less than 1 month.**

Grafica de prueba inicial

Hora inicial: 11:30 @ 955 grados , 499,076 M3
Hora Final: 15:00 @ 955 grados, 499,151 M3
Hora Final: 16:38 @ 1200 grados, 499,222 M3

Tiempo total hasta llegar a tolerancia: 5:08 hrs
Total de gas consumido: 146 m3



FRISA

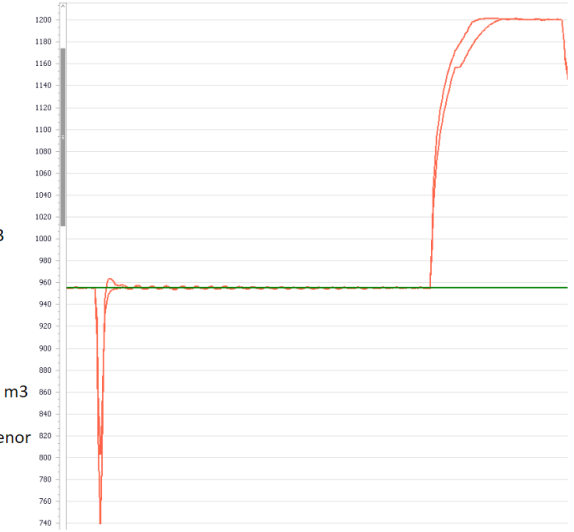
Grafica de prueba Final

Hora inicial: 10:33 @ 955 grados , 507,795 M3
Hora Final: 13:51 @ 955 grados, 507,869 M3
Hora Final: 14:58 @ 1200 grados, 507.924 M3
Agregando 43 min de dif vs 1er prueba, 507,933 M3
15:41

Tiempo total hasta llegar a tolerancia: 4:25 hrs
Total de gas consumido: 129 m3

Consumo de los siguientes 43 minutos: 9 m3
Consumo igualando el tiempo de primera prueba: 138 m3

Podríamos decir que el consumo fue de un 5 a 13% menor ya con el recubrimiento.



FRISA

CASE HISTORY - BATCH KILN, ESSEN, GERMANY

Furnace Information
Furnace Type: batch kiln, volume about 600 liters
Location: Institute for Brick and Tile Research - Germany
Fuel Type: natural gas, hydrogen
Substrate: Ceramic fiber – about 30 years old
Operating Temp: 1100°C (2010°F)

Application Information
In August 2020 the walls were coated with Emisshield Ceramic fiber coating. The furnace was loated with about 50kg of bricks and heated up. Gas consumption was compared to same settings as prior Emisshield installation.

Emisshield® Benefits – comments from Mr. Rimpel, deputy director of IZF:
„We were surprised about the result after the first run as the ratio of load volume compared to the furnace volume was very small. To eliminate our doubts possibly caused by a potential wrong measurement in gas consumption, we repeated the test and got the same result as from the 1st run, a ***6% reduction in gas*** **consumption – a remarkable result!**“

Before Application of Emisshield

After Application of Emisshield

CASE HISTORY - ROLLER KILN, BREMERHAVEN, GERMANY

Furnace Information
Furnace Type: Roller kiln from SACMI
Location: Bremerhaven - Germany
Fuel Type: Gas
Substrate: Refractory – about 20 years old
Operating Temp: 1220 °C (2230°F)

Application Information
In July 2022 walls and ceiling were coated with Emisshield® in preheat zone from 600°C till end of burner zone, total about 250m²

Emisshield® Benefits:
Increased production of 4% and energy savings of 6 %.
More uniform heating

Our team

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THANK YOU FOR YOUR ATTENTION