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Take a Fresh Look at Your Process Heaters

A simple four-step program can lead to significant savings

By Ven V. Venkatesan, Energy Columnist

MOST OF the fuel that plants purchase is converted into heat in furnaces and boilers. So, the efficiency of these units has a big impact on a plant's energy cost. In this column, we'll focus on how to improve the efficiency of process heaters.

Furnaces either directly heat the process or media like heat transfer fluids and air. Unfortunately, minor details often are overlooked at the design stage.

For example, a chemical plant I visited in Alabama vented considerable amounts of surplus steam. Because the designers missed the excess steam availability, modifying the process heater to utilize that steam would be very expensive. Only a few limited options, like selling steam to a neighboring plant, are available now.

The biggest loss in any process heater is in heat conversion, which normally results in higher stack-gas losses. The two factors that contribute to the stack losses are the quantity and temperature of the gases leaving the heater to the stack or exhaust fan. If these factors are higher than required, stack losses also are higher and heater efficiency is reduced.

Controlling the quantity of stack gases is the most-talked-about savings opportunity for process heaters. However, at 80% of the process plants I visit no significant efforts have been undertaken.

Plants of course supply air instead of oxygen for combustion. Sadly, many forget they're providing four times greater volume of nitrogen than oxygen to the burner. The excess nitrogen gets into the furnace at ambient temperature, picks up heat directly at the flame and leaves the stack at an elevated temperature without contributing anything. Hence, the first step in process heater optimization is to control the quantity of excess air supplied to the burner.

Most burner manufacturers recommend about 10% excess air. Many plants add a further safety margin, increasing this to 20% or more. At some sites, either operators are unaware of excess air levels or burner control systems are too primitive to make changes. In any case, it's worthwhile to evaluate the opportunity to trim excess air.

Burners firing natural gas typically require about 1% excess oxygen (or about 5% excess air) to achieve complete combustion. So, if the level exceeds 2%, the first step is to reduce it. If a heater already is maintained at 2% oxygen in stack gas, it still may be possible to trim further. For some heaters, you can reduce excess air without significant capital investment.

Address the quantity of stack gas by setting up a small team or task force and having it follow a simple four-step action plan:

1. Organize an on-site meeting about the furnace to discuss and finalize its tuning program. If multiple departments have heaters, conduct meetings at each department because each unit may have different characteristics of operation.
2. Initiate a heater-tuning program. Use a portable stack-gas analyzer to validate the readings of any on-line analyzers.
3. Give all relevant operators on-site refresher training on fuel efficiency fundamentals.
4. Start to measure stack condition on a daily basis and create a monitoring database for each heater.

Have an experienced engineer clearly define task details in such a way that operators can follow them easily.

Field-tune each major heater to meet a target operating level — a combustion efficiency exceeding 80% with 1%–2.5% oxygen and near 0% combustibles in the flue gas. This target range is neither new nor unrealistic. The tough part of the task is convincing plant operators to shift from their comfort zone to the optimum operating zone. Seeking the assistance of an external expert may be worth considering in a few cases.

Implementing the above tasks doesn't require big capital investment but instead a strong commitment from the team and plant management. You'll surely notice positive results after a month. Give the team and operators credit by duly reporting to management and publicizing the results.

The results usually are measurable at the end of the first year — and can add up to significant savings if the annual purchased fuel bill exceeds $25 million. Typically, the first year payoff is five times more than the cost of the first year efforts. The program also provides spin-off benefits, particularly a motivated in-house team. ●

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Don’t Get Heated Up By a Hot Stack

Consider several projects to lower temperatures and recover energy

By Gary Faagau, Energy Columnist

I HATE hot stacks! It always bothers me when I check furnaces for an energy efficiency study and the first thing I notice is that the stacks are above 600°F. It’s even worse when I’m asked to evaluate a unit’s maximum capacity and the furnace stack is hot. From a consulting standpoint, my job becomes easier, but I still hate to see a hot stack.

Why? Because it means someone designed the furnace to have a hot stack and no one bothered to correct it or, worse, ignored it. In addition, it means that through all the years the stack has been hot, the plant couldn’t justify saving that energy.

So, as a hired consultant, I’ll have to point out that the plant can save money and increase capacity by reducing stack temperatures, which they probably already heard. In five years, I could show up again and likely say the same exact thing.

This isn’t an isolated phenomenon. It’s cheaper to build a less efficient furnace and project people like cheap. I’ve even been in meetings where the project engineer insists that it’s the only way to stay on budget.

I’ve even been told that heat recovery could be tacked on as an additional project later and then watch as capital spins out of control and the furnace is installed with a hot stack. Then a consultant is brought in to tell them they need to reduce stack temperature to be more efficient.

So, before you spend money on a consultant, put a project together to lower stack temperature. Here are a few ideas.

Air Preheater – For large furnaces, air preheaters generally make the most sense. The amount of energy saved can be very large since stack temperature can be reduced to below 350°F. Air preheaters require plot space, but energy savings can be as much as 30%.

If you already have a Selective Catalyst Reduction (SCR) unit to reduce NO_x, your design probably has room for an air preheater. If you don’t, it may be an opportunity to reduce NO_x as well.

Process Heat – In some cases, you may have a process stream nearby that’s using steam or another heat source. Instead, heat that stream with stack flue gas. Either have a hot-oil circulating stream that can be used in multiple locations and you can have better control of the exchange with your process. Or use direct exchange by adding process coils to the furnace convection section. It doesn’t require another medium but gives less flexibility against over-firing.

Make Steam – Look at this as free steam. Adding an economizer and even heating boiler feed water is easy to do. The system can be set-up to make any type of steam you need. You can even superheat steam with added coils or by creating a higher-pressure steam and reducing pressure after it leaves the steam drum.

The Capacity Coil – So, you have hit your furnace limit and are looking to redesign the tubes to try to gain some capacity. However, your redesign has the box getting too hot, the pressure drop too large, or the project too expensive. Add a new coil to the convection section.

Chances are there’s enough heat in your flue gas to heat some of your process. The added coil doesn’t increase pressure drop because it gives the process an additional path (if correctly designed). In most cases, you can add 5%–10% more flow through the new coil.

For any of these projects, the furnace must be in shutdown mode, but you can minimize shutdown time by installing a whole convection section at one time. It’s usually very difficult to remove or rearrange tubes in an existing convection section. Instead, just have a completely new section built and install it as one piece. You’ll save time and money versus tube replacement.

Similarly, when you have convection sections designed, make sure they can be easily bolted and unbolted. In some processes, it’s easier to replace a convection section with a spare than to try to clean the section that’s already in place. Then you have years to clean the replaced bundle at ground level.

GARY FAAGAU is a former *Chemical Processing* Energy Saver columnist. To view his articles and others relating to energy efficiency, visit www.ChemicalProcessing.com/voices/energy-saver

Cut the Cost of Waste Gas Incineration

An RTO often can offer an effective and fuel-efficient option

By Dan Banks, Banks Engineering, Inc.

A REGENERATIVE thermal oxidizer (RTO) burns very lean waste gases without using much fuel. If an RTO can be used, it's always more fuel-efficient than any other type of oxidizer. Operating temperature is about the same as a normal thermal oxidizer (say, 1,600°F) but the hot flue gas passes through a heat exchange module before reaching the stack.

The module is an insulated box full of heat exchange media, usually ceramic packing. At least two modules are used — one absorbs heat from the flue gas while the other sheds heat into the waste gas (Figure 1). When a box has absorbed all the heat it can, it's taken offline; waste gas then passes through it backwards until the box is cool again. Once cooled, it's returned to handling hot flue gas. Two boxes are needed so the flue gas always has a path to the exhaust stack — specialized valves set on a timer switch each box from heating to cooling every 5 minutes or so.

In this way, if one pound of waste gas enters at 70°F, one pound of flue gas exits at 200°F. With other thermal oxidizer designs, the pound of flue gas may exit at 500°F or 1,600°F — a lot more heat is lost up the stack. If the waste gas is lean, most of this heat comes from firing auxiliary fuel. The popularity of RTO units stems from the desire to cut such fuel costs.

THE BASICS

Waste gas incinerators react oxygen with waste hydrocarbons at high temperature to produce a clean flue gas. A perfect incinerator would have a destruction and removal efficiency (DRE) of 100%, zero fuel usage and zero emission of carbon monoxide and nitrogen oxides. A small amount of the original hydrocarbons always remains, though. If 1% is left, the DRE is 99%. Some CO and NO_x always are produced, too. However, NO_x emissions are lower for an RTO than for almost any other type of thermal oxidizer. Table 1 compares various options.

The U.S. Environmental Protection Agency and local air boards require DRE values from 95% upward, and CO and NO_x emissions measured in the "tons per year" range. Fuel usage is up to the operator but more fuel means higher operating cost and more greenhouse gases, so lower is better.

For good DRE values, furnace temperature must be high enough, residence time of the flue gas in the furnace must be long enough and 2% to 3% O_2 must remain in the flue gas leaving the stack. Stack temperature doesn't matter — furnace temperature is all that's important.

For most incinerators, furnace temperature is 1,400°F to 1,600°F. Higher temperatures require more expensive refractory to avoid heat damage. Furnace

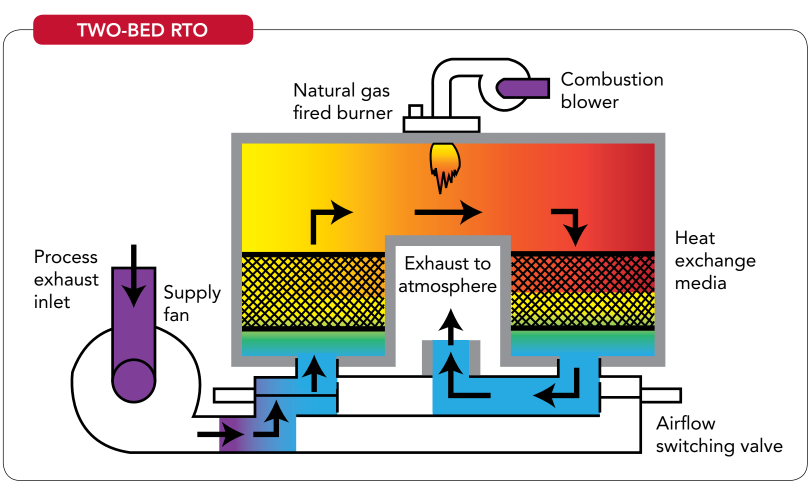
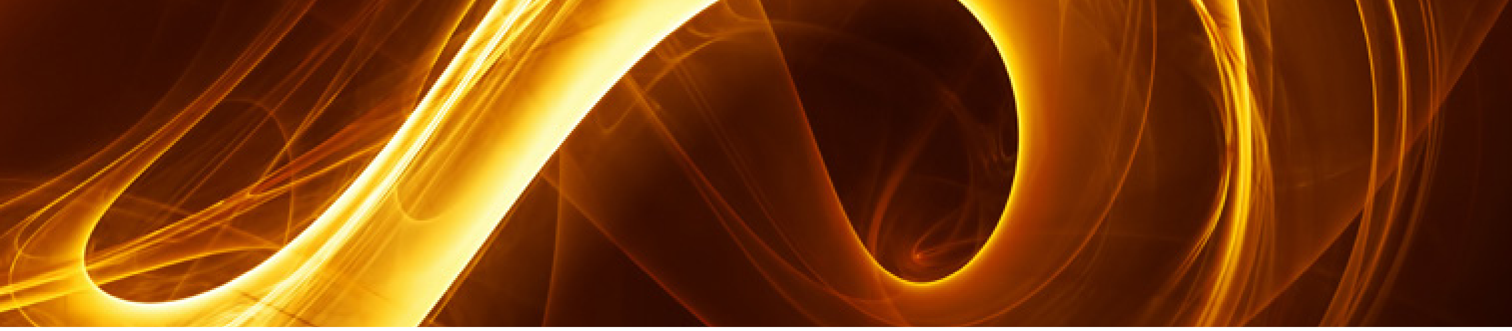


Figure 1. Heat exchange media alternate between heating and cooling. *Diagram courtesy of CMM Group.*



residence time typically is 0.5–1 seconds. Hydrocarbons that are hard to burn, like pesticides, may require more time. Oxygen content usually is about 3% or more by volume; as low as 2% O_2 might be OK. If the waste gas is "dirty air," it will contain all the oxygen needed. Otherwise outside air has to be added.

If the waste gas is relatively rich with hydrocarbons, a simple "direct fired" thermal oxidizer with a small burner will do the job. In this case, heat recovery is unnecessary but you can add a boiler if you need steam for process heating or to generate electricity.

Lean waste gas, in this situation, may require a large burner. That means some sort of heat recovery will make sense, because the cooler your stack gas, the lower your net operating costs. An RTO recovers heat very efficiently.

LIMITATIONS

While an RTO is the most fuel-efficient oxidizer, it doesn't suit all applications:

- A waste gas with entrained particles or droplets may cause fouling of the heat exchange media. In-place cleaning of the media is difficult or impossible. Fouled media means pressure-drop and efficiency problems. A direct fired oxidizer would be better.
- An intermittent waste gas requires idling or shutting down the RTO when waste isn't flowing. It can take several hours to heat an RTO system for operation. A direct fired oxidizer probably would be better.
- Too rich a waste gas may lead the RTO to be too efficient, resulting in furnace temperatures that can cause refractory damage. If the waste-gas heating value significantly exceeds 20 Btu/ft^3, an RTO is a bad choice. Most RTO designers want waste gas no richer than 25% of the lower explosive limit.
- A waste gas containing chlorinated hydrocarbons, like methyl chloride, or sulfur bearing compounds, like hydrogen sulfide, will form a stack gas that might

AVOID COMMON RTO MISTAKES

Most RTO problems stem from incorrect application of the technology:

- Waste-gas heating value is higher than expected. The RTO overheats without major changes to the system (e.g., removing packing or installing hot or cold bypass). This may cause premature ignition of waste or even flashbacks to the process.
- Waste-gas heating value is lower than expected. RTO fuel usage will be high. The fix requires addition of heat exchange packing, which may be limited by chamber dimensions.
- Waste gas has unexpected particulate matter. Simple dusts will block gas passage through the heat exchange medium but can be vacuumed off. Reactive particles can bond to the medium, ruining it and, thus, requiring bed replacement. Combustible particles may collect in the medium and light off, causing thermal damage. Waste gas filters might be needed.
- Waste gas flow is greater than expected. Pressure drops through the RTO system may require larger blowers or different heat exchange medium.
- Waste gas flow is intermittent, with rapid startups required. From a standing start an RTO system can require several hours of heat-up. Abrupt flow or heating value changes cause temperature excursions and higher stack emissions.

Other RTO problems involve operating and maintenance practices:

- Nuisance shutdowns tempt operations to use automatic restart logic. Stay with manual restarts to catch potential safety problems and avoid disaster.
- Maintenance takes shortcuts. Using the wrong type of replacement thermocouple, leaving access doors loose (leaky) and other casual mistakes can result in elevated emissions, thermal damage or worse.
- Staff doesn't pay due care with the waste-gas gathering system. Spilling solvent under a process vent collection hood can convert the low-Btu waste gas into a high-Btu hazard for the RTO.
- Seasonal plant operating changes are ignored. Fuel usage can creep up. So, review RTO bed switching times. They affect heat recovery and fuel usage.
- The refractory lining is neglected. It doesn't last forever. Look for developing hot spots so you can schedule repairs to avoid unplanned shutdowns.

produce acid droplets if cooled enough — keep in mind that an RTO provides cooler stack gas than other types of oxidizer. If acid droplets are expected, you may need special construction, driving up cost.

The sidebar summarizes some common mistakes in RTO selection and operation.

TYPICAL CERAMIC BLOCK

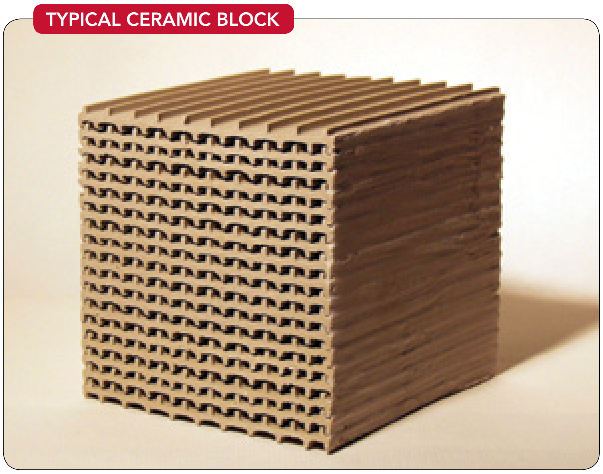


Figure 2. Structured packing requires smaller volume than random packing for the same heat transfer. *Source: Lantec.*

THE ROLE OF PACKING

Directing the lean waste gas through a packed bed enables its temperature to be brought close to the target furnace temperature using only residual heat left in the bed by the hot flue gas. Sometimes this results in the waste gas hydrocarbons igniting on their own, achieving a further rise in temperature. While an RTO furnace always has a fuel gas burner, with good design fuel gas consumption might be zero during normal operation.

Without heat exchange packing, an operating RTO would perform like an ordinary incinerator — fuel usage to reach the needed furnace temperature would be high with a lean waste gas. More bed packing lowers fuel gas needed or raises furnace temperature reached.

If the beds were never switched, an RTO would perform like an ordinary incinerator — the hot flue gas would heat the bed it's flowing through to the flue gas temperature and the lean waste gas would draw all of the heat out of the other bed. Fuel consumption would be high with a lean waste gas. Shorter bed switching time reduces fuel gas needed or increases furnace temperature reached.

The flow and composition of the waste gas determine bed size and packing type. You must use enough packing to absorb the heat from the full flow of stack gas — once a layer of packing is heated to combustion chamber temperature, it can't pick up any more energy so another layer must be added. The designer sets the pounds of packing in each bed according to the rate of stack gas flow and the time the bed is absorbing heat before it's switched. The type of packing used is an economic decision — random packing is cheaper but structured packing (Figure 2) takes up less room for the same amount of heat transfer.

Bed construction and the flow and composition of the waste gas dictate bed switching time. For greater heat-transfer efficiency, switching time needs to be shorter. But with larger beds switching time can be extended because there's more packing to absorb the heat. Every time the beds switch, a small burst of unburned waste gas flows to the stack; a high required DRE mandates longer switching times, which results in larger packed beds.

VARYING QUALITY GAS

A waste gas that usually is lean but occasionally can be richer demands special attention, as waste gas with more hydrocarbons requires less heat recovery to maintain low fuel-gas consumption. To reduce the heat recovery efficiency of the system, you can remove bed packing — but this is difficult. So, in such situations, units generally rely on either cold gas bypass (CGB) or hot gas bypass (HGB) to divert some gas around the heat recovery section of the RTO. With CGB, part of the cold waste gas is ducted directly to the furnace; with HGB, part of the hot furnace exhaust is ducted directly to the stack.

CGB and HGB also are used to keep the furnace from reaching an excessive temperature, which could cause permanent refractory damage or require specification of a different refractory grade. A typical high-temperature-shutdown set point might be 1,800°F.

HGB gives a higher stack temperature than that for most RTO designs. Special stack construction (stainless or refractory-lined carbon steel) may be required to avoid damage.

During normal operation RTO furnace and stack temperatures vary over a narrow range. This is because when the beds switch the waste gas entering the furnace (and the furnace gas entering the stack), they now are flowing through the alternate bed. The waste gas suddenly is hotter because it's flowing through the bed recently in contact with the hot flue gas. The flue gas suddenly is colder because it's flowing through the bed recently cooled by the incoming waste gas. If the beds switch every 5 minutes, the flue gas and combustion chamber reach their "average" temperatures approximately 2.5 minutes after the switch.

DIFFERENT DYNAMICS

In a direct fired incinerator increasing the fuel flow results in hotter stack gas within 5 seconds to 10 seconds. In an

TYPE	WASTE TYPES	HEAT RECOVERED?	STACK TEMPERATURE, °F	MAXIMUM DRE, %	HEAT RECOVERY METHOD
Direct fired	Any gas or liquid	No	1,200–2,200	98–99.99+	None
Catalytic	Lean waste gases	Yes	≈500	95–99+	Metal gas/gas heat exchanger
Recuperative	Lean waste gases	Yes	≈500	95–99.9+	Metal gas/gas heat exchanger
Boiler	Any gas or liquid	Yes	350+	98–99.99+	Boiler and economizer
RTO	Lean waste gases	Yes	200–300	95–99+	Packed beds

Table 1. An RTO provides the lowest stack temperature.

RTO increasing the fuel flow to the burner immediately heats the furnace — but the stack gas temperature rise is delayed by the heat absorbed in the packed beds. The higher RTO furnace temperature puts more heat in the packed bed receiving the flue gas. At the end of the cycle that bed is hotter than at the end of the previous cycle; when the waste gas is switched back into it the waste gas temperature entering the furnace will be higher than in the previous cycle. The stack temperature as well as the furnace temperature will swing around an average value as the bed switching proceeds. In fact, a step change in fuel flow may require several cycles of bed switching to reach stable average stack and furnace temperatures.

This type of delayed response happens with any variation in RTO operation, including changes to waste gas flow, waste gas hydrocarbon content, burner fuel or air flow, and CGB or HGB flow.

DESIGN CONSIDERATIONS

As we all know, every pound of waste gas, air or fuel gas entering must be matched by a pound of flue gas out the stack and every Btu entering the RTO (as sensible heat due to a heated waste gas or as hydrocarbon heat release) must show up as a Btu in the stack gas or as heat loss through the vessel shell. What happens in the packed beds or the switching valves is important for saving fuel but, taken as a whole, "what goes in has to equal what comes out." So, for instance:

- If it's impossible to feed enough air to produce around 3% oxygen in the stack gas, then the RTO can't operate as intended.
- If the measured stack temperature is higher or lower than predicted by the Btu balance, then some other input isn't being considered — maybe the waste gas is richer or leaner than expected.

Given a specific waste gas, air flow, fuel gas flow and heat loss through the vessel refractory and insulation, you can calculate the stack gas flow, composition and temperature even if nothing is known about the bed packing, switching times, bypass flow or any other detail.

RTO design involves eight steps:

1. Perform a heat and material balance on the waste stream, including minimum/maximum flow, minimum/maximum hydrocarbon load, etc. Determine if any of the cases excludes use of an RTO — for instance, is the waste-gas hydrocarbon load so high that a different type of incinerator would make more sense?
2. Specify the packing types and amounts, along with the bed switching times to achieve the heat recovery efficiency needed for all operating cases. Packing vendors can provide these calculations for their products.
3. Size the combustion chamber, stack, inlet ducting, any bypass ducting, etc.
4. Size and specify the waste gas blower, fuel gas burner and combustion air blower.
5. Specify the type and amounts of refractory lining and external insulation.
6. Prepare the process and instrumentation diagram and process flow diagram(s).
7. Put together specification sheets for purchase of blowers, burners, instruments, etc.
8. Prepare fabrication drawings, parts lists, operating instructions and other documentation.

AN ATTRACTIVE ALTERNATIVE

An RTO provides the highest fuel efficiency of any type of waste-gas thermal oxidizer and, thus, may allow you to cut costs for incineration. However, it isn't best for all services, so you must understand its limitations. When an RTO is the right choice, you must then consider its particular design and operational issues. ●

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HarbisonWalker International and Emisshield®: Providing High Emissivity Coatings Solutions for Process Heaters

DEVELOPED BY NASA and used in hundreds of various kinds of furnaces worldwide, Emisshield® is a proprietary, high emissivity refractory coating that is proven to increase efficiency, reduce emissions, prevent oxidation and corrosion, and reduce maintenance in a process heater. HarbisonWalker International (HWI) is the lead distributor of Emisshield High Emissivity Products in North America. HWI also provides in-house installation services for all Emisshield coatings. The partnership has spanned more than 10 years and is successfully working in numerous industries including, glass, petrochemical, power generation, and iron and steel. Through increases in combustion efficiency, HWI customers using Emisshield are cutting fuel usage, increasing production, and saving costs.

The Emisshield product was originally developed by NASA to protect space vehicles, including rocket nozzles and the next generation shuttles. In these applications, the coating is designed to modify the surface of the substrate on which it is placed to increase the emissivity, and therefore the amount of energy radiated from it. In space applications, temperatures can range from sub-zero to over 3000°F in a matter of seconds. On rocket nozzles, the coating sheds heat quickly to prevent deformation of the metal that would cause a rocket to be thrown off-course. The Emisshield coating was designed to maintain adhesion and not lose its emissivity under these conditions. Because it is used on space vehicles, Emisshield is a Space Certified technology. Emisshield comes in a variety of formulas designed to adhere to various substrates, whether it be refractory or metal alloys. Most versions are applied just 2-3 mils thick – the thickness of a garbage bag – and are capable of operating at temperatures up to 3500°F.

Emisshield has been licensed from NASA by Emisshield Inc. for industrial applications. One of the most effective applications is for process heaters, such as reformers, crackers, or boilers. Emisshield can provide several benefits to these types of units. The high emissivity of the coating at high temperatures can significantly improve the efficiency of a furnace by decreasing fuel consumption, increasing production, reducing stack temperatures, and reducing heat loss through furnace walls. Emisshield can also provide an impermeable, pin-hole free coating on the surface of a substrate, preventing corrosion and/or oxidation damage. In addition to these functions, Emisshield can reduce maintenance in a variety of places within process heaters.

To understand how high emissivity coatings work in a furnace, a quick review of the effects of emissivity is important. Emissivity is measured on a scale of 0 to 1; 0 being a low emissivity, 1 being high. An emissivity of 1 is known as a theoretical black body; nothing currently exists that has this emissivity. A surface with a very low emissivity will be very reflective, like polished metal or a mirror. High emissivity coatings should be in the 0.85 to 0.95 range at a given temperature. Materials with these properties are known as gray bodies. Many materials, including refractories, might have a high emissivity at room temperature, but have a lower emissivity as temperatures increase -- as low as 0.2 to 0.5. Higher emissivity surfaces exhibit higher absorptivity, higher radiance, and lower reflectivity. Absorptivity is the amount of energy absorbed into the surface, radiance is the amount of energy radiated from a surface, and reflectivity is the amount of energy reflected in identical wavelengths.

When applied to the interior of a process heater's walls, high emissivity coatings absorb more energy, but also radiate more energy. This energy has to be radiated to a cooler body; in this case, the process tubes inside the furnace. Furnace atmospheres often have another limiting factor. A typical combustion atmosphere can only carry energy on limited bandwidths. This limits the amount of energy transmitted from the atmosphere to the load. It is also one reason why low emissivity walls are not ideal. With a higher reflectivity, those identical wavelengths would be transmitted back to the load, not creating any additional energy transfer. But by modifying the surface with a high emissivity, the energy is absorbed and reradiated to the load more effectively. These factors have big effects on the furnace: 1) more energy is transferred to the load in the radiant section, 2) the surface temperature of the refractory walls are reduced, and 3) less energy is lost through the stack and walls.

High emissivity coatings can also improve the efficiency of process tubes in the radiant section. New or recently cleaned tubes usually have a rather low emissivity, which means they have a low absorptivity and high reflectivity. Having a low emissivity limits the amount of energy that can be absorbed, reducing the heat flux through the tube to the product. In this case, radiance is not a factor because there is nowhere with a cooler temperature for the energy to radiate, so all the energy will be conducted through the tube. As the uncoated tube is used in service, it will eventually develop an oxidized layer that will have a high emissivity and bring the heat flux up. But this layer continues to develop over time. It will eventually become an insulating layer that reduces the heat flux again and must be cleaned of these layers. Using Emisshield will give the tubes a high emissivity from day one of operation, providing added efficiency through a higher energy flux on the tube walls. In addition, Emisshield even prevents oxidation buildup, almost eliminating any need for cleaning the tubes.

Because more energy is transferred to and through the process tubes, one or two things must be done to maintain the proper temperature of the product: the burners can be turned down and/or the feed rate can be increased. Depending on how much of either of these is done, a fuel savings or an increase in production of 5-10% can be realized. Other modifications to the furnace may be necessary as well, like closing the damper 10%, to ensure proper operation of the unit. The increase in radiation from the surface of the refractory results in a reduced surface temperature on the refractory, therefore reducing the energy lost through the lining. In many cases, the exterior temperature has been reduced by as much as 30°F making catwalks safer for employees to work on. Because more energy is transferred to the load, stack temperatures are effectively reduced, further illustrating the added efficiency. Consequently – due to the added efficiency – there is a reduction in amount of NOx, SOx, and CO_2 produced per unit of product made. Companies concerned about, or limited by, emissions can take advantage of high emissivity coatings to increase production, while decreasing emissions.

As noted, Emisshield can prevent oxidation buildup and corrosion damage. There are three different methods of how Emisshield accomplishes this effect. The standard method, used in the above scenarios, simply resists oxidation by adhering to the substrate with a matte-like finish. Although not completely impermeable it does prevent oxidation of the substrate. This can be taken a step farther by selecting a version of Emisshield that sinters to form an impermeable, glaze-like barrier. This sintered effect is pinhole-free and stops gasses from passing through preventing corrosion. For products with this feature, it must be fired to 1500°F for one hour. This could be longer or shorter, depending on the size or complexity of the pieces. Non-sintering Emisshield products do not require any special heat treatment prior to operation. The last method is by using a thermal-spray or flame-spray method, this product is known as ThermEShield. With this method a pre-sintered coating is applied to the substrate that does not require any special firing schedule. Both the sintered Emisshield and ThermEShield can prevent corrosion of metals or refractory. This was tested on a metal substrate by subjecting samples to a highly sulfurous atmosphere for 500 hours at 1100°F. Non-coated samples experienced heavy corrosion, whereas the samples with sintered Emisshield developed no corrosion at all between the substrate and coating.

Many of these effects of Emisshield also have secondary benefits on the maintenance of a furnace. Refractory Ceramic Fiber life can be increased significantly due to the reduced surface temperature. This reduces shrinkage and prevents devitrification of the fibers. Shrinkage can lead to gaps in the insulation and devitrification creates dust inside the unit that builds up on tubes in the radiant and convection sections, reducing the heat flux through the tubes. This dust must be cleaned out occasionally, but using Emisshield will eliminate this.

Another effect reducing major maintenance in processes that crack hydrocarbons is a reduction in the buildup of coke (carbon) inside the tubes. This buildup is caused by hotspots on the tubes where the coke slowly builds up, slowing the process down until the unit is shut down for several days to have the tubes cleaned. Using Emisshield on the tubes helps do disperse the heat more evenly over the surface of the tube, eliminating or reducing hotspots. In one case, a customer had to shut down for 3 days every 9 months to de-coke; after applying Emisshield they only had to shut down every 25 months.

Applying Emisshield to burner parts, metal or refractory, has been known to significantly extend their life. Just like the refractory walls, there is a reduced surface temperature that helps to extend the life by reducing. For metal burners the sintering effect can prevent damage caused by corrosion. A great example of this is in black liquor recover boilers used at paper mills. The conditions in here are extremely corrosive and burners are frequently replaced. Emisshield-coated burners can last 2-3 times longer.

There are many advantages to using high emissivity coatings like Emisshield, including increased efficiency, oxidation and corrosion protection, and reduced maintenance. Emisshield is unique in its ability to exceed temperatures of 1700°F and up to 3500°F, maintain a high emissivity at high temperatures for extremely long durations, and sinter to form an impermeable barrier. The cost of the product is very affordable such that the return on investment is typically less than one year, but the benefits can be seen for at least 5 years.

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For more information, visit HarbisonWalker International at http://thinkhwi.com

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