Prepared by:

INDUSTRIAL SERVICES

Your Alliance Partner

Ceramic Thermal Barrier Coatings

Covanta Energy
Ceramic Thermal Barrier Coatings

Index

Waste to Energy Power Generation
Asset Protection

Critical Assets

Pollution Control Systems
Protection for…

- Ducts
- SDA's
- Baghouses
- Hoppers
- Stacks
- Boiler Tubes
- Refractory Enhancement
- General Infrastructure

JC Industrial Services, brings over 30 years of industry experience to every project. Along with our manufacturing partners we offer and engineered coating solutions that solve specific problems common to heavy industrial facilities in numerous sectors such as
Power, Cement, Metals and Petro/chemical facilities throughout
USA and Internationally.

As your Alliance Partner our Goal is to…

- Increase critical asset overall life cycle
- Reduce downtime and maintenance = $ SAVED
- Lower material and installation costs
- Increase system efficacy
- Capture energy otherwise lost because of outdated insulation technology
- Develop a culture of preventive maintenance to increase system life
- Provide rapid and measurable return on investment (ROI)

Power Generation
Asset Protection

Problem: Severe Corrosion in Combustion Exhaust Systems

Acid Dew Point Corrosion

Condensing flue gas in combustion systems cost facilities and owner's globally hundreds of millions of dollars every year in rehabilitation, downtime and maintenance.

Corrosion Under Insulation(CUI)

Both Acid Dew Point Corrosion and CUI are global infrastructure problems and the recurring costs are directly related to or attributed to the use of…

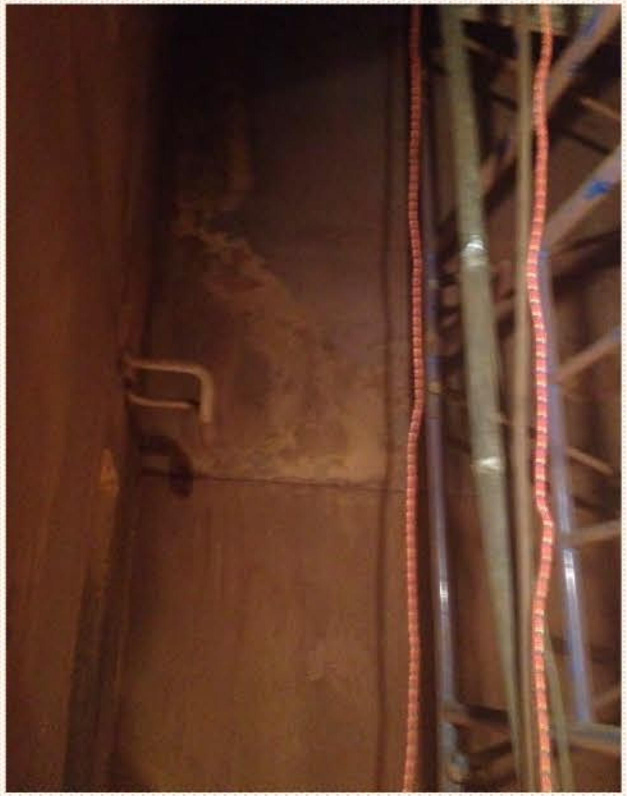
Inadequate and Outdated Insulation Materials

Traditional insulation such as mineral wool or fiberglass blanket covered with metal cladding does not block heat transfer it allows rapid to slow heat transfer. This loss of heat energy to is detrimental to Waste to Energy and Coal Power Generation process systems in numerous critical locations.

Power Generation
Assets Unprotected

Flue Gas or Acid Dew Point Corrosion and Corrosion Under Insulation

Baghouse Interior Acid Dew Point Corrosion



Corrosion Under Insulation and Acid Dew Point Corrosion

Power Generation
Plant Critical Asset Protection

Engineered Coating Systems Designed to Protect Critical Assets

Inspectioneering®

Flue Gas Dew Point Corrosion

Last update: July 28, 2015

Most flue gases produced by the combustion of fuels contain contaminants that can condense into sulfuric, sulfurous, or hydrochloric acid droplets. **Flue Gas Dew Point Corrosion** occurs when these aggressive acids condense on carbon and stainless steels in convection sections, flue ducts, and stacks. The amount of contaminants in the fuel is directly correlated with the concentration of the acid droplets, and therefore with the degree of corrosion.

There are several ways in which flue gas dew point corrosion can be avoided. More resistant materials can be used in the construction of flues, which can prevent **corrosion**. Also, limiting the number contaminants in **heater and boiler** fuels is another good way to prevent corrosion from occurring. Although, it should be noted that the latter method is far more difficult to accomplish, since most fuels contain sulfur compounds and some are contaminated with chlorides. Another way to prevent corrosion is to maintain the surface metal temperatures of exposed equipment above the dew point. Finally it is possible to protect cooler surfaces by applying a **coating** that is resistant to the acidic condensate and will withstand the temperatures to which it is exposed.

Power Generation
Traditional Insulation

Standard Insulation Technology

Today most power plants still use conventional insulation materials such as mineral wool or fiberglass with metal cladding designed to protect and hold fibrous insulation in place. This material is normally place a few inches from the exterior surfaces when placed over equipment, on pipes the fiber is placed direct to the surface. The fiber must be secured mechanically with welded pins or lath then covered with metal jacket or cladding.

Question: Could this method of insulation on Industrial Combustion Systems/Exhaust Systems be creating more problems than it solves? The evidence says YES.

Traditional insulation standards specifies or identifies mineral/fiberglass materials to be used by the use of the R or K factor as it's known by industry professionals. This data or formula is the measurement of the expectable rate of heat loss through the specific fibrous material and how many inches are required for a specific exterior surface. This measurement or gage R rating is not relevant when related to exhaust process equipment the important data to know is how much heat is actually being held in and to the steel surface under the insulation material. The R fact or measurement only tells you about the material not the substrate's expected ability to hold heat.

"The release of heat energy through mineral wool and fiberglass material = example R19"

Waste to Energy Power Generation Process Equipment

Heat Loss and Acid Dew Point

Traditional insulation materials allow heat energy to transfer through the steel shell to the colder atmosphere, these materials do not hold heat energy to the steel surface. This loss of heat causes interior steel temperatures to cool below the acid dew point which in turn causes the flue gas to condensate or condense from its gas state to an acid charge liquid state that can do catastrophic damage to equipment as these acids corrode the steel.

Waste to Energy Power Generation Process Equipment

CTB-1 Ceramic Thermal Barrier Coatings

JC Industrial Services along with our manufacturing partners offer engineered systems that utilize ceramic thermal barrier coating technology to block heat transfer whether on the exterior cold side or on the hot interior side of process equipment.

INDUSTRIAL SERVICES
Your Alliance Partner

Product Line Card
Ceramic Thermal Barrier Coating Systems

Rev. 1.0 7/27/2015

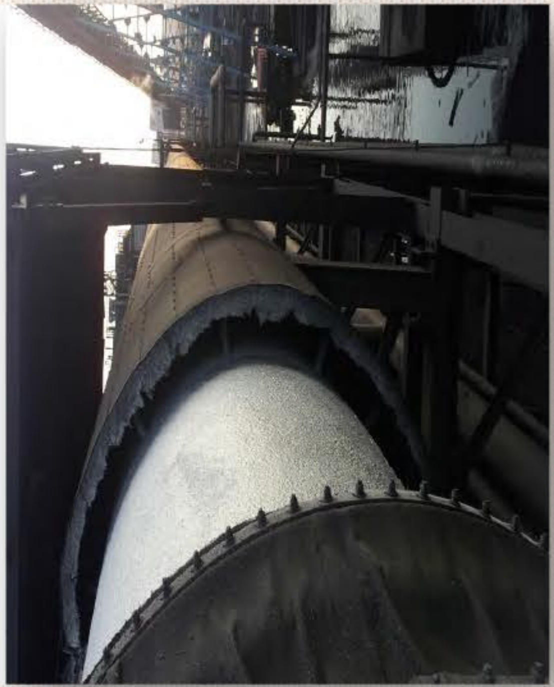
System Identification Cold Side Treatment Exterior Ceramic Thermal	Tanks	SDA's	Baghouse	Ducts	Pipes Corrosion Under Insulation	Hoppers	Stacks	Furnace	Burners	Tubes	Refractory	Concrete	Roofs	Structural
CTB-1 (HPC-Super Therm-Enamo Grip 175- 425 mils DFT Temperature Profile 0-475° F * *Note Enamo Only required if color is required.*	x	x	x	x	x	x	x	x						
CTB-2 (HPC Hybrid 75 % HPC-25% Super Therm) 75- 175 mls DFT Temperature Profile 0-275° F	x	x	x	x	x	x	x	x					x	x
CTB-3 HT (213-100HT- HPC-Super Therm) 400-900 mils DFT Temperature Profile 475-1,200°				x	x		x	x					x	x
CTB-4 UHT 900 (213-100HT-Fiber-HPC-Super Therm) 500-1,200 mils DFT Temperature Profile 600-1,800° F				x	x	x	x	x					x	x

Waste to Energy Power Generation Process Equipment

A Paradigm Shift 21st Century Solutions for Age Old Problems


Old Woman


Young Woman


Traditional Mineral Wool


Ceramic Thermal Barrier Coating

Waste to Energy Power Generation
Process Equipment

Baghouse Hopper Cladding and Traditional Insulation

BH Hopper with cladding and mineral wool traditional insulation.

First test coupon CTB-1 system cladding removed reveals air gap and mineral wool insulation.

- Substrate covered can't see issues unless cladding is removed.
- Significant heat loss.
- Corrosion under insulation.

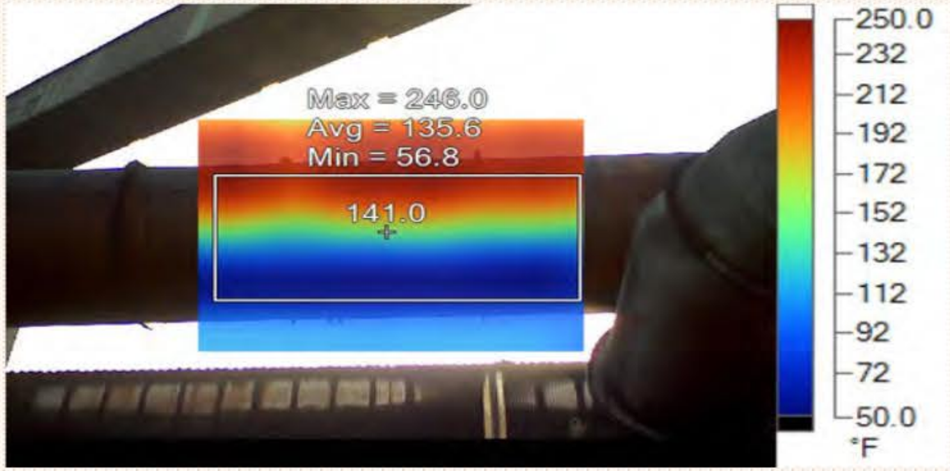
Insulation Mineral Wool

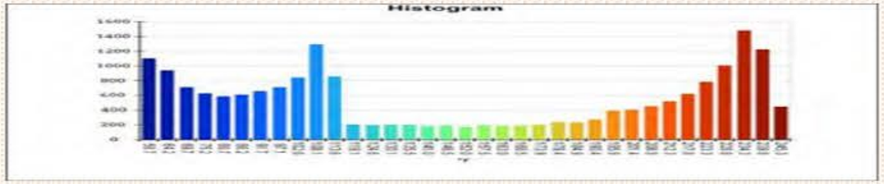
Baghouse Hopper & Screw Conveyor

CTB-1 Ceramic Thermal Barrier (Block heat transfer and protect critical assets

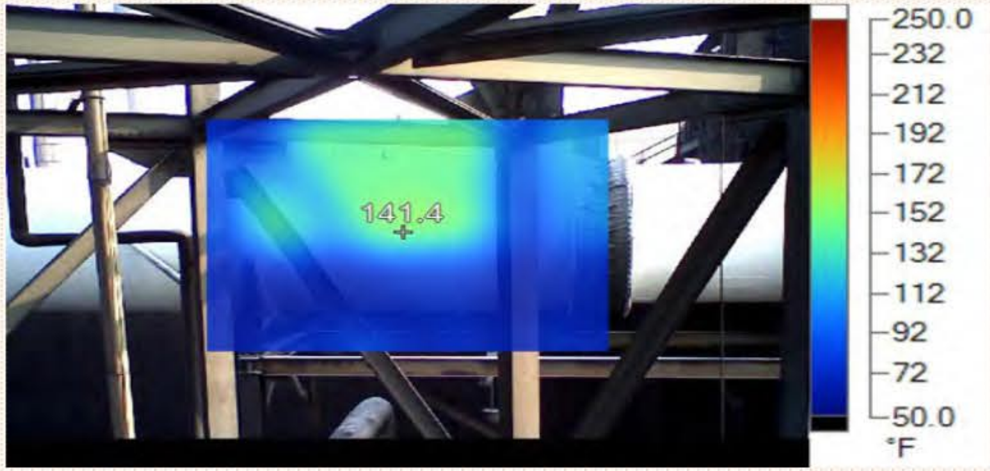
Block Heat Transfer and Hold Heat to Steel Surface

Before Ceramic Thermal Barrier Coating





After base coat only 150 mils DFT

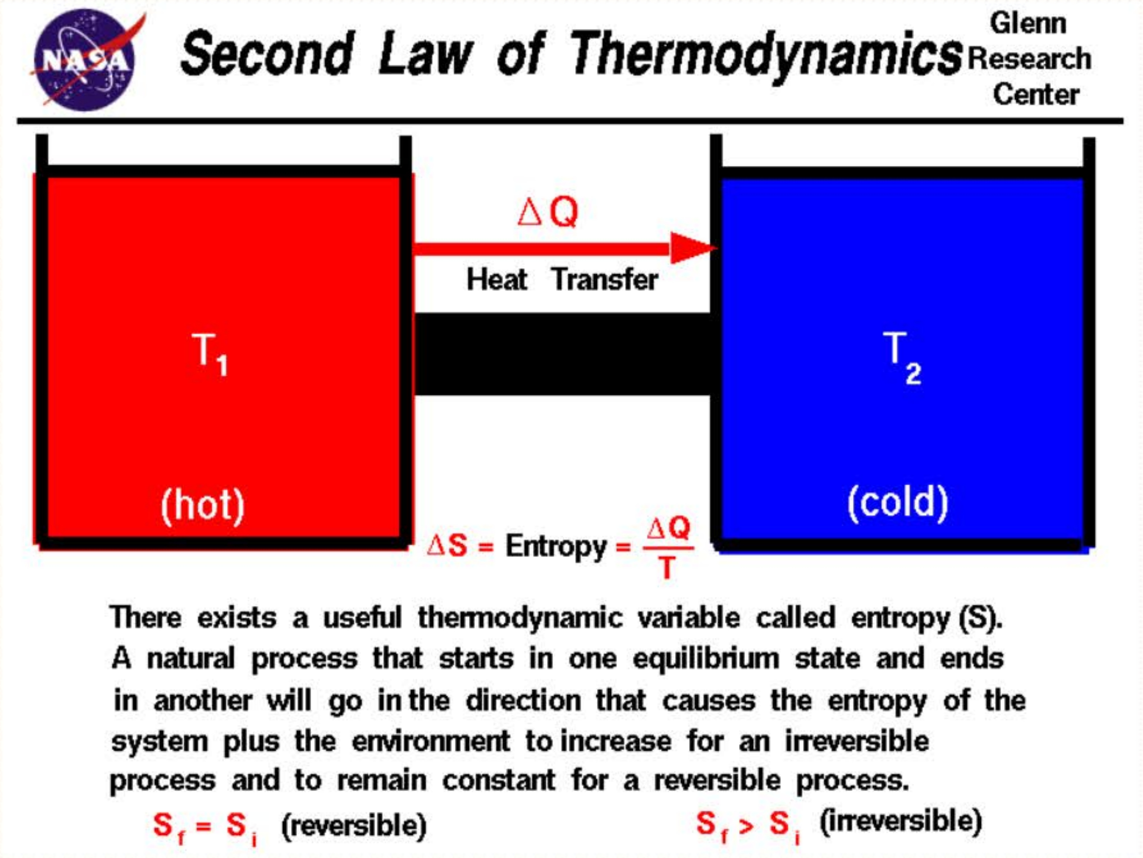


Full specified mil thickness 400 mils DFT. Inferred camera pictures taken in winter outside temperature 20°-10° degrees F.
Charts gives a visual example of the physics behind Ceramic Coating Technology hot gas flowing from a continual heat source
"Hot will go to Cold" – *"Cold does not intrude on Hot"as long as heat source is continual .*
CTB-1 at the exterior steel surface blocks heat migration to cold keeping steel temperatures elevated.

The Science
Heat Transfer

The Physics Hot Goes to Cold

How does heat travel?
There's a basic law of physics called the second law of thermodynamics and it says, essentially, that cups of coffee always go cold and ice creams always melt: heat flows from hot things toward cold ones and never the other way around. You never see coffee boiling all by itself or ice creams getting colder on sunny days! The second law of thermodynamics is also responsible for the painful fuel bills that drop through your letterbox several times a year. In short: the hotter you make your home and the colder it is outside, the more heat you're going to lose. To reduce that problem, you need to understand the three different ways in which heat can travel: called conduction, convection, and radiation. Sometimes you'll see these referred to as three forms of heat transfer.



The Science
Heat Transfer

Ceramic Technology Blocks Heat Transfer Dealing with All 3 Way Heat Travels

Conduction

Conduction is how heat flows between two solid objects that are at different temperatures and touching one another (or between two parts of the same solid object if they're a saucepan of soupaStir with a metal spoon and you'll soon have to find a wooden one t different temperatures). instead: heat travels rapidly along the spoon by conduction from the hot soup into your fingers.

Convection

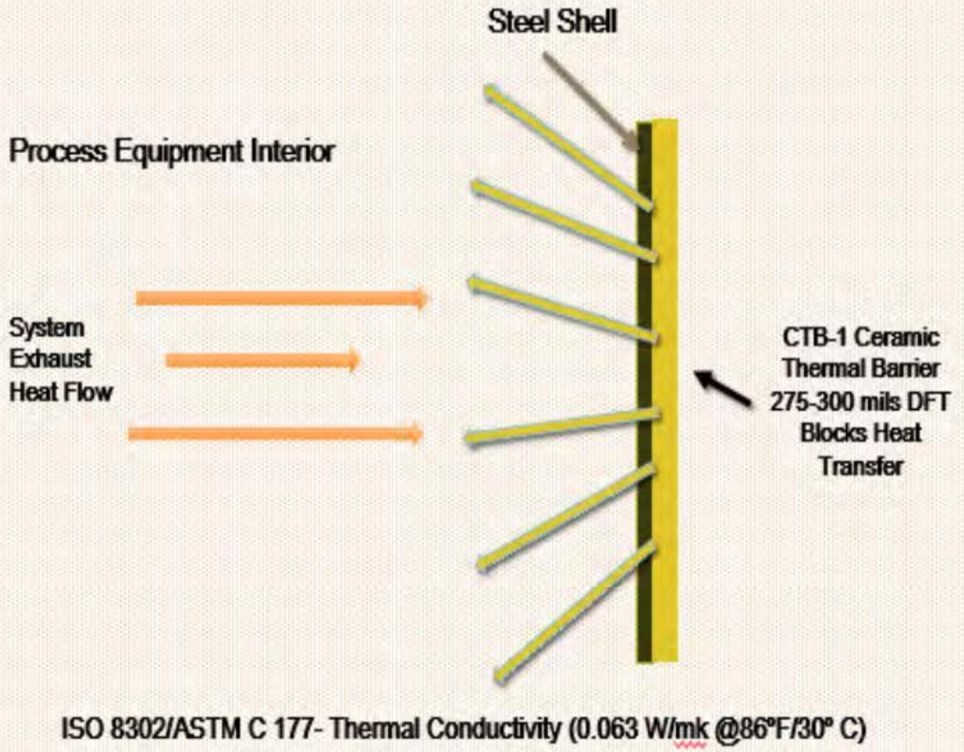
Convection is the main way heat flows through liquids and gases. Put a pan of cold, liquid soup on your stove and switch on the heat. The soup in the bottom of the pan, closest to the heat, warms up quickly and becomes less dense (lighter) than the cold soup above. The warmer soup rises upward and colder soup up above it falls down to take its place. Pretty soon you've got a circulation of heat running through the pan, a bit like an invisible heat conveyor, with warming, rising soup and cooling, falling soup. Gradually, the whole pan heats up. Convection is also one of the ways our homes heat up when we turn on the heating. Air warms up above the heaters and rises into the air, pushing cold air down from the ceiling. Before long, there's a circulation going on that gradually warms up the entire room.

Radiation

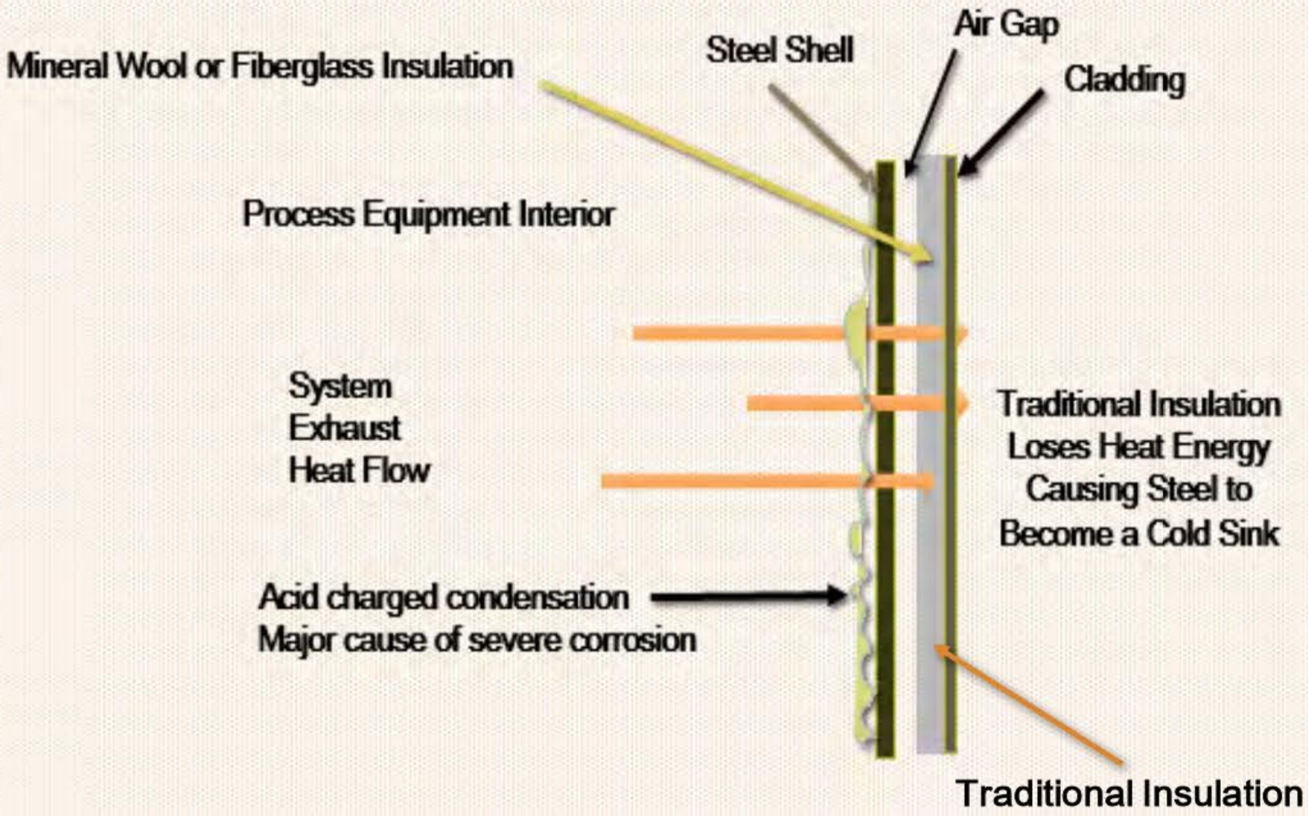
Radiation is the third major way in which heat travels. Conduction carries heat through solids; convection carries heat through liquids and gases; but radiation can carry heat through empty space—even through a vacuum. Sit near a crackling log fire and you'll feel heat radiating outward and burning your cheeks. You're not in contact with the fire, so the heat's not coming to you by conduction and, if you're outside, convection probably isn't carrying much toward you either. Instead, all the heat you feel travels by radiation—in straight lines, at the speed of light—carried by a type of electromagnetism called infrared radiation.

The Science
Ceramic Thermal Barrier vs. Traditional Insulation

CTB-1 Block Heat Transfer and Hold Heat to Steel Surface



Ceramic Coatings Block Heat Transfer



Ceramic Thermal Barrier Coatings
Benefits and ROI

Advantages and Disadvantages

Ceramic Thermal Barrier Systems

- Greatly reduce and eliminate interior condensation
- Reduce maintenance and steel repair costs
- Stabilize interior temperatures driving heat energy through system increasing normally cold parts of system as you capture otherwise lost heat energy.
- Reduce fly ash build up
- No corrosion under insulation
- Recapture more heat energy in recovery systems
- Extend life cycle of critical assets

Traditional Insulation

- Rapid heat loss allowing interior condensation to form on interior steel shell causing aggressive corrosion as flue gas drops below acid dew point
- Because of interior corrosion from acid dew point drop ongoing maintenance and costly steel repairs
- Problems are concealed behind cladding making it impossible to access and identify problems before they are severe
- Holes from corrosion in process unit and equipment can result in bad stack tests and emission violations

CTB-1 Ceramic Thermal Barrier Coating System

Standard Waste to Energy Equipment Specification

- Superior Product International II HPC® 275-300 mils DFT
- Superior Products International Super Therm® 4-6 mils DFT
- Superior Products International Enamo Grip® 3-4 mils DFT * Note: only required when specific color is required

Misc. Steel Repairs "Patching System"

- Base Superior Products International II Rust Grip® 4-5 mils DFT
- Fiberglass Roving Cut into Patches and Saturated in Rust Grip®
- 2nd Saturate topcoat Rust Grip® 3-4 mils DFT

Baghouse Hopper

Baghouse Hoppers NAES Facility Hartford, CT CTB-1 Ceramic Thermal Barrier Coating System

< Before

- Heat loss
- Corrosion from flue gas condensation
- Corrosion under insulation
- Ash build up due to condensation
- Cladding conceals damages and makes access costly and difficult

After >

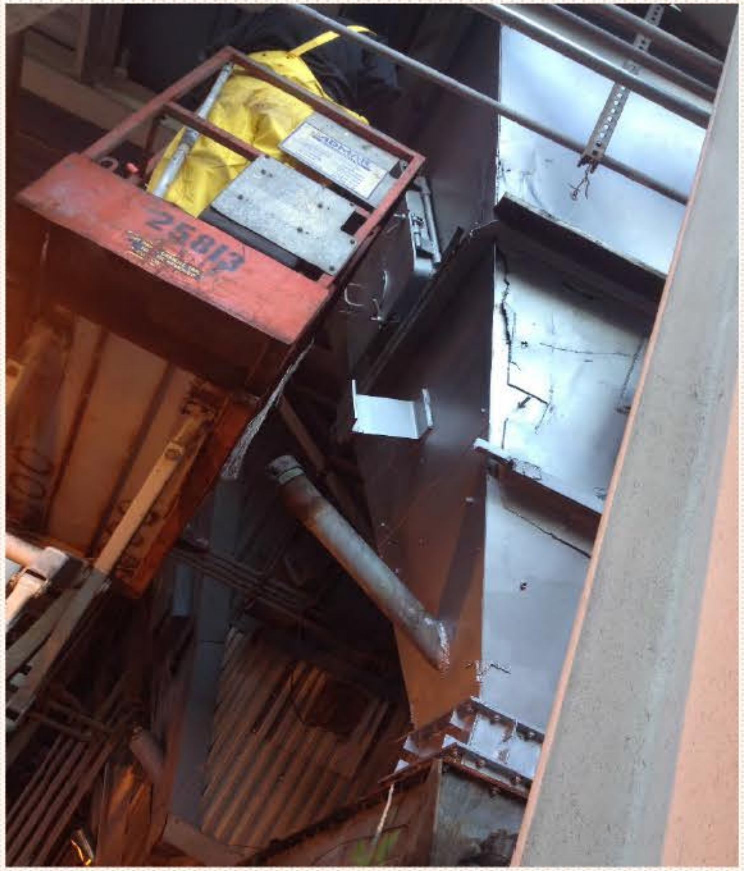
- Block heat transfer keeping steel Temps elevated
- Keeping steel elevated reduces temperature drops below the acid dew point
- Reduced maintenance
- Accessible and repairable

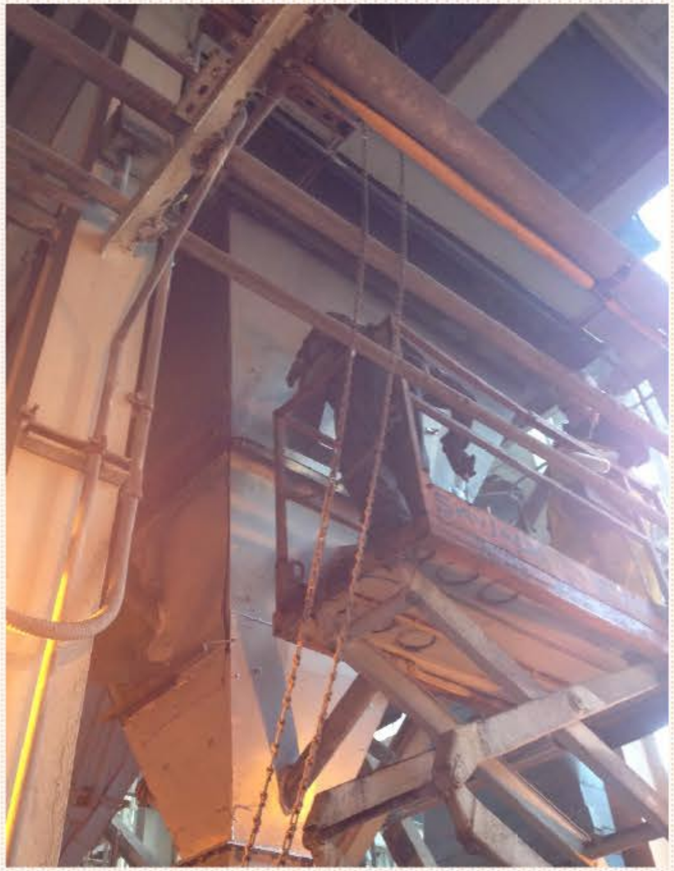
Baghouse Hopper

NAES Waste to Energy Generation Facility

NAES Hartford, CT CTB-1 (HPC® 250 mils DFT Super Therm® 6-8 mils DFT
In service exterior harsh winter exposure application excellent performance

Covanta Onondaga BH Hopper Base Coat Rust Grip





Rust Grip® is a high performance moisture cure polyurethane coating system with unique resin and metallic bends that form a strong and durable film. Rust Grip® upon full cure will achieve a tensile strength of 6,780 psi. In addition to strength the material is ideal to protect substrates from chemical exposure and chloride attack interior and exterior surfaces.

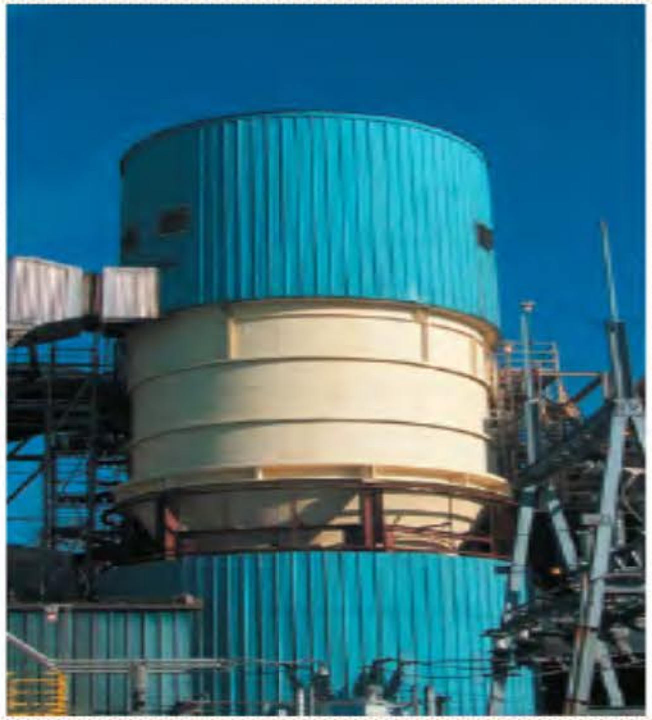
Covanta Onondaga
BH Hopper Repairs
Rust Grip and Fiberglass Roving

Spray Dry Absorber (SDA) w/Hopper

CTB-1 Ceramic Thermal Barrier Coating System

Before Traditional
Mineral Wool & Cladding

After
CTB-1 System



Benefits

Reduced fly ash build up eliminated need for regular a nd extensive explosive blast cleaning.

Eliminate interior condensation and cold sinks by coating steel with Ceramic Coating keeping steel temperatures elevated.

Blocking heat transfer is key to stable interior temperatures and keeping steel above acid dew point-which is major contributor to aggressive and severe corrosion.

Rapid Return on Investment.

Energy Recovery System
10’ Diameter Hot Gas Return Duct
CTB-1 Ceramic Thermal Barrier Coating

Baghouse Hopper Waste to Energy
Under CTB- Base HPC®
Thermocouple Temperature Comparison

Steel Temp Uncoated
87º degrees F

Lower Hopper Section 1st coat
120º degrees F

Upper Hopper Section 1st coat
184ºdegress F

Final coat specified thickness 275 – 300 mils DFT
Both top and bottom thermocouple readings the same.

Results: Thermocouples demonstrate steel temperature profile under ceramic coating after installation and cure CTB-1 base HPC® at total specified thickness of 275-300 mils DFT.

Thermocouple shows increased steel temperatures

150º F minimal

87º F to 238º F

Also increased steel temperature under the HPC®, at the full cure, both thermocouple locations read close to the same temperature. The material proved to block heat transfer keeping steel hot and stabilized interior temperatures.

Covanta Ft. Myers, FL
Lee Station

Outlet let and hot gas recovery ducts CTB-1 System to OSHA Personal Protection Temperature s

Hot Gas Recovery Duct
Before Coating
Surface Temperature
400° F

After HPC 350 mils DFT
Surface Temperature
120° F

Baghouse Clean Air Plenum
GDF Suez

CTB-1 HS Ideal for door ways, pulse pipe penetration, roofs and clean air plenums

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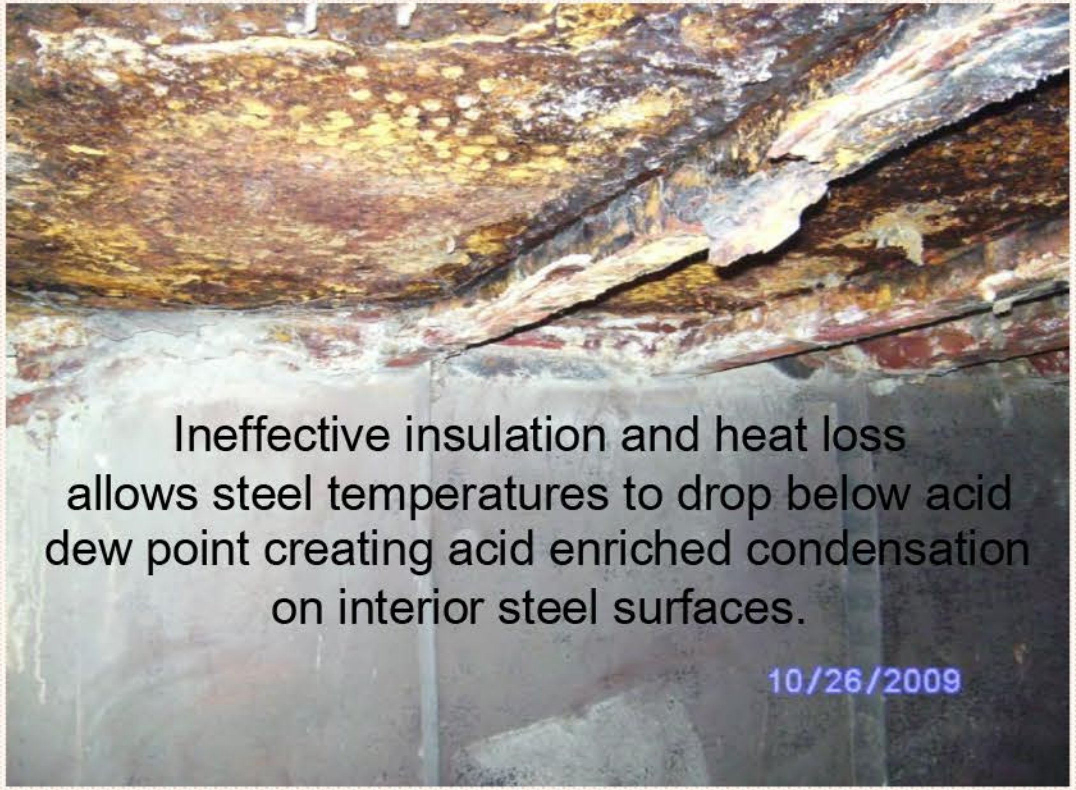
Example of Condensing Flue Gas Corrosion



CTB-1 HS (Rust Grip – HPC- Rust Grip - Lining Kote)

Baghouse Interior
CTB-5 IL
High Temp Ceramic Thermal Barrier
Lining Systems

NAES Hartford, CT Waste to Energy entire interior including tube sheet and hoppers

Waste to Energy Facility
Covanta Onondaga, NY

Screw Conveyor Ash Trough

The Conveyor Cover Coated with 150-175 Mils DFT CTB-1 Ceramic Thermal Barrier Coatings

Blocked heat transfer keeps the steel hot, helps combat corrosion, and reduces sweating which causes back-ups and clogging of the conveyor.

Conclusion

To create a path forward, provide quotations and specifications, please contact:

Doug Pearce
Eagle Specialized Coatings And Protected Environments

604-576-2212
president@eaglecoatings.com

We look forward to the opportunity to earn your business!