F.S. SPERRY
REFRACTORIES EXPERTISE SINCE 1946

Refractory Installation and Maintenance

Recommendations and Case Studies for Maximizing the Value of Your Heat Processing Equipment

From the refractory experts at F.S. Sperry

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Introduction

Refractories might not be exciting, but they are a vital component of industrial manufacturing; they're used in just about every type of industrial process that utilizes heat.

The tremendous volume of choices for different types of refractories results in a wide range of potential outcomes.

The right choice can lead to the safe, low-maintenance and cost-effective protection of vital industrial heat-processing equipment for a 5- to 10-year period.

The wrong choice can lead to downtime, equipment failure and accidents that place our friends and colleagues in harm's way.

Understanding the difference between the two isn't something you learn overnight. Yet as the years pass, we're finding that we're encountering more competitors who don't have the proper expertise and experience to do the job "the right way."

We love talking about our craft, because it's more than just a job to us. We hope that you find our guide interesting and valuable.

—The Team at F.S. Sperry

5 Common Misconceptions About Refractories

For many industrial plant engineers and managers, selecting and installing refractories in a new construction project (or during maintenance of important heat processing equipment) are almost an afterthought.

Industrial engineers and plant managers are often overworked, and many don't have any formal training about refractories. This often causes them to place the "refractories portion" of the project at the end of the Gantt chart or "To Do" list, treated as an expense . . . to be minimized any way possible.

This thinking can cost industrial facilities tens of thousands to millions of dollars in lost productivity and maintenance over a 2 to 5-year period.

The Value of Refractories

Refactories have been referred to as the "backbone of industry," because they're used during the heat and chemical processing of all commodities. Our cars, buildings, transportation infrastructure, utilities, and many products and services couldn't be created without the use of refractories.

Refractories provide:

- **Protection of Capital Investments**

  Industrial heat processing equipment such as boilers, kilns, furnaces, incinerators, gasifiers and dryers can be multi-million dollar investments. Refractories protect

them from thermal damage and can extend their lifespan, and thus the return on capital invested in them.

Protection for Workers

Refractories also play a significant role in protecting industrial workers from serious or fatal injuries. Industrial heat processes can routinely create temperatures in excess of 2500 degrees Fahrenheit, and are used to protect workers from extremely dangerous heat conditions.

Protection Against Lost Production

When they require maintenance, or worse yet, fail, factory downtime can create significant sales losses; for some plants, one day of downtime can cost the company over a million dollars in revenue. The proper choice of refractories can serve as an insurance policy against downtime.

Surprising Misconceptions About Refractories

Even though refractories are extremely important components of any industrial heat processing operation, the industry is filled with misconceptions about refractories. It's not uncommon for industrial construction contractors who don't specialize in refractory contracting to use the wrong materials and the wrong application process, without the plant engineer ever knowing.

If you're preparing for a new construction project, or are looking to optimize your existing heat processing equipment, here are 5 concepts to remember:

01. Refractories are NOT standardized products.

It's a challenging task to teach young managers and engineers at industrial heat processing facilities that refractories are not homogenous materials. There are very general classifications of refractory product types, including:

- Fireclay and high alumina refractory bricks
- Fireclay and high alumina plastic refractories and ramming mixes
- Zircon refractories
- Silica refractory brick
- Castable refractories, alumina and alumino-silicate

- Chrome, chrome-magnesite, magnesite-chrome and magnesite brick
- Insulting firebrick

Within these general, high-level classifications, there are a multitude of different combinations, including variations of chemical content, weight, PCE value and modulus of rupture value.

02. Refractories are consumable, and must be replaced.

Refractories WILL wear out. They're like the brakes or tires in your car—protecting you, until they fail. Understanding the maintenance and repair schedules of your refractories *at installation* will help extend their life, and work to prevent accidents, downtime and equipment failure.

03. Water is water.

An inexperienced contractor might use dirty water when mixing a castable. Could this cause a problem? Absolutely. Water containing suspended solids can modify the composition of the castable, leading to possible premature collapse or failure. The general rule of thumb is to use drinkable water when mixing a castable.

04. Refractories made by different manufacturers are identical.

Refractory products of the *same type* often *vary* from manufacturer to manufacturer. What might appear to be similar products might have different chemical compositions, so only an experienced refractories engineer should select refractory products for your installation.

05. Weather doesn't affect castable refractories.

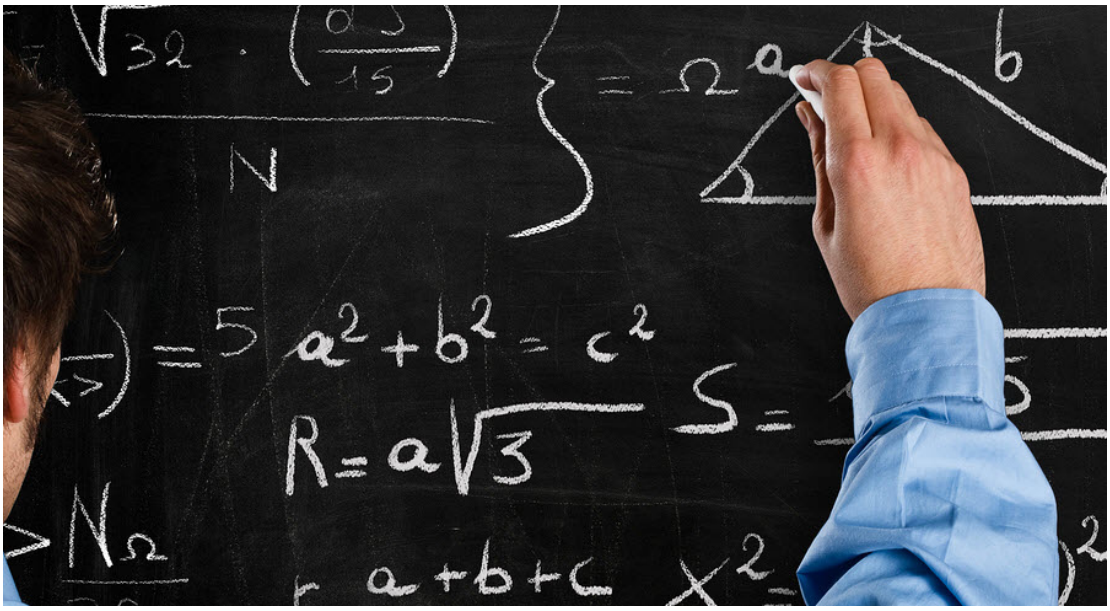
Cold temperatures affect the ability of castables to bond, and have a direct effect on the performance and the integrity of the installed lining. Precautions must be taken during the mixing, installation and storage of castables by the contractor.

Keep these points in mind the next time you're considering new construction, or refractory repair or maintenance. Refractories are *not* a commodity, and refractory selection is not a "one size fits all" process.

Careful consideration and care will yield the best long-term results, for your people and your company's bottom line.

Refractories Primer: 3 Things Every Plant Manager Should Know

If you're new to refractories, there are a few important things to know about them before you begin making product selections or installation decisions.



First, here are the basics. The term "refractory" refers to a variety of materials that are non-metallic and heat resistant. Refractories are used in a number of heat processes, including boilers, furnaces, ovens, kilns, gasifiers, incinerators and dryers. Not only must refractories withstand significant stress caused by heat and corrosion by chemical agents, they must also be able to contain substances at those high temperatures as well.

Refractories can be a substantial investment for many industrial facilities, either in new construction or for repair work. While the refractory products and installation may only comprise a portion of the entire budget for a new factory construction project,

they protect expensive equipment, keep production online and protect your people and facility, so their value is far greater than their cost (as long as you choose the right materials for your application along with the right application method.)

Here is a more detailed discussion of the 3 things to know.

Temperature

Think about the average and peak temperatures in your manufacturing processes. Refractories are used with heating applications that generate temperatures over 1000°F all the way up to approximately 3000°F.

This leads to three different classifications of refractories based on temperature:

- Normal refractory—These are typically fire clay and used for temperatures up to 1780°F, which cover processes such as melting aluminum
- High refractory—These are typically cromite-based refractories for temperatures from 1780–2000°F, which cover processes like melting copper
- Super sonic refractory—These are typically zirconia-based refractories for temperatures greater than 2000°F, which cover processed like melting iron

Depending upon what you will be using the refractories for, and the application of the materials, there may be different requirements that your company may have in order to get the right materials

Chemical Composition and Resistance

Refractories also have to be resistant to the chemicals that will be released during the manufacturing process. There are many different types of materials that can be utilized in combination with one another to create refractories that can stand up to different chemical processes.

Refractories are always going to be nonmetallic, as metallic refractories are not able to stand up to the high temperatures that most refractories must undergo. Natural materials are most commonly used, but synthetic materials can added to the blend.

Careful consideration must be given to the chemical interaction between the refractory and the other materials being heated, since chemical breakdown in a refractory can cause catastrophic failure.

- **Acidic refractories** consist of acidic materials like alumina and silica. Acidic refractories aren't affected by acids and include substances such as silica, alumina and fire clay brick refractories. They are affected by basic refractories though.
- **Neutral refractories** are used when the slags and atmosphere are either acidic or basic and chemically stable to both acids and bases. Alumina (Al_2O_3), chromia (Cr_2O_3) and carbon from the R203 group typically comprise neutral refractories.
- **Basic refractories** are used on areas where slags and atmosphere are basic. These are stable to alkaline materials but could react with acids. Magnesia is a very common example, along with dolomite and chrome-magnesia.

Size and Shape

Refractories come in many different shapes and sizes. The size and shape are dependent upon how they are going to be used. Typically, refractories are going to be one of three different types of refractory materials:

- **Bricks** are going to be utilized in most furnaces
- **Fiber blanks** for linings
- **Monolithic refractories** that can be shaped depending upon how it is going to be used

Science + Art

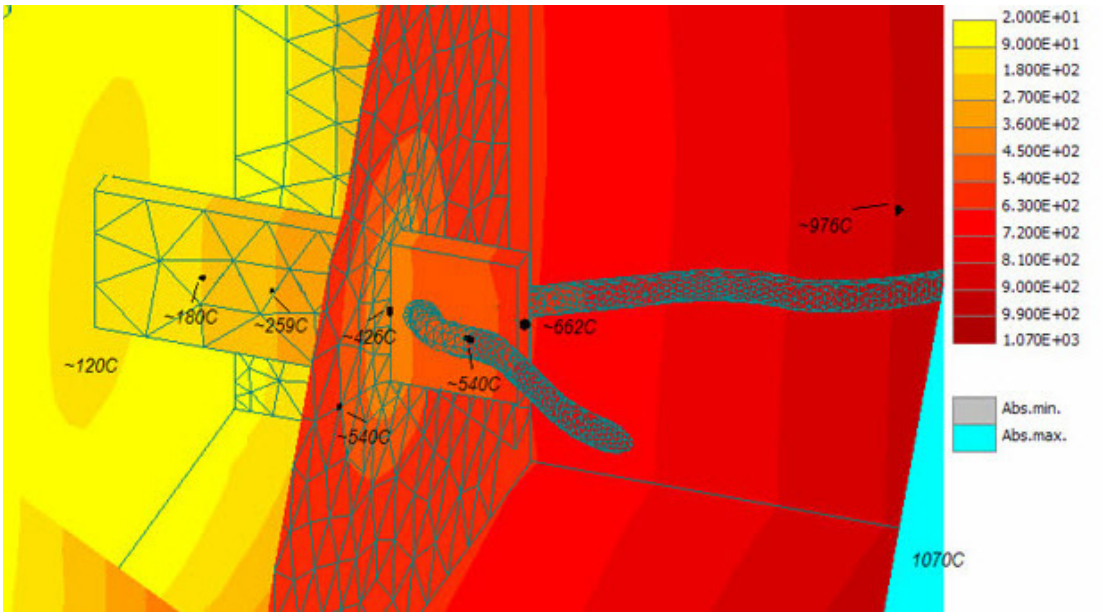
While there's a tremendous amount of science behind the matching of refractories to production processes and installation methods (which is discussed in more detail here), we like to think that there's also some art involved with it as well.

Many big manufacturing companies end up with custom refractory ingredient combinations that are created specifically to provide the right protection for their particular application. Refractories have come a long way in the past last few decades due to years of research and scientific progression, and optimizing refractory performance has become important for manufacturers' bottom lines.

If you own a small to midsize production facility, or are a part of an engineering team for an international corporation, we can guide you through these advances and show you how to find the best solution for your refractory application.

A Primer on the Basic Physical Properties of a Refractory Product

A refractory's physical properties are listed on its data sheet and provide an indication of how the refractory should perform under different operating conditions. While technical data sheets should never be considered as the only basis for selecting refractory, the refractory's physical makeup is an important element to consider.



Let's take a look at the properties:

01. Bulk Density

The Bulk Density of a refractory is the ratio of weight (or mass) to volume. It's expressed in pounds per cubic foot (lb/ft^2) or kilograms per cubic meter (g/cm^3).

02. Cold Crushing Strength

Often referred to as CCS, Cold Crushing Strength measures the maximum stress needed to crush a refractory sample to structural failure in compressive loading. CCS is measured, according to ASTM C133, on typically a 2″ cube. Cold crushing strength of a refractory material is an indication of its suitability for use in refractory construction. (It is not a measure of performance at elevated temperature.) CCS measures the mechanical strength at room temperature. It is not indicative of mechanical strength at operating temperature. Also, high CCS values don't necessarily translate to better resistance to load deformation.

03. Modulus of Rupture (MOR)

The MOR indicates the refractory's tensile strength, that is, MOR evaluates failure with the loading in tension. It is determined by supporting a refractory across a span and using a testing maching to apply load at a specified rate until the refracotry breaks. It's calculated at room temperature. A higher temperature calculation is called a hot modulus of rupture.

04. Apparent Porosity

Apparent porosity in a refractory is reported as a "percentage apparent porosity" that represents the volume fraction of pores present. A higher porosity refractory will typically have excellent insulating properties but a lower strength, density and resistance to corrosion. A lower porosity refractory will typically be stronger, with less resistance to corrosion, but it can lower the thermal shock resistance.

05. Thermal Shock Resistance

A refractory typically endures rapid and extreme temperature changes. These fluctuations create thermal stresses within the refractory that can cause rapid expansion or contraction of a section of the material. There are two common tests used to measure thermal shock resistance: the loss of strength test and the prism spalling test.

In the loss of strength test, a sample is cycled five times from room temperature to 2200 degrees F. MOR is then performed on both cycled and uncycled specimens, and the "percent loss of strength" is calculated by subtracting the MOR of the cycled sample from that of the uncycled sample. This test is repeated on an average of 5 specimens. The lower the percent loss of strength, the better the thermal shock resistance.

In the prism spalling test, refractory samples are cycled from 2200 degrees F for 10 minutes, to water for 2 minutes, to air for 8 minutes, until the samples have broken or have undergone 40 cycles. The higher the number of cycles, the better the material's thermal shock resistance is.

Be sure to only compare data from the same test method.

06. Reversible Thermal Expansion and Permanent Linear Change

A refractory will expand when heated and contract when cooled. Most data sheets contain a thermal expansion curve graph, which depicts the expansion rate at specific temperatures. Different materials expand at different rates. When cooled, the refractory could end up larger or smaller than the original dimension. Reheat tests for each class of refractory will display the permanent linear and volume change.

07. Thermal Conductivity

This is a measurement of the amount of heat which flows from the hot face to the cold face of a refractory lining. The heat flow is inversely proportional to the thickness of the wall, and is directly proportional to the conductivity value of the refractory, the temperature drop from the hot face to the cold face, the area of the wall, and time.

There are several different methods for measuring thermal conductivity, so make sure to compare the results of the same test methods during a comparison.

Standard load tests place a refractory in a furnace with a load applied, which is then heated and cooled. The new sample is measured and compared to the dimensions of the original sample.

08. Abrasion Resistance

It's common for a refractory to be exposed to moving materials in a furnace, including abrasive dusts and rapidly moving gases. Strong and well-bonded materials provide the greatest resistance to abrasion. The most common method of measuring abrasion resistance subjects a refractory to an impinging stream of silicon carbide grain, with the volume loss measured after the test and expressed as volume (cc) loss. Again, only compare abrasion resistance from the same testing method.

Data Sheets Are Just One Piece of the Puzzle

The content of this post is geared toward those interested in technical details. Just be sure to remember that data sheets are only one part of the “big picture” that you need to consider when selecting refractory material. There are many other variables about your particular project and environment that are just as crucial to the final selection. We’d love to share our years of experience with you, so give us a call if you’d like our input.

How to Choose the Best Refractory Material

We commonly hear engineering and maintenance managers tell us, "I want to use the latest technology" or "I want to use the best refractory material."

It's a logical request, right?

And there's been some buzz in our industry over the past few years about new refractory materials on the market such as gunite and shotcrete technologies that incorporate colloidal silica or other similar binder systems. And in the right applications these are really good materials.

We appreciate buzz about new refractory products, but we've been noticing that it's causing some of our prospects and customers to ask for (or in some cases, demand) a specific product.

And in some cases, that's a mistake.

It's About the Application, Not the Material

Let us start by stating that there's no single "perfect" refractory material. There are many well-engineered refractory products that are ideal for some applications, but a poor fit for others.

The focus should be on the best material for the specific application. Because the application is what matters most—even more so than the material. Naturally time and cost come into play.

Let's take a look at an example. In the next photo, the material on the burner wall was installed via shotcrete by another contractor. It lasted 3 years next failing.

The next photo shows the same type of burner wall in a similar facility, but it uses rammed plastic instead of shotcrete. F.S. Sperry installed this rammed plastic over 11 years ago. It's still holding strong in 2015.

Both shotcrete and rammed plastic are good materials. But on the surface, someone starting in our craft would probably consider shotcrete a better material than rammed plastic. It's a common conclusion, but the above example shows:

> Though rammed plastic is not considered "the best" refractory material technologically, it far and away outperformed shotcrete in this application!

Beware of the Hype

Setting up shop as a refractory contractor isn't difficult. There are plenty in our industry who have come and gone over the years. But staying around is difficult.

One thing to watch out for when reviewing contractors in our craft is the contractor who universally pushes a specific material for most applications. They may be genuine in their promotion of a new high-quality material, but if that's all they do, they're going to recommend it for every application, right?

Neither the contractor nor the customer understands what's happening at the time: the contractor is recommending a new material, and the customer wants the best material, so all is good, right?

And then the refractory underperforms or worse, fails, and nobody understands why.

If we recommended using rammed plastic instead of high-tech shotcrete or castable, an inexperienced plant manager might feel like we're not offering him the latest technology and best material. But keep in mind that sometimes, hype is short-lived. Since many contractors no longer know how to properly ram plastic, there's no hype about it.

Rammed plastic wasn't sexy or cutting edge for this customer, but it was clearly the "best" refractory material for their application. Just like they requested.

Takeaways

1. Research your material options fully—particularly with regard to lifespan in your specific application.
2. Be leery of contractors who focus on a single material or single application type. We call them one-dimensional contractors.
3. Decide what you want to spend.
4. Work with a team who understands a wide variety of materials and application methods to find the best material and price combination for you.

Of course, we hope you'd reach out to us and let us help you select the best material for your application.

Choosing the Best Refractory Material for an Aluminum Furnace

For our aluminum customers and prospects (primary, secondary, smelters) we're frequently asked a new, but old, question, "What is the best refractory material for an aluminum furnace?"

With over 68 years of experience, we've worked with all of the prominent manufacturers for aluminum resistant materials, not to mention the first-hand knowledge of how these products perform "in the field" which is really where it counts!

We all know refractory is engineered to contain molten aluminum, but which material is best? Well, that depends.

There are several tests that are useful and these are addressed below; however, the answer is subjective and honestly depends on many variables. Are we talking corrosion resistant/below the metal line, at the metal line (belly-band), upper walls/ roof or sills and ramps?

For example, a material that performs well in corrosion resistance (below the metal line) is usually very dense with low porosity. This type material usually has poor thermal shock properties. Plus many of the additives used in corrosion testing have

temperature limits which may preclude their use at and above the metal line where temperatures are higher. The corundum growth, mechanical abuse and fluxes make this an even more difficult problem.

What are the expectations? What is the budget? What are the operational factors? What are the specific "problem" areas?

Use Tests to Work Through the Variables

There are many contributing factors that go into determining "the best" material: furnace cycle, metal throughput, temperatures, alloy, fluxes, cleaning/maintenance procedures, aluminum alloy, aluminum supply, combustion and combustion by-products to name a few. These are all important.

Although the initial answer may come from the molten aluminum test, it may require multiple tests.

There are three (3) generally accepted molten aluminum test methods for evaluating refractories for use in aluminum furnaces, but remember these primarily address corrosion:

- The "Cup Test" (originally developed by ALCOA)
- The "Immersion" test
- Test Furnace Method

The Cup Test

The standard ALCOA cup test is run at 1700°F for exactly 72 hours with 7075 alloy aluminum.

- This temperature is chosen because the aluminum is very fluid and active.
- This alloy is chosen because it has been historically a very corrosive alloy with high magnesium and zinc which allows for several reactions.
- Any reaction will generally occur within 72 hours.
- The standard cup test was designed to simulate actual furnace loading practice. A "cup" is cast from the chosen refractory material. The refractory cup is pre-fired and the molten aluminum added. This assures direct contact with the refractory. There are several variations of the cup test that can be run based on your aluminum alloy to "zero-in" on a suitable refractory.

The Immersion Test

The second method is the “Immersion” test. This test can be run at variable temperatures/time. ALCOA’s standard is 1700°F for 7 days, ALCAN’s standard is 850°C for 96 hours. As the name suggests the refractory is “immersed” in a bath of molten aluminum alloy.

The Test Furnace

The final method is a test furnace lined with various refractories. The furnace may be only a few cubic feet in capacity. As you can imagine, this is rather expensive compared to the other two tests. This type of test is usually carried out over several weeks or even months. Again, the temperature and alloy may vary to simulate actual field conditions.

Regardless of the test method, the results are analyzed in the same manner, that is, the amount of penetration and degree of reaction with the refractory. Each of these tests has its merits and drawbacks. For most the cup test is quick, simple and effective. The immersion and furnace test are larger, more complex and costlier. They require maintaining a molten bath and this is a major drawback; however, many aluminum producers prefer these two methods for final approval of a new refractory material or change in furnace design.

Test Results + Field Experience for the Best Results

The above tests are good for materials below the metal line where corrosion is the main concern; however, they may not be as good for what goes on above the metal line.

The furnace conditions at and above the metal line are more complex and more difficult to address. Temperatures are elevated. Thermal shock must be considered as well as corundum growth and operational factors.

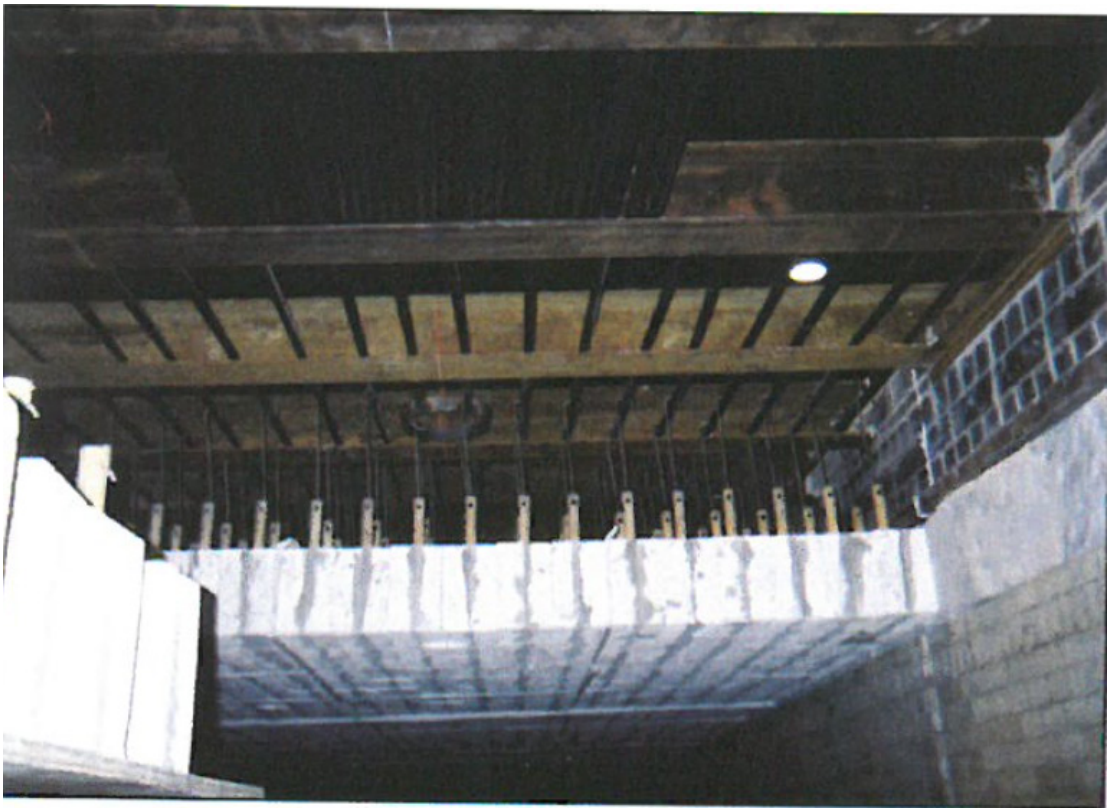
Last, there are researchers developing tests for this area but most of these tests are not yet proven, add complexity to the test itself and increase the difficulty to recreate results.

Currently it is our opinion that it’s better to look at multiple tests along with field experience to find materials that perform well in several environments as opposed to testing for one attribute which can be expensive and not meet your overall expectations.

Foamfrax RG Instead of a Low-Temperature Board System

It's not uncommon for the best solution for our customer to be different from what they originally asked for. Our engineers' high level of experience, knowledge and skills allows us to consider a far wider range of solutions and present options the customer might have not even been aware of.

Since real-life examples are always helpful, here's a case study from one of our projects. Our customer had us engineer and install a suspended brick roof for a tunnel kiln that operated at 2100 degrees Fahrenheit.

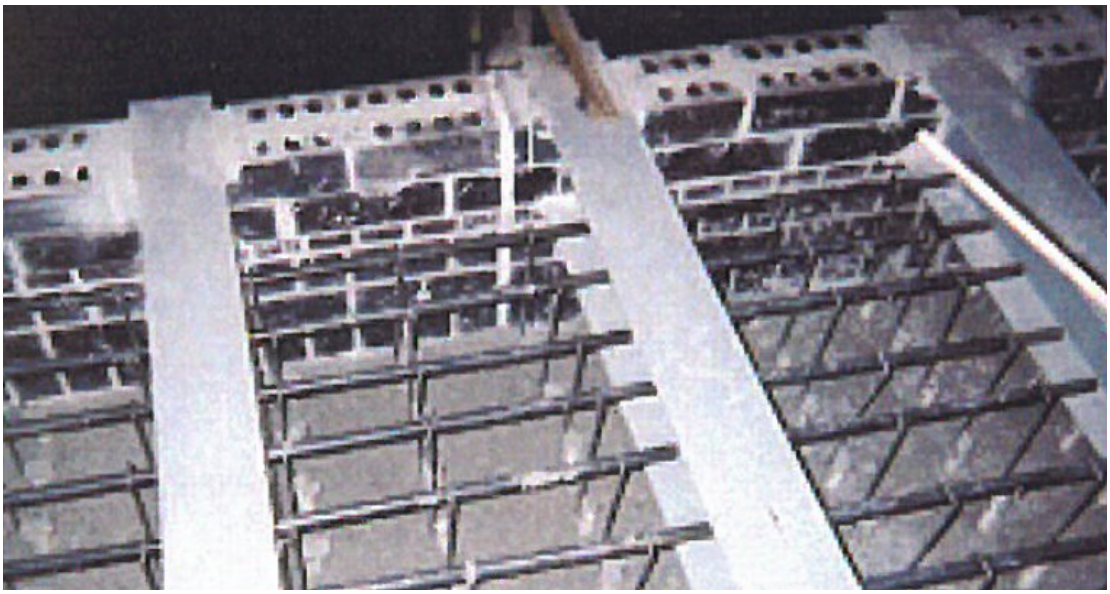


A low-temperature board system was specified as backup insulation behind the brick crown. Note that the tiles are suspended from structural I-beams using a ceramic/alloy hanger system.

Here's a closer look:

If we had followed through with installing the board system as specified, it would have required cutting through two layers of board to accommodate each anchor. That's a labor-intensive task.

Instead, we suggested using Foamfrax RG by Unifrax as a viable alternative. The Foamfrax RG was easily installed around the ceramic/alloy hanger system assuring a good seal with minimal joints.



This alternative to the original job specifications provided our client with:

- Lower Installation Costs

  The Foamfrax RG Insulation system was installed in ⅓ of the time that would have been required to install the board backup system.

- Better Thermal Efficiency

  The Foamfrax RG Insulation monolithic system provided a one-layer backup lining system without joints and heat leaks, increasing the overall lining thermal efficiency.

- Less Job Hassle

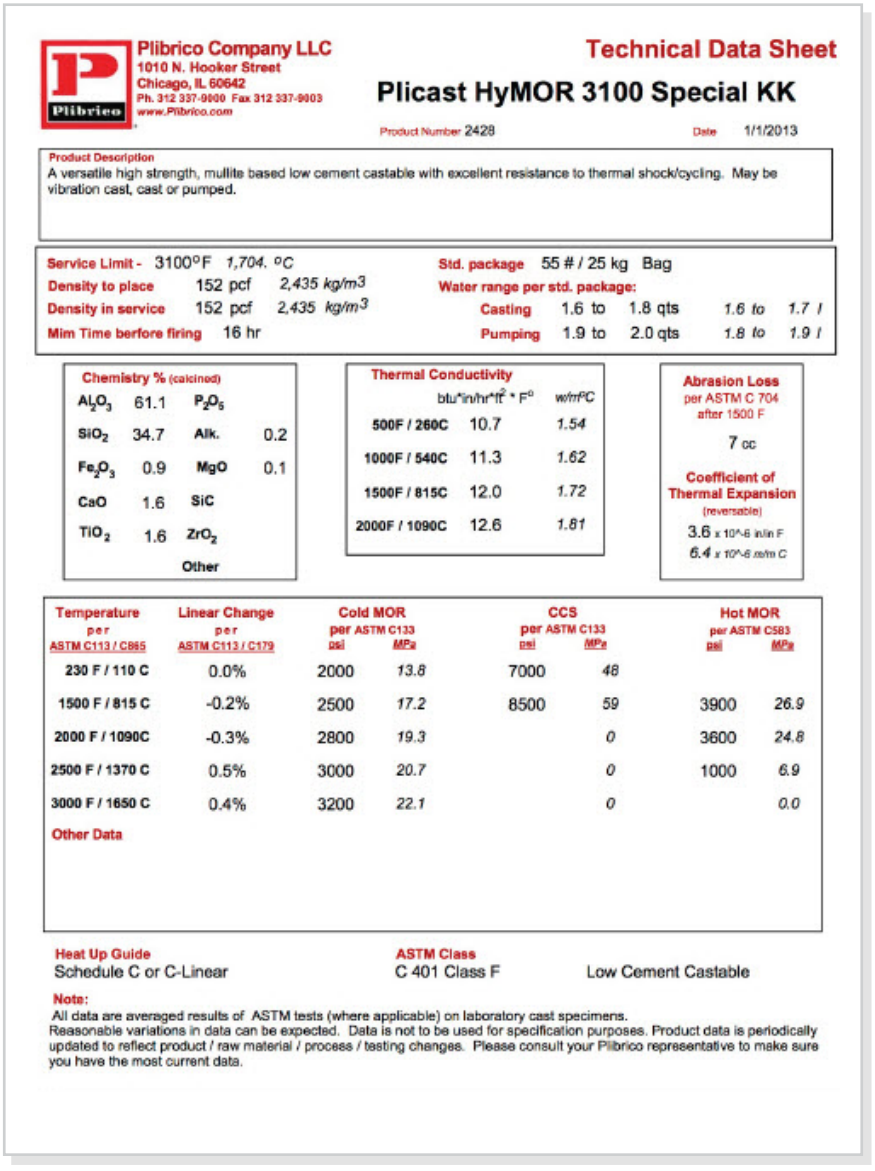
  F.S. Sperry Co. is a specially trained Unifrax distributor/contractor and was able to supply engineering, materials, equipment and installation as a complete package.

F.S. Sperry has been in the refractory business for over 60 years. That kind of experience can really pay off for customers—both in dollars saved and in peace of mind. If you have a challenging project, talk to us—it may be that you have more options than you think.

Interpreting a Refractory Technical Datasheet

Today we're going to share a datasheet and discuss how we evaluate them.

Let's start out by reviewing a datasheet. This is for Plibrico's Plicast HyMOR 3100 Special KK. (And thanks to our partner Plibrico for contributing to this post).



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Technical Data Sheet

Plicast HyMOR 3100 Special KK

Product Number 2428 Date 1/1/2013

Product Description
A versatile high strength, mullite based low cement castable with excellent resistance to thermal shock/cycling. May be vibration cast, cast or pumped.

Service Limit -	3100°F 1,704. °C	Std. package	55 # / 25 kg Bag
Density to place	152 pcf 2,435 kg/m3	Water range per std. package:	
Density in service	152 pcf 2,435 kg/m3	Casting	1.6 to 1.8 qts 1.6 to 1.7 l
Mim Time berfore firing	16 hr	Pumping	1.9 to 2.0 qts 1.8 to 1.9 l

Chemistry % (calcined)

Al_2O_3	61.1	P_2O_5	
SiO_2	34.7	Alk.	0.2
Fe_2O_3	0.9	MgO	0.1
CaO	1.6	SiC	
TiO_2	1.6	ZrO_2	
		Other	

Thermal Conductivity

	btu*in/hr*ft² * F°	w/mºC
500F / 260C	10.7	1.54
1000F / 540C	11.3	1.62
1500F / 815C	12.0	1.72
2000F / 1090C	12.6	1.81

Abrasion Loss per ASTM C 704 after 1500 F
7 cc

Coefficient of Thermal Expansion (reversable)
3.6 x 10^-6 in/in F
6.4 x 10^-6 m/m C

Temperature per ASTM C113 / C865	Linear Change per ASTM C113 / C179	Cold MOR per ASTM C133 psi	Cold MOR per ASTM C133 MPa	CCS per ASTM C133 psi	CCS per ASTM C133 MPa	Hot MOR per ASTM C583 psi	Hot MOR per ASTM C583 MPa
230 F / 110 C	0.0%	2000	13.8	7000	48		
1500 F / 815 C	-0.2%	2500	17.2	8500	59	3900	26.9
2000 F / 1090C	-0.3%	2800	19.3		0	3600	24.8
2500 F / 1370 C	0.5%	3000	20.7		0	1000	6.9
3000 F / 1650 C	0.4%	3200	22.1		0		0.0

Other Data

Heat Up Guide
Schedule C or C-Linear

ASTM Class
C 401 Class F

Low Cement Castable

Note:
All data are averaged results of ASTM tests (where applicable) on laboratory cast specimens. Reasonable variations in data can be expected. Data is not to be used for specification purposes. Product data is periodically updated to reflect product / raw material / process / testing changes. Please consult your Plibrico representative to make sure you have the most current data.

There's a lot of good information here, but the first thing to remember is that data sheets are not product specifications! Data sheets present a variety of "typical" product physical and chemical characteristics, and are useful to group or compare available refractory products.

As you can see from the above example, data may be presented as an average or a range and subject to "normal" sampling and testing variations including:

- Test method / procedure
- R&R (repeatability and reproducibility)
- Size of the available data base

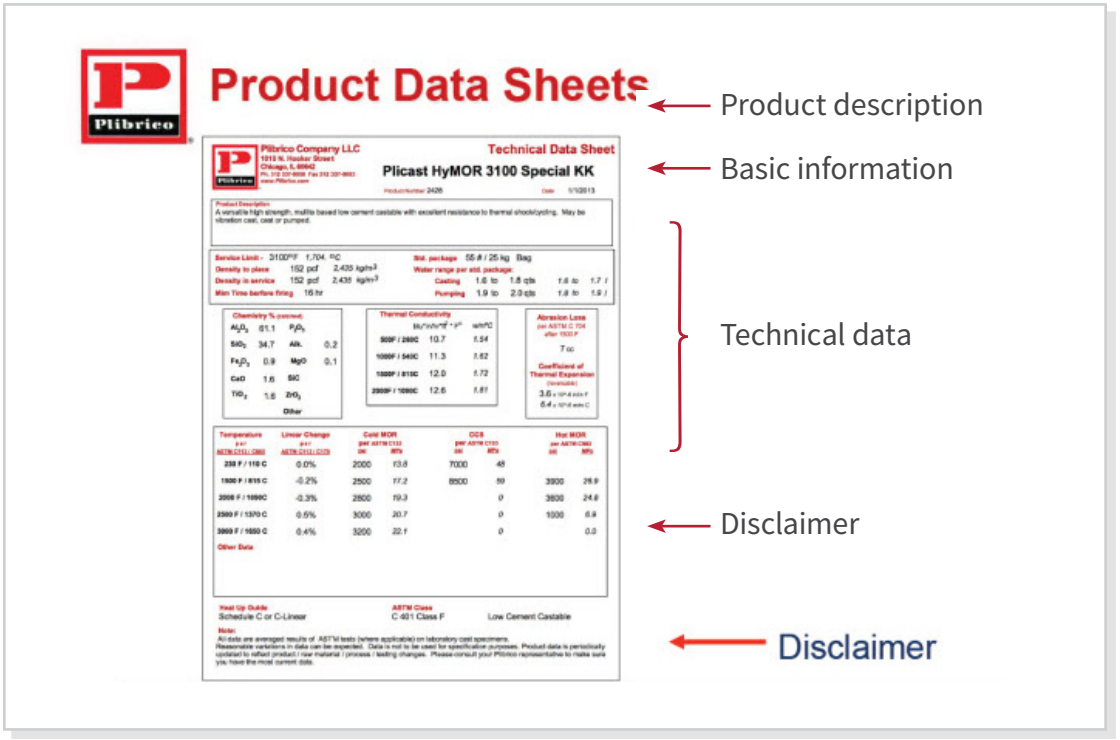
We follow the same approach as the Plibrico engineers for evaluating data sheets in the refractory selection process, starting the basics, which includes and evaluation of:

- Chemical Analysis
- Mineralogy
- Service Limit
- Density
- Linear Change
- Thermal Expansion
- Strength
  - CCS
  - Cold MOR
  - Hot MOR
- Abrasion Loss
- Thermal Conductivity

If the refractory passes the basic criteria for its intended application, we then perform the advanced analysis, evaluating:

- Porosity
  - Amount
  - Size

- ASG (apparent specific gravity)
- RUL (refractoriness under load)
- Creep
- Elastic Modulus
- Compressive Strain
- Thermal Shock Resistance
- Fracture Properties
  - Fracture Toughness
  - Work of Fracture



Understanding the Disclaimers

After that, we evaluate the disclaimers. Data sheets almost always contain a disclaimer!

Here are a few examples from real data sheets:

"All data are averaged results of ASTM tests on laboratory prepared samples. Reasonable variations can be expected. Data should not be used for specification purposes."

"This data represents average properties obtained on commercial production lots and should not be considered guaranteed specifications."

"This data contains typical properties only and should not be used for specification purposes. It is intended as a guide only. For specification and estimating purposes, contact your nearest "X" representative."

What?

While these statements make it sound like the data might not be reliable, they're meant to make it clear that you shouldn't rely solely on the technical data. When interpreting a technical datasheet, it's important to remember the following:

- Refractories are in an isothermal condition in very few applications
- Refractory linings exhibit a thermal gradient both through and between refractory layers
- Mineralogy, physical properties and textural characteristics therefore vary through the installed refractory thickness

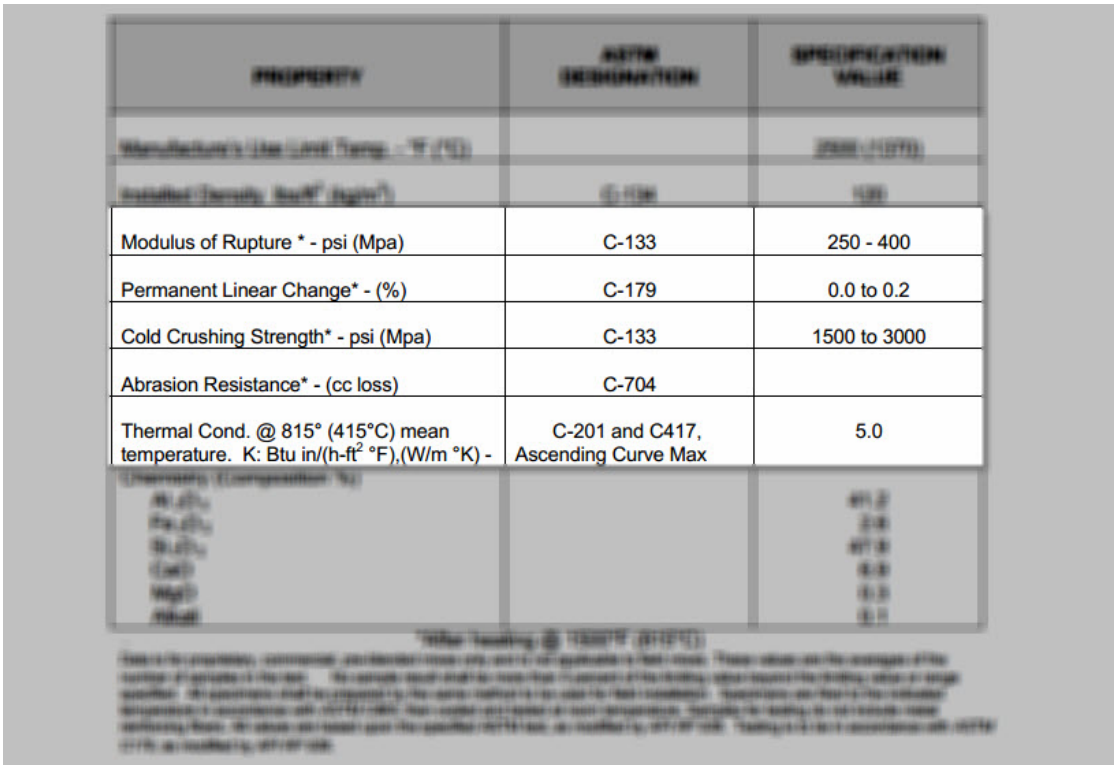
As we mentioned in a previous post, the data should be evaluated along with all of the other relevant factors before making the final decision.

If you're currently reviewing datasheets for a future application and would like some guidance interpreting the data, give us a call or connect with us online.

Refractory Technical Datasheets Don't Tell the Whole Story

Refractory technical datasheets are important. They provide relevant data that should be considered in the overall process of selecting a particular refractory for a specific application.

Technical datasheets list the physical properties of the refractory and the pertinent testing results, as well as the chemical makeup of the material. While they are important, technical datasheets should never be considered as a stand-alone reason for selecting a refractory.



PROPERTY	ASTM DESIGNATION	SPECIFICATION VALUE
Modulus of Rupture * - psi (Mpa)	C-133	250 - 400
Permanent Linear Change* - (%)	C-179	0.0 to 0.2
Cold Crushing Strength* - psi (Mpa)	C-133	1500 to 3000
Abrasion Resistance* - (cc loss)	C-704	
Thermal Cond. @ 815° (415°C) mean temperature. K: Btu in/(h-ft^2 °F),(W/m °K) -	C-201 and C417, Ascending Curve Max	5.0

The Difference Between Projected Performance and Performance in Service

While many refractory products may appear to apply to a specific installation application on paper, the results in service may vary dramatically. One of the problems with relying solely on datasheets when deciding on materials to use is that datasheets don't often take into account all of the other factors that will affect the refractory performance, from environmental and structural/mechanical factors to the specific fuels used, all of which will contribute to the refractory performing as intended.

This is especially true in molten metal applications, where liquid metal is in contact with the refractory surface. While some refractories may appear to apply on paper, the actual results may be very different—even disastrous.

One of the biggest misconceptions is the temperature limits of a refractory. Just because the technical datasheet might show a refractory in-service temperature up to and exceeding 3000 degrees F, it does not mean that the refractory will necessarily function at those temperatures under load.

Other factors may also affect the eutectic of that refractory, whereby material that seemingly should function at 3000 degrees F could actually fail at much lower temperatures.

Technical Datasheets Are Simply a Data Point

The competent refractory contractor knows how to incorporate technical datasheets into the overall scope of the project and use them to help select the material that is best for the application.

It's not a good practice simply to select a refractory based on its datasheet. They're a data point, but not the entire story.

Make sure to consult with your refractory installer before making the final selection.

Expansion Joints for Installation of a Castable

If you're having a castable installed, your refractory contractor's ability to properly calculate for expansion is essential to obtaining the expected life of the refractory. It's never fun to learn this the hard way—improper calculations can force you to replace material far too soon after installation and incur downtime and replacement costs.

New Materials Need New Calculations

In the old days, it was common to use certain “rule of thumb” expansion calculations when installing refractory products. That’s changed today, due to the creation of new refractory materials and a stronger understanding of how these materials react under different types of heating and cooling conditions.

The castables produced today (and even plastics) do not exhibit the “creep” that was inherent in older versions of these materials. Basically, the older materials were less rigid and had more give to them, which allowed them to compensate during thermal expansion. Many of the newer materials are more rigid, because raw materials today are more pure and significantly denser. This causes them to be more rigid at operating temperature, making it more critical to have accurate expansion calculations when creating a thermal lining.

Two Types of Expansion

There also is some confusion in our industry regarding the different types of expansion. The two main types are:

- Permanent linear change
- Thermal expansion

Permanent linear change results from a dimensional change after the initial bakeout. This is a one-time phenomenon that occurs when the material returns to ambient temperature. These figures are contained in the refractory’s product data sheets and can be either positive or negative, depending on the material and the temperature to which the material was baked out.

Thermal expansion is different because it is expressed in inches per inch per degree Fahrenheit. This means that a material could exhibit a negative permanent linear change but still exhibit expansion during bakeout or at operating temperatures. Accurately forecasting thermal expansion is part art and part science; calculations need to consider whether the castable is being installed on a wall, roof, or hearth, and in an enclosed or unenclosed area, because all of these factors affect the net change.

The 4 Parameters for Calculating the Expansion Joint

To calculate the allowance for expansion joints in castable refractory construction, the following five parameters must be evaluated:

1. The coefficient of expansion of the material to be cast, which is a known constant
2. The permanent linear change of the castable
3. The temperature that the castable will be subjected to
4. The length of any dimension of a cast that is being restrained

Always Ask Questions!

The goal of this explanation is not to teach you how to accurately calculate the proper expansion joint for your installation; that is far beyond the scope of this short article. Instead, our goal is to give you some background regarding the importance of expansion joints and some of the key factors that your refractory contractor should be evaluating prior to installing your castable.

Ask these questions before your job starts, or even before you select your contractor. There is a lot of confusion in the industry about expansion, and improper calculations can cost you a lot of money down the road.

Shotcrete vs. Gunite vs. Pump Casting vs. Casting

Misconceptions About Refractory Installation Methods

I'm amazed at how many times we've met with a potential client where another refractory contractor has told them something off the cuff like "you need to shotcrete this" or "you need to pump that" … without taking the time to actually go through the proper steps to evaluate the best method for the application. This usually happens because the other contractor is limited in their offering.

That's like telling someone who drives an SUV to buy off-road tires—without determining what they drive, where they drive and how they drive it!

There's a lot of chatter out there in our industry, and sometimes partial explanations or incomplete evaluations can lead to the incorrect installation method, the wrong materials, or higher costs than needed.

Some of that chatter is causing plant engineering and maintenance teams to think they are behind the curve by not shotcreting or pumping their furnace lining.

Please don't fall into this trap! The best installation method depends entirely on the specifics of the job.

If you're considering a refractory application that requires a monolithic castable refractory, there are essentially four main installation methods:

- Casting (or vibration-casting)
- Pump casting
- Shotcrete
- Gunite

Which one is the best for your project? Well, it depends. We wish it was simple, but the truth is, there are many factors that influence the decision for the best application method (and ultimately the best installation) including:

- Location and site conditions
- Environmental factors & installation equipment
- Volume required
- Storage conditions
- Skill of installation team
- Bake-Out (curing) requirements
- Budget

Refractories are not a commodity, and the proper installation method for your job requires a careful evaluation of the details of your project.

To start, let's take a quick look at each installation method.

Casting

Casting is a fairly straightforward method of mixing and pouring (casting) wet castable into forms. The forms hold the castable in place until it's set, and then they're removed.

Pump Casting

Since refractory castable is fluid, most types of castable can also be pumped to the location where it's needed. Typically, pneumatic truck or trailer-mounted line pumps equipped with pipe and hoses are used to convey large volumes of material to a specific location.

Gunite

Gunite is a dry monolithic refractory designed for use with dry gun equipment. It usually includes additives to make it stickier. Gunite is applied by a special machine that uses air to push the dry (or pre-dampened) gunite through a hose and to the target. Water (or additive) is added at the nozzle to moisten the dry mix so it sticks to the surface.

Shotcrete

Shotcrete is typically a low-cement, low-moisture refractory that is fully tempered and mixed with water (or special additives), and then applied through a machine that uses a piston pump and air to spray the wet material from a nozzle like gunite.

Choosing the Right Method

When considering each method, think of them as tools in a toolbox. Sure, all methods may work; however, one method may be better for your current application, and another method might be better for a future application.

Assuming you've selected the best refractory for your specific application, consider each of the following elements and how they apply to your job:

Location and site conditions

Where in the furnace is the refractory being placed? Are there obstacles to go around, over or under? How high is the location for the application? Are you going to be starting and stopping often? Are you going to need to move the equipment around?

If you can set up right at the furnace, boiler, etc, then casting may be the best method and usually provides the application with the best physical properties and the least potential equipment issues.

Installations at higher elevations have other considerations. In many applications, gunite is easier to use, especially at higher elevations, and the equipment and dry castable can usually fit in an elevator or be easily lifted to where it is needed. Pump casting and shotcrete can also be a good solution for high locations, if the pump has enough energy to get the material to the desired elevation, the pipe and hoses can reach the desired spot, and it can handle the volume of material needed.

In the right application and environment, shotcrete works extremely well. The advances in technology have increased dramatically in the last few years.

Environmental factors & installation equipment

How clean does the environment need to be around the application? Is dust a factor? Are there plant operational issues to consider? What types of safety requirements are required?

Although the general properties of each material may be similar, each castable is engineered to be installed via its respective method. That is to say, shotcrete material is engineered and manufactured to be installed via shotcrete, gunite material via gunite, etc. Some companies advertise their materials may be both cast in place or by gunite, but generally in practice most materials cannot be cross-installed with equal results.

Volume required

Pump casting and shotcrete can deliver greater volumes faster than regular casting or gunite; however, you must be prepared to accept the large volume of material, otherwise it doesn't help you. Also, you have to consider waste. Gunite application is typically 2 to 5 tons an hour. Shotcrete is the fastest and can typically be applied at 5 tons (or more) an hour.

Storage conditions

The length of your job, quantity of materials, available storage for materials and the physical space required for the equipment and materials at the job site are also important factors.

Skill of installation team

Pump casting, gunite and shotcrete typically require more experience than casting. Is the contractor manning your project with company people or a crew of travelers?

Bake-Out requirements

Many refractory materials have different bake-out (curing) schedules that can impact your overall project schedule. Don't forget to consider this in planning your overall outage. You do not want to cut corners here!

Budget

The cost of the materials (assuming similar physical properties) is relatively equal, but the size of the project can affect the materials cost because of waste. For example, for pumping or shotcrete, waste doesn't impact the materials cost in a job with 20 tons of material, because waste in the hose and pipe is insignificant. However, waste can be significant in a job requiring only a few tons of material—sometimes adding an additional 30% to 50% of material cost.

The main cost differentiators are equipment and labor. High-quality pump casting equipment is expensive. Shotcrete equipment is expensive, but the cost can be mitigated by the high volumes. Gunite equipment is relatively inexpensive and readily available.

In addition, pump casting and shotcrete both add the element of potential equipment issues that must be taken into consideration. An example might be turnarounds where more than one pump may be required on the job as a back-up, in case one pump goes down.

As you can see, there's no "one-size-fits-all" application. Selecting the appropriate method is like choosing the perfect tool for a job.

But don't let the application method distract you from the most important decisions: selecting the right refractory material and selecting skilled and experienced workers to install it.

If you're not sure which approach to take, talk to us. Our company has installed millions of pounds of material and would be glad to help in selecting the right refractory and installation method for the unique conditions of your project.

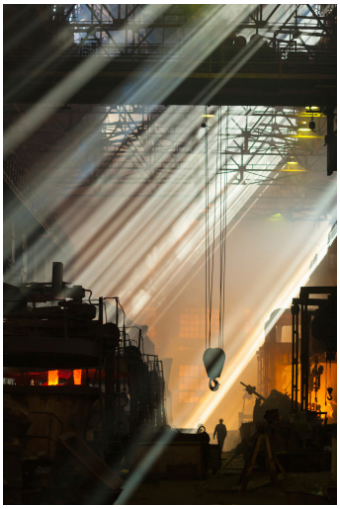
When Traditional Vibe-casting with Large Mixers Beats Pump Casting

Recently, we were asked to attend a pre-bid meeting for a secondary aluminum facility to discuss a project—a rebuild of the hearth, ramp and sill of an aluminum melt furnace.

The purchasing department was leading the meeting, and they had already selected the refractory materials, defined the scope of work and listed all of the specifics of the project. We were told that the refractory would be installed via pump-casting and that installation time was very important.

So far, nothing seemed unusual. Since we were expecting a fairly large-volume placement, we anticipated that job logistics, such as obstacles, plant operations or environmental factors, would dictate that pump-casting was the best refractory installation choice for this job.

Free and Clear Furnace Access Dictated Vibe-casting



After a walk-through and some discussions with the maintenance engineer and production folks, we learned the plant was going to be offline during this project, and there would be free and clear access to the furnace. There would be no lengthy distances to travel, no need to set-up in another area, or no real delivery issues to contend with.

In other words, we could set up directly in front of the furnace with no obstacles, encumbrances or plant production issues to work around. There were also no related environmental or safety issues.

As we continued discussing the scope of work with the plant's engineers and managers, we brought to their attention that—since the plant was going to be down and there was very good access to the furnace—we could set up large-capacity mixers, and place the material directly in the desired area without the need for an expensive pump (and all of its related equipment).

This setup, using vibe-casting, also provided the best physical properties for their selected refractory materials, and still allowed us to meet their time schedule.

By the conclusion of the meeting, the plant's team was convinced of the benefits provided by vibe-casting and decided to select this alternate method.

Experience is Key

The takeaways from this meeting are two-fold:

1. Pump-casting is not necessarily the wrong installation approach. However, it should be considered in the overall scope of the project and the customer's project expectations. This is why it is important to work with an experienced contractor who can provide feedback on your project setup. An inexperienced contractor may just say yes to your plans, rather than being able to add new insight to your project. In fact, some contractors are only comfortable with one installation method—such as pump-casting—so they are incapable of suggesting other options.
2. Industrial purchasing departments serve a valuable function for their company, but they typically lack the depth of knowledge needed to select, organize and determine all of the variables for a refractory project on their own. In this case, the purchasing department focused on the general concept of time (and thus cost) savings that pump-casting would provide. The purchasing department's choice of an experienced contractor—and their willingness to explore other options—led to a successful outcome.

As we always say, refractories are not a commodity. Always talk to the people who have deep experience in all types of refractory installation projects before determining your materials, installation method and scope of work.

How to Choose a Refractory Contractor

Choosing a refractory contractor isn't always a simple job. Refractories can be more complex than most realize—there are refractories based on chemical composition, refractories based on method of manufacturing, refractories based on shape and size, and refractories based on process application.

Refractories are not a commodity, and refractory selection is not a "one size fits all" process.

Selecting and installing refractories is typically the lowest priority for maintenance managers or for manufacturing and plant engineers—refractories end up being the last thing on the Gantt chart or "To Do" list. But that doesn't mean that they're the least important.

It's not uncommon for significant challenges to appear during a typical refractory installation project. These challenges can cause extended plant downtime, which can cost millions in lost production, and worse, safety issues.

What to Review Before Choosing a Refractory Contractor

If you're wondering how to choose a refractory contactor consider the following 7 points to evaluate the balance between quality, initial job quote and total potential job costs:

01. Track Record

Does your contractor have a quality track record? While the refractory contracting industry boasts a number of reputable players, it also is flooded with inexperienced newcomers and part-timers from other industries that jump into the business without proper resources or experience. Beware of the "taillight guarantee"—when support ends as the truck leaves your lot. The next time you call, these contractors may no longer be in business. Ask for a list of verifiable completed jobs across a number of different industries.

02. Service and Support

What type of service and support will your contractor provide? Ask about technical/engineering support, research and development efforts, and other behind-the-scenes capabilities. Get a customer reference list with names and numbers and make some calls; there is no better gauge of a contractor's worth than satisfied or disgruntled customers.

03. Guarantees

Does your contractor stand behind his service and materials? With an eye on their own bottom lines, many less-reputable contractors buy the cheapest available materials. Refractory products should be matched carefully to the application, dependent on the type of furnace or processing unit, operating temperatures, exposure to abrasion, and a range of other variables. Some companies may not use what is necessarily the best for the job.

04. On-Time Completion

Will the job get done on time? Whether refractory work occurs during planned or unplanned downtime, the person in charge of overseeing the project must ensure that operations are not interrupted for an extended period of time. Management and production personnel count on lining repair or replacement being completed in a timely fashion. Make sure your contractor has the resources, in both staff and installation techniques, to handle your project without disrupting your schedule.

05. Safety Record

Does your contractor expose you to unknown liabilities? Just as some contractors cut bottom-line costs with low-grade materials, some may sacrifice safety for profits. This poses a threat to employees of both the contractor and the customer company, either through unsafe installation practices or exposure to hazardous materials. Review your contractor's safety program. This should include comprehensive training for all employees, proper safety equipment, and knowledge of and strict adherence to environmental and safety regulations.

06. Technical Expertise

Does your contractor know what is best for you? Refractories are not one-size-fits-all. What works for a furnace door jamb may not be the best material for a rotary kiln. Because plant engineers and maintenance personnel cannot be expected to keep pace with all refractory technologies, choose a contractor who is experienced and up-to-date on new products and the latest installation methods. These include hot-spot grouting, plastic refractory gunning, and castable pumping. For example, let's say you begin experiencing numerous hot spots on a boiler or furnace wall but absolutely can't afford to stop production for the length of time needed to make the necessary repairs. Can your contractor suggest temporary repair and sealing? Technology now exists with which hot-spots can be detected and repaired online with refractories that are injected through the wall. The material quickly hardens into an air-tight seal. While this process is temporary, such repair work can give old walls several extra months of efficient, cost-effective service until your company is able to conveniently schedule downtime for permanent rebuilding work.

07. Total Lifetime Job Cost

Can you afford downtime later if the job isn't done right now? Refractory repair and replacement does not end when your operation is on line and running again. It must last. Regardless of initial material and service price savings, recurring problems will invariably cost more than a premium job done right the first time. Again, the sure-fire test of a contractor's mettle is the endorsements of past and present customers.

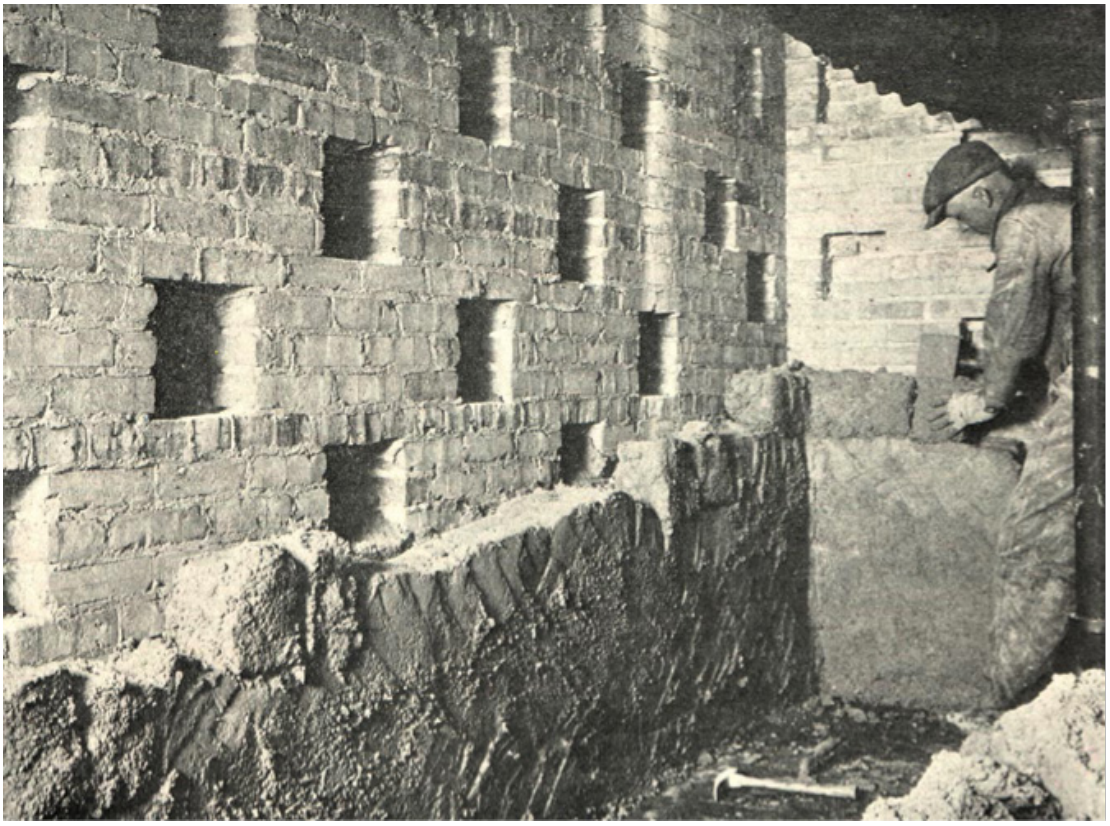
If you follow these steps, the refractory contractor that is the best fit for you should be clear.

Proper Anchor Selection

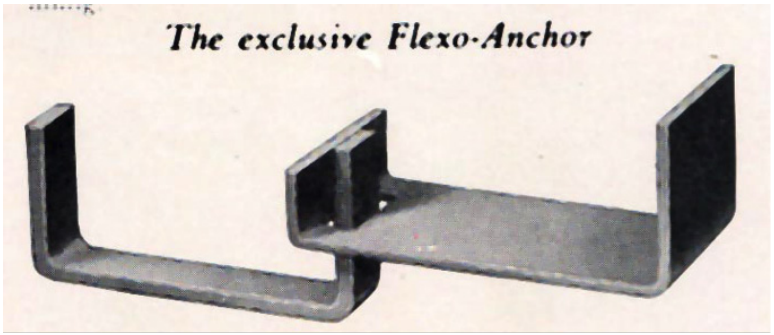
Proper anchor selection and installation is one of the foundations to help assure a successful refractory installation project.

Over 60% of structural monolithic refractory failures are caused by the contractor's (or design engineer's) lack of understanding of proper anchor design and installation.

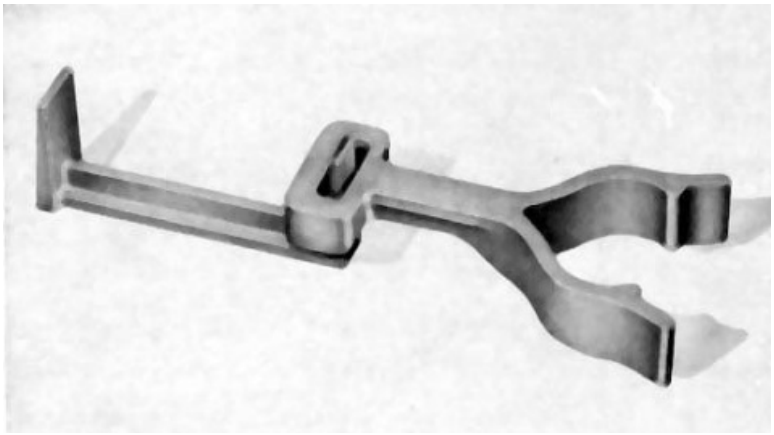
The early twentieth century monolithic refractories were commonly plastic. At that time brick was still the predominant refractory material. The refractory plastic was "anchored" by ramming into pockets created in common brick walls.



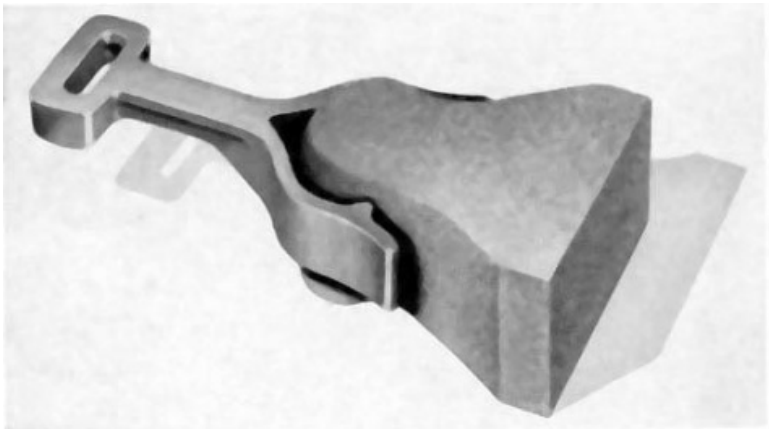
The first “True” refractory anchor was the “Flexo-Anchor” designed and supplied by Plibrico Company. This anchor was designed to allow for movement in two axes.



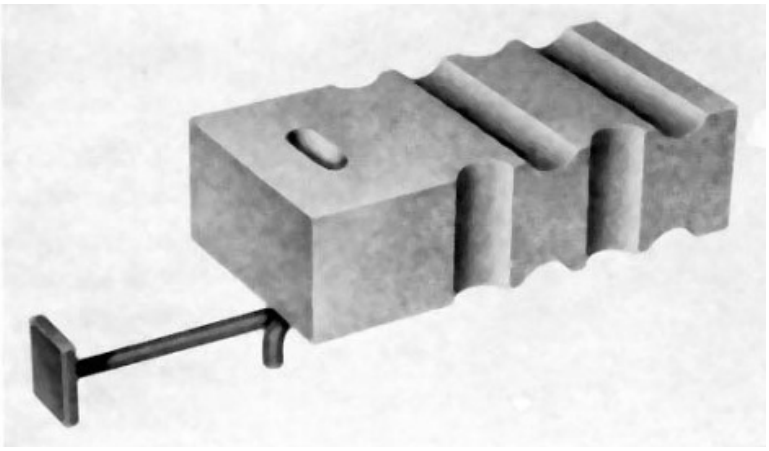
The “Flexo” went through various improvements during the mid-twentieth century.



Ceramic Tile Anchors were engineered into the “Flexo” system.



This ultimately led to the current version of floating Ceramic Tile Anchors.



Anchor Selection

Proper anchor system designs should take into consideration the following:

- Type of refractory (plastic, castable, etc.)
- Installation technique (gunite, cast, rammed, etc.)
- Lining configuration (single, dual, multiple, etc.)
- Operating and interface temperatures
- Geometry of the vessel
- Joints, penetrations, etc.

There are essentially three (3) types of Anchor Systems:

- Metallic (alloy) anchors
  - Cast iron (usually good up to 1000°F)
  - Fabricated stainless steel (good to about 2100°F depending upon grade)
- Ceramic Tile Anchors (can withstand over 3000°F)
- Wall support systems—castings and fabricated stainless steel

With metallic anchor systems the fabricated anchors are primarily used for castables and gunned/shotcrete refractory. There are several types of configurations but predominantly a “V” type shape.

Alloy castings are traditionally used for plastics in low to moderate temperature applications (Flexo-type and arch hangars.)

An experienced refractory contractor should consider all of these important factors and offer the best anchoring system for your application.

Here are the highlights of Ceramic Anchor Systems:

- Used for castable linings where service temperatures are extremely high
- Extend full lining thickness
- Available in various compositions
- Anchor shape & design varies with supplier
- Various attachment systems available (both casting and fabricated)
    - C-clip
    - C-clip & stud
    - Ice tong
    - Casting insert

Here is a typical anchor installation for refractory plastic.

And for gunning or shotcreting (plastics or castable).

Please contact us if we can be of assistance.

If the Instructions Are Right on the Bag, Can Anyone Install Refractory?

Some people think refractories are a commodity. Why do you need an expert installer when the mixing instructions are stamped right on the bag? After all "mud is mud" right? Wrong!

It's a common assumption, and we field a lot of calls from folks who used to think that way. Here are the typical questions we hear:

- Why didn't my castable set up?
- My material set up, but crumbled when the forms were removed. What happened?
- My material isn't strong enough, but the data sheet claimed it should work?

Typically, after performing our inspection, we often find:

- too much water was added during mixing
- the material was not properly vibrated
- the material was vibrated too much
- the wrong type mixer was used
- the forms were removed too soon

The list goes on.

They followed the instructions on the bag… but the instructions weren't enough.

Penny Wise But Pound Foolish

Many purchasing agents are focusing on keeping costs down. Nothing wrong with that, but they often use low-cost labor with little to no training to handle the installation. And they end up paying MORE when something does go wrong, because the job has to be done again. Not to mention the unplanned "downtime" which is never factored into the cost.

We've handled more of these calls than I can ever remember, our advice is simple: Pick a well-trained and experienced installation company from the start. There is nothing "simple" about a material that is expected to work under extreme conditions.

The Nuances of Our Craft

Material manufacturers list the recommended installation procedures (water content, mixing time, setting times, etc.) on the bag based on their best estimates from testing in their labs under ideal conditions. But often the lab cannot reproduce the exact environmental and mechanical elements that exist in the field. That's why the instructions on the bag are often simply guidelines or a range of suggested values.

Sometimes the guidelines work, and other times they don't—not because they are wrong, but because of factors unique to a particular job. You simply cannot place someone at a refractory mixer, give them a measuring cup and a watch, and turn them loose to mix and install refractory. There's a bit of art to our craft.

A well-trained refractory installer must know the basics, but must also know when and how to make changes during installation. When castable refractory is being installed you may commonly hear a trained installer communicating with his "mixing man." You may even hear phrases such as,

Tighten it up!

Loosen it up!

Hold!

You may even see hand signals being used such as the opening and closing of his fist. Other times you might see him snapping his fingers.

This “chatter” and “sign language” during installation from an experienced team is critical. The installer is telling his “mixing man” he needs to tighten up his castable (less water) or loosen it (more water).

Why vary the water content? Maybe it’s raining outside or the humidity is high so the material actually needs less water. Or, it could be just the opposite—extremely hot outside and inside the plant. This type of environment may require more water (within the stated range) for the proper refractory consistency and properties. Or maybe the cast area is thinner and longer behind a form, which requires a slightly wetter material. The list can go on and on.

Building the Foundation

The team at F.S. Sperry believes refractory basics are critical to master. That’s why our personnel (no matter what their position) periodically review our “basic training.” This allows each employee to see how properly installed material looks and what happens when it’s installed wrong or in different ways. We mix and cast panels of castables—one by the book, one too wet, one over-vibrated, etc., to see the results.

We focus on the fundamentals just like a football team focuses on blocking and tackling at the beginning of training camp. We continue training our supervisors and foreman on how to take the proper action based on the different scenarios that arise in the field.

It’s this kind of training and preparation that makes your project successful.

Deciding Between a Sole Proprietor or Full-Service Refractory Contractor

If you're a plant engineer at a large multi-national industrial manufacturer, you probably have the expertise and bandwidth on staff to manage all of the maintenance for your heat processing equipment.

It's common, however, for small to midsize manufacturers to lack the resources or knowledge to take on maintenance and repair projects by themselves.

Because cost is always an issue, this entices some to use a sole proprietor or small specialist firm to handle their refractory maintenance or repair projects. This can be a good decision . . . or a bad one, depending on your situation.

If you're deciding on which type of refractory contractor to use, here's a discussion of different factors to consider before making your decision.

Cost

The sole proprietor will have much lower costs out the door, since you are only paying wages. But don't forget to consider overhead, management time and total downtime. These costs will add up quickly—they're the hidden costs that sneak up on you. Sometimes the sum of all the costs of using a sole proprietor can equal the cost of a full-service firm.

Speed

A full-service refractory contractor will most likely be able to perform the work quicker, which outweighs the cost savings from using lower cost labor. Getting things done under tight timelines is very important (especially when one hour of downtime can cost $100,000+ in lost revenue).

Management

A sole proprietor typically requires a fair amount of management. Make sure to budget that time into your calendar. If you don't have time to monitor the work closely, you could end up with safety issues, quality issues or rework. With a sole proprietor, you may also be responsible for ordering parts, prepping the maintenance area and the cleanup afterwards. With a reputable full-service firm, you receive general task directions and allow the firm to complete the job from start to finish.

Technical Expertise

If you have questions concerning your project such as refractory selection, installation method, time to complete, refractory dry-out procedure, material storage etc., your best selection would be a full-service contractor. Refractories are not a commodity and something simple as storing a castable at the wrong temperature can cause significant problems.

Guarantee

Sole proprietors won't provide a guarantee. If you need a guarantee from a contractor, always clarify what type of written guarantee they will offer. Do they guarantee their work, their materials, or both? In general, full-service firms will provide a more comprehensive guarantee. Be sure to understand what will happen if something fails after the project is complete. The last thing you want is the so-called "taillight guarantee" that ends as your contractor drives out of your parking lot.

Insurance

If there is an insurance claim during or after your project, the sole proprietor normally has only limited insurance coverage. Full-service contractors have extensive insurance coverage for all types of claims. Make sure you always ask for a current copy of the Contractor's Certificate of Insurance before entering your facility.

Safety

Whenever there's work on industrial heat processing equipment, safety is paramount. Nothing can replace a strong baseline of safety training, along with the approval of third-party safety administrators. If your project has increased risks, such as heights or high temperatures, be sure you understand the type of safety training your contractor provides.

If you're not sure of whether you need a full-service firm or can get by with a sole proprietor, reach out to us. We'll be happy to provide our recommendation. If using a sole proprietor is truly the best option, we'll tell you.

The “Taillight Guarantee”

We use a term in the industry called “the taillight guarantee.”

Any idea what it stands for?

(Hint: It’s not positive.)

The taillight guarantee means that your support ends when your refractory contractor’s truck pulls out of your lot at the end of the job.

Sometimes it elicits chuckles, but many times we have to use the term when we’re with an upset plant engineer who’s in a serious bind due to a safety issue or a plant shutdown resulting from his previous refractory contractor’s inability or unwillingness to support their work.

How to Avoid Getting the Taillight Guarantee

The only way to avoid the taillight guarantee is to do your homework before selecting your refractory contractor.

Yes, we know that it's hard to find the time to research the bids. Also refractories are typically one of the last items for your plant's equipment repair or maintenance project.

But if you don't do your homework, and your work is not supported, you could run into trouble that's not in your budget. Repair costs could easily exceed the savings by going with the lowest bid. Or, even worse, trouble that causes serious downtime, injury or death.

Here's a checklist to review before selecting your refractory contractor:

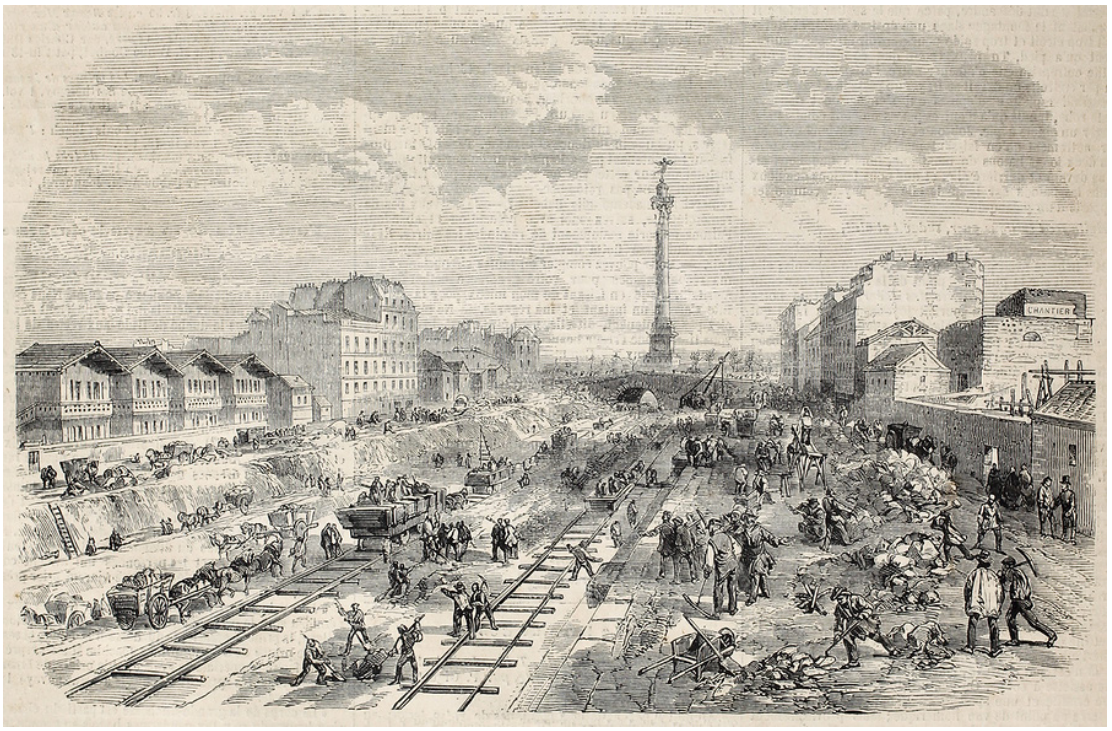
- Do they have a valid contractor's license in your state? You'd be amazed how many contractors are operating without a license.
- Do they have a quality track record? How is it quantified? Ask for names and contact information from their last 5 jobs, and also ask for job references completed 5 years ago. It's not uncommon for a spotty contractor to have a recent job reference that's decent. It's the number of quality references over an extended period of time that paints the true picture.
- Do they use their own installation personnel or do they staff their jobs predominately with "travelers?"
- What type of service and support will they provide after the job is complete?
- What is their safety record? What safety organizations are they members of? Do they have an ISN rating? Are they prequalified by PICS?
- What are the specific guarantees they provide? Will they put them in writing? For example, do they stand behind both the products and their services? Some refractory contractors will purchase low-grade, inexpensive materials and use the cheapest (instead of the most effective) installation methods to keep their upfront cost low—and then only guarantee their work, not their material. When the $*#* hits the fan, they often point to the material supplier.
- And finally, how long have they been in business? More importantly, how long have they been in the refractory contracting business? What is their financial strength? Are they bondable? These questions will help you to determine whether they will be in business when you need them in the future.

And remember that verbal reassurances aren't worth much. Be sure to get the relevant details in writing—either by email or from the company's website, etc. Save or take screenshots of everything so that if a dispute occurs in the future, you have proof of what was promised. And if you have trouble getting a company to answer these questions? Well, that's a red flag right there.

There are a number of reputable refractory contractors in our market, but unfortunately, it's also flooded with inexperienced newcomers and part-timers from other industries. These firms dive into our business without the proper experience, resources or financial backing, and are the ones who deliver the "taillight guarantee."

Mobilizing a 100-Man Job in 24 Hours

Recently, we completed one of the most challenging projects—if not *the most challenging* project—that we've encountered over the past decade in our Knoxville office.



The job started out pretty straightforward. Our customer was taking down two rotary kilns for some routine maintenance—small repairs and gunning work in the kiln and fines chute. Based on the customer's request, we scheduled a small crew for a single shift (12 hours) to handle the repairs. More than sufficient based on the initial scope-of-work.

But everything changed as soon as we got onsite and inspected the first kiln. The inspection revealed:

- 50 additional feet of brick that needed to be replaced in the kiln
- Work in the cooler where refractory was damaged from operational and mechanical abuse
- Refractory repairs in the Charge Dam of the kiln
- Extensive refractory repairs in the Dust Catcher

As we were assessing the new scope of work required, which was about 10 times the original estimate, the second unit was taken down. The inspection of kiln #2 revealed:

- Substantial roof failure and refractory damage in the Dust Collector
- Over 30 feet of brick needing replacement in the kiln

The real kicker was the customer could not afford a downtime of more than 48 hours. So we had just two days to mobilize all men, equipment and materials and complete the repairs! What we thought was a small job for 1 shift turned into the equivalent of 100 men (50 men for two 12-hour shifts).

Solution

Needless to say, this was a daunting task. One shift of work had become a *week and a half* worth of work that needed to be completed within 2 days. It was a monumental challenge (I felt like we were tasked with moving Mount Everest!).

We began working the phones immediately. Being a refractory contractor with multiple offices in several states, and a unique data base of skilled refractory craftsmen, three of our managers coordinated with each other in a 4-hour period to handle:

- Logistics
- Manpower
- Equipment
- Material
- Parts
- Consumables

To get material turned around in a single day, we leveraged long-standing relationships we have with numerous manufacturers, and called in a lot of favors. This job couldn't have happened without that relationship capital.

Results

We completed the work on time, the customer was ecstatic, and the results were excellent.

It was one the largest projects we've had to plan and complete on such short notice. It was very challenging, yet very rewarding.

Not every refractory contactor would, or can, undertake this challenge. But we didn't see that we had a choice; it's in our nature to overcome any challenge that occurs during downtime.

We pride ourselves in finding a way to get it done.

An Alternative Hot-face Lining Reduces Electricity Consumption by 10%

This Case Study Outlines How F.S. Sperry Reduced the Electricity Consumption Requirements of the Aluminum Holding Furnace Equipment at a Global Die Casting Company

Challenge

It's no secret that manufacturers have been feeling a constant pressure on profit margins, both abroad and in the United States. In the die cast industry, the ever-increasing cost of electricity has created a downward pressure on margins for years.

Last year, a global die cast manufacturer approached F.S. Sperry with a goal of reducing the energy consumption requirements of its aluminum holding furnace equipment.

Solution

With the assistance of our material manufacturing partner, F.S. Sperry conducted a long-term study to analyze the power requirements and heat loss of the current lining configuration in the furnace.

After gaining a better understanding of the energy and heat loss averages, we worked with the engineers of our refractory material manufacturing partner to identify an alternative refractory hot-face lining, which we then installed.

Results

After the installation, the manufacturers' engineers monitored the furnace for over six months. The results were compelling. Our customer was able to realize a reduction in power consumption of up to 10%.

While this might sound like a small percentage, when the savings were multiplied across many units, the overall reduction in power cost was staggering. This number went directly to our customer's bottom line.

Takeaways

- The current lining configuration of your heat processing equipment affects its power consumption requirements. During routine maintenance, or when considering a reline, try to determine if the configuration has deviated from the OEM's original configuration.

- Many OEMs offer equipment that included the best lining configurations on the market at the time they were originally built. If they were constructed 10 to 20 years ago, more recent technological improvements could yield a substantial reduction in energy requirements, translating into significant bottom-line savings.

As your refractory maintenance partner, F.S. Sperry has the experience, relationships and know-how to analyze your energy consumption and deliver the optimal lining for your equipment.

Your refractory is not a commodity. Treating it as such can prevent you from achieving significant cost reductions and improving your bottom line.

Silver Linings in Unscheduled Downtime

Unplanned downtime is something we all prefer to avoid at all costs. But once in awhile, a problem with your boiler, oven or kiln can deliver an unexpected benefit.

They're hard to see when you're staring at expensive repairs, lost production revenue or a safety issue, so we thought we'd share a couple of examples from recent projects.

Maximizing the Value of Old Heat Processing Equipment

In our first example, our customer was running two wood-fired boilers—one 600 hp and one 1200 hp. They needed to tear-out the existing refractory lining and install a new lining in the 600 hp boiler prior to a scheduled inspection.

The customer preferred rammed plastic, but since there wasn't enough time we installed a cement-free gunning mix to complete it within the 8-day project timeframe. We were able to complete the full bakeout and get the boiler back online after a successful inspection.

The initial cost of this job wasn't cheap; there were definitely less expensive materials and installation methods available. But our customer had over 15 years of experience with various refractory materials for lining wood-fired boilers and knew of the pitfalls of going with the cheapest options.

The silver lining was that the extra money spent and our installation recommendations improved the efficiency of the 600 hp boiler to the point where he no longer needed to run the 1200 hp boiler.

A few extra bucks invested in the refractory work saved him a considerable amount of operating costs shortly after. This wasn't his original plan, but a very welcomed result!

Better Installation Reduces Routine Maintenance

In our second example, our customer had a tunnel furnace that was operating inefficiently. The heat in the furnace was escaping through openings in the refractory around the rollers of the tunnel furnace.

In their previous installation they had used a ceramic-fiber blanket packed into their roller openings. This lasted only a few months before additional blanket had to be installed. After F.S. Sperry representatives explained the long-term benefits of sprayable ceramic-fiber, they decided to move forward with the Foamfrax installation around the tunnel furnace roller openings. This was considerably *more expensive* than the existing option, but in addition to the decrease in heat escape from the furnace due to tighter packing of the sprayable ceramic-fiber around the rollers, there was an additional unexpected benefit.

The silver lining was the Foamfrax providing additional protection to the roller bearings, therefore extending the useful life of the tunnel furnace rollers. The customer no longer had to replace multiple $30,000 rollers per year and also didn't have to replace the ceramic-fiber blanket in the roller openings every 6 months. The savings provided to the customer by this solution are easily in the **six figures per year** by reducing the need to purchase new rollers and eliminating frequent labor and material costs with the existing roller opening solution.

Equipment failures and unplanned downtime are stressful situations that are filled with potential dangers. While these unexpected positive outcomes aren't the norm, they happen more often than you might think when you use high quality installation methods and materials for your specific job.

The Refractory Failed … Or Did It?

Sometimes refractories fail. From our perspective (as installers) the most important question is: "What caused the refractory to prematurely fail?"

A majority of the time, the cause is not immediately known. An investigation is required.

And even then a "conclusive" reason may never be found. But here is what our experience has shown us.

It Usually Isn't Simple

When a refractory failure occurs, the facility operators usually assume the cause is one of two things:

1. Bad Installation

2. Bad Materials

First, let me say that improper installation could very well be the cause. After all, there is still the human element involved. And most of the time, faulty installation is fairly easy to determine. However, from our generations of experience and analysis, if the material has functioned properly for any reasonable length of time, generally the cause is not installation-related.

As far as bad materials go, while this is possible, it is not probable. Reputable refractory material manufacturers pay close attention to quality control (QC), material selection, mixing, packaging, etc. They can provide QC results throughout their process. Further, most refractory manufacturers source basic components from the same global suppliers who also provide QC results with their respective products.

So, if it's not installation and it's not materials, then what is the cause? Good question. If you're truly interested in determining cause, you have to go back to the main factors involved:

- Design of furnace and/or process equipment
- Detail engineering
- Refractory material selection and specification
- Refractory anchor type, spacing and welding
- Installation of lining
- Dry-out (curing) of the refractory
- Start-up
- Operational practices
- Maintenance practices

A Complex Chain of Events

Our experience shows that in the overwhelming majority of cases there is never one, definitive cause, but instead a "chain-of-events" that lead to the "failure." In other words, there were multiple variables that impacted the refractory material in service.

Remember, the refractory material is only one component in the overall design of process equipment and industrial furnaces. It is sensitive to (and influenced by) time, temperature and operational factors.

In our experience, the culprit will likely be one (or a combination) of the following:

1. Improper combustion (fuel, ratios, atmospheres, flow, etc.)
2. Flame impingement (flame geometry, improper set-up, etc.)
3. Improper furnace controls (PLC's controls, circuitry, thermocouples, dampers, etc.)
4. Operational change (cycling, throughput, load, etc.)
5. Operational procedures
6. Maintenance practices
7. Shell and lining movement due to a difference in expansion rates
8. Mechanical stresses
9. Environmental factors
10. Catalysts

From a refractory perspective, these all impact and can cause:

- Excessive temperatures (shrinking, etc.)
- Hot spots
- Excessive cracking due to:
  - Spalling
  - Thermal shock (a result of temperature fluctuations)
  - Mechanical shock
  - Compressive forces, linear change, bending, etc.

- Structural issues
- Erosion and abrasion of the refractory lining
- Anchor failure
- Failure of the steel shell which supports the refractory
- Mechanical damage

All of the above can cause the refractory material to fail sooner than originally expected. As variables do change, the selection of the refractory used may need to be reconsidered. If there are new variables that the product must face, than an upgrade or change in material may be warranted.

If you have questions about refractory failure, we would love to hear them and share our insight with you. Don't hesitate to give us a call.

Using a No-Cement Castable Instead of Firebrick to Prevent Rapid Expansion in Rotary Kiln

Firebrick is a versatile product, but since refractories are not a commodity, there are applications where firebrick is effective … and applications where it's ineffective.

Recently, a project was completed to correct damage caused by the failure of firebrick installed by another refractory contractor.

Our client's process was super-heating EAF dust to extract the pure zinc that's contained in the dust. The facility contained a large baffle wall located in the secondary unit, or chamber, off of the high temp rotary kiln.

The original baffle wall was constructed with firebrick design. The brickwork failed in 6 to 8 months. The main failure mode was rapid expansion due to chemical attack.

As you can see in the photo below, the expansion pressure was great enough to actually break seam welds on I-beams and on the shell near where the baffle wall is located.

It also damaged the roof system, as it expanded both sideways and upwards.

The Solution

Our solution was to replace the entire baffle wall utilizing a true no-cement product. The material used was Ultra Tek 70NC, pump cast in place.

This no-cement castable was chosen due to its resistance to the alkali attack from the zinc-extraction process, as well as the other chemicals that are byproducts of the high-heat process. Here's a photo of the completed work:

The customer is very pleased because they no longer have the expansion issues previously caused by the firebrick, and they're getting more life out of the new no-cement construction.

If you're considering firebrick for your next refractory project, contact F.S. Sperry to be sure it's right for your particular heat processing conditions.

Foamfrax Veneer vs. Coating

We're always on the lookout for innovations that improve the performance of refractories and linings.

Though it requires a substantial undertaking to evaluate the quality and performance of new products in our industry, we've found that the rewards far outweigh the costs. Of course, we'd never use a product that's untested, but when we find a new product that delivers significant benefits over "the status quo," we're not afraid to use it on the job. Call us pioneers, if you will.

This is a bit unusual in our industry, as some refractory contractors operate year after year using the same products and application methods, irrespective of whether more effective options exist (from either a total cost or performance perspective).

This is a case study for one of the first installations of the Foamfrax insulation product, which we performed back in 2001.

Customer Challenge

In 2001, a steel manufacturer in the Midwest needed to repair its continuous roller hearth furnace. After six years of service, the ceramic fiber module lining in this unit had become severely fluxed and as a result, the lining system had sustained some mass loss. This fluxing phenomena and shrinkage gaps in the lining caused the furnace shell temperatures on this unit to gradually increase.

The repair options to lower the furnace shell temperature were as follows:

1. Completely replace the lining

2. Add more insulation on the existing lining hotface

One of the main factors in the decision-making process was speed. Could we complete the repairs during their monthly one-day plant shut down for maintenance? Or would they have to incur costly additional downtime?

We chose to add more insulation to the existing lining hotface, and knowing our customer's need for speed, we chose to use the Foamfrax Insulation System.

Foamfrax is a unique, proprietary form of ceramic fiber made by Unifrax. We selected it because it can be quickly installed, and the plant had a one-day maintenance shut down every month.

We decided against using a standard coating because our experience has been they do not work for these applications. We don't doubt the engineering and science behind them, but in the field we've seen little measurable success relative to their cost.

Installation

Prior to the Foamfrax installation, we wet the lining with water to minimize airborne fiber generation and remove loose material from the hotface surface. (Note: if you need to remove any after-service refractory material, refer to the product MSDS for proper material handling guidelines.)

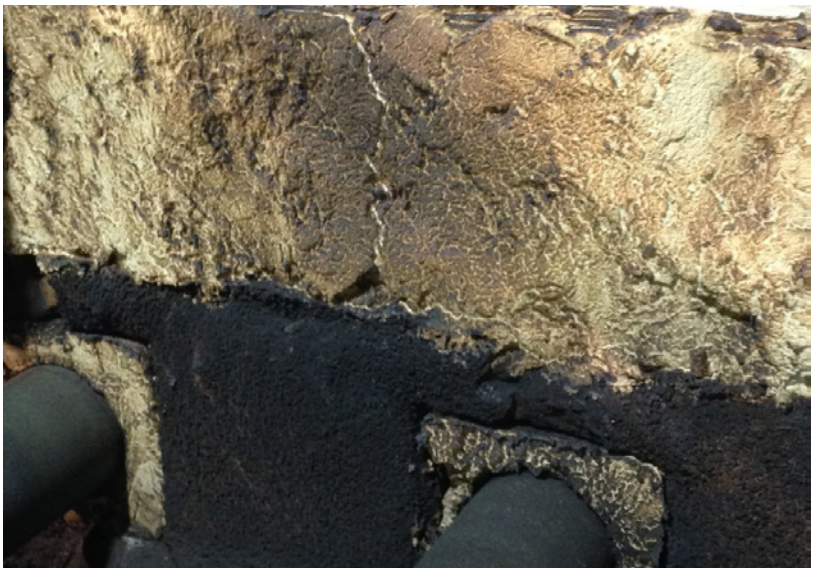
We kept in place any of the glassy surface material that still maintained its physical integrity. After this procedure, we wet the lining with water once again, and then gunned a 3" (76mm) veneer of Foamfrax Grade II fiber onto the module surface.

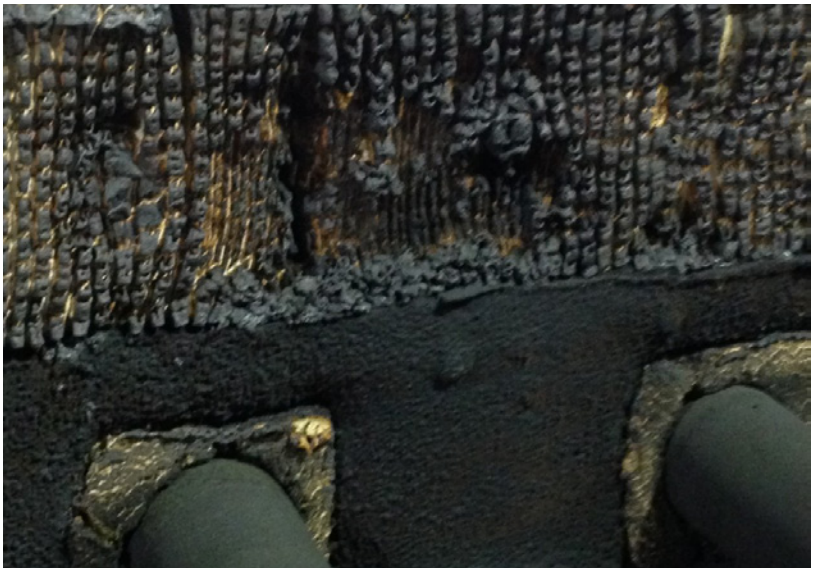
The completed Foamfrax lining added insulation thickness to the existing lining and filled any shrinkage voids on the surface of the modules. Our team took extreme care during installation to work around the burner areas and the removable roll bungs.

Results

Once in service, a noticeable and ongoing reduction in furnace coldface temperature was observed. Based on our experience with this project and numerous jobs since that time, we have found that Foamfrax performs better than coatings as a veneer to existing module linings to upgrade and protect the refractory.

These two photos were recently taken after 8 months in service in the same furnace. One photo is Foamfrax; the other photo is of a coating. The Foamfrax veneer clearly outperformed the coating.





Benefits

The installation of Foamfrax Grade II Insulation provided the following benefits to the manufacturer:

Turnkey Installation

A specially trained Unifrax distributor/contractor was able to supply materials, equipment, and installation as a complete package.

Fuel Efficiency

The additional thickness of Foamfrax Insulation sealed all lining openings and added insulating value, resulting in reduced furnace shell temperatures and reduced fuel usage.

Extended Service Life

The Foamfrax Insulation upgrade provided extended service life for the furnace lining and the customer avoided a complete lining reline and costly downtime.

Installation Speed

Due to the quick installation of Foamfrax Insulation, furnace sections were easily completed during the monthly 24-hour maintenance shutdown of this furnace.

If you need to reduce the shell temperatures of your heat processing equipment or just want to upgrade a deteriorated lining, consider Foamfrax, and tell us about your project.

F.S. Sperry is the largest installer of Foamfrax in the United States.

5 Tips to Reduce the Total Cost of Your Refractory Installation

If you're planning the construction of a new industrial facility or maintenance for your existing heat processing equipment, you're juggling a lot of variables. One of those, which may be near the bottom of your Gantt chart, deserves a deeper look:

Your refractory selection and installation

Why? On the surface, refractory products don't seem very complex; they're just products that maintain their strength at high temperatures. But a deeper inspection reveals that there are many variables which determine the best type of refractory to use in a specific installation or application. If something goes wrong, you can end up risking the lives of your workers and incurring significant costs down the road.

So, if you're focused on having the lowest *total cost* for your project, you might need to change your thinking. Manufacturers have felt pressure on margins for decades. We understand your need to minimize costs. But refractories are not a commodity, and shouldn't be evaluated solely on the initial installation price. You'll receive the lowest total cost by doing the job right the first time, which will minimize future work, downtime and lost production revenue.

How NOT to Approach Your Refractory Bid Evaluation

As an example, we're often asked to provide a quote for a refractory project with few or no defined parameters or scope of work. The prospect says, "Look at it and give me a price."

Accordingly, we deliver a proposal that includes all of the recommendations to handle the job properly. The prospect reviews the price, compares it to other proposals that are based on different criteria, incorrectly assumes that an informed decision can be made, and chooses the lowest bid.

In these situations, we commonly hear things like:

- "Your price was too high. We went with the other bidder."
- "There's no scope of work. Just bid on the way it's built now."
- "We don't want to review different installation methods. Just get the work done."

Here's what actually happened in one of these situations (and this is common):

- The "other guy" didn't quote or build the job the same way.
- The entire lining thickness was installed using a single material—no intermediate and back-up layer. This is why it was cheaper and faster.
- The prospect didn't read the quote.

What happened? The decision to go with the other bid and its more limited criteria caused the furnace shell temperatures to go through the roof because there was no insulation. The heat is now deteriorating the steel casing, wearing out the bearings and components on the motors.

How much money did that prospect really save?

"Just Give Me a New Set of Tires"

A comparison we like to use is to think about tires for your car. Tires help get you from point A to point B, and most of us don't think much about them, unless they fail.

When you need new tires, you have to consider these questions:

- Any particular manufacturer?
- What type?
- What size?
- How do you drive?
- Do you want them to be speed-rated? If so, what rating?
- What is your climate? How does your vehicle perform in wet/wintery conditions?
- All of these considerations make a difference in the price.

Approach your refractory selection and installation in the same manner, and you'll be much better off down the road.

What to Look for in a Refractory Contractor's Proposal

Here are our recommendations to prevent you from ending up in a situation like the one we described earlier.

1. Do not base your refractory decision solely on price. The "low price" option often produces the highest total cost.
2. Make sure your bidders have ALL of the facts. That means explaining all the parameters and defining the scope of work clearly.
3. Many people make the decision based on short-term factors because they won't be there long enough to deal with the long-term problems from a "low price" decision. Have at least one long-term stakeholder involved in the decision.
4. You cannot know all of the salient factors relating to refractory and installation. These affect price! Therefore, ask questions so that you better understand the criteria your bidders are using.
5. If you're really going to make your final decision based upon price:
    - Take the time to prepare and provide a scope of work.
    - Require that all bids MUST be based upon the same type of refractory with similar properties. Be specific.
    - Make sure that you understand what installation technique being used is.
    - Disclose ALL relevant factors.

Finally, we highly recommend to include somebody with direct refractory experience in the evaluation process.

An Unusual Way to Get the Lowest Cost for Your Refractory Project

We've all heard the term "penny-wise, pound foolish." This is particularly true when it comes to refractories—sometimes the *lowest cost solution* means spending more upfront in order to save significant maintenance costs in the near future.

It's common knowledge that margins in U.S.-based manufacturing continue to get squeezed, so it's critical for our clients to keep construction and maintenance costs as low as possible. F.S. Sperry supports this goal, since if costs got too high and all our clients moved offshore, we wouldn't be able to stay in business!

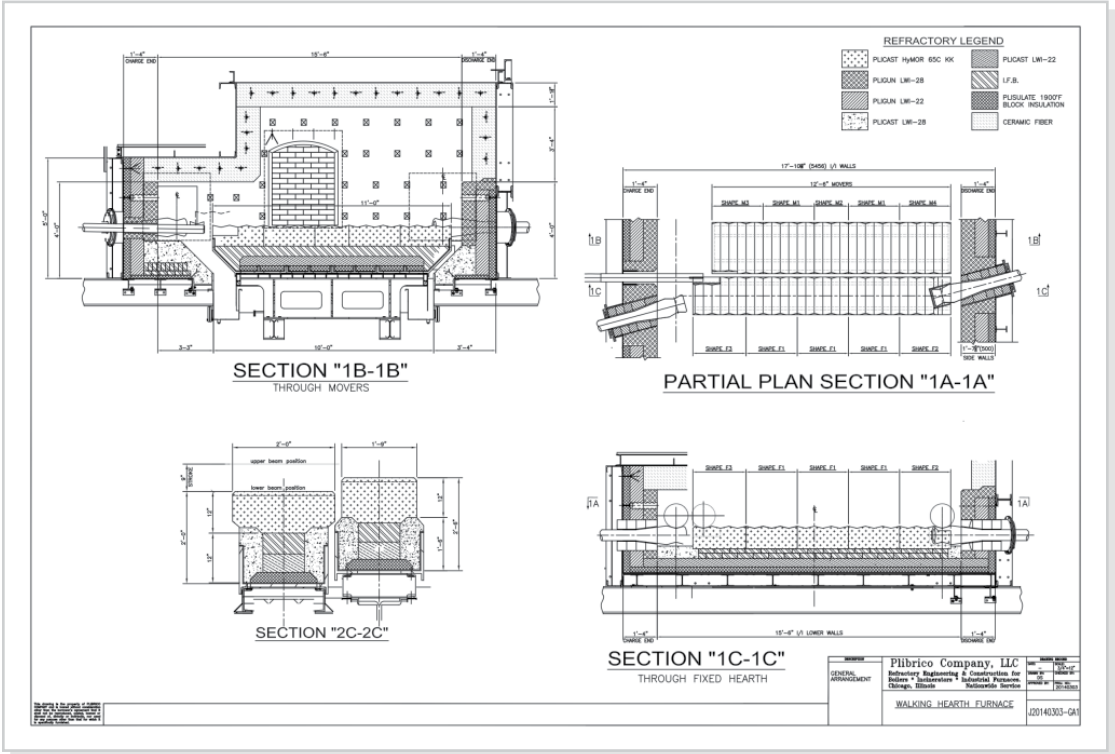
Since we're passionate about our business (we've been serving the Mid-South since 1946), we always examine a wide range of solutions before making recommendations to a client.

A recent example occurred when we were bidding on an industrial furnace project. The customer's product dragged across the furnace hearth. This created a high-wear area that required significant maintenance. Due to the location and geometry, it was very difficult for them to get a good bake-out of the refractory material and therefore maximize its engineered properties.

The customer asked for the "best material" and the "lowest cost" solution. Because of our product knowledge and experience, we reviewed numerous options and projected the entire cost from installation to maintenance for each option. Many end users don't always consider the maintenance cost when evaluating total cost.

The clear solution ended up having us provide and install engineered shapes. With the engineered shape, we could absolutely control the bake-out process to achieve maximum physical properties, thus limiting future maintenance requirements.

Here are some of the engineered drawings we produced while working with the customer to present the optimal solution:



The key to achieving the customer's goals was their willingness to consider all the alternatives. We presented them with options that cost up to 20% less up front, but also showed them how the downtime, maintenance and repair costs to patch and fix the wear areas added up each year. Bringing the furnace off-line once before their schedule negated any savings when compared with "low bid."

Because they were willing to work with us to review different options, they were able to clearly understand the best choice. In the end, we delivered exactly what the customer wanted: *the best material and the lowest overall cost.*

If we were forced to complete a request for proposal and submit a bid without working with the customer directly, they may have chosen an inferior solution. Sometimes, the true "low-cost" bid is not the lowest cost solution.

Buying Refractories the Smart Way

What's the most cost effective method for buying refractory materials for most OEM and end use customers?

A. Buying refractory products direct from the manufacturer

B. Buying refractory products from a distributor

For full disclosure, F.S. Sperry is a distributor in addition to being a refractory contractor. Many of our OEM and end user customers buy refractory materials from us without needing any services. And what most have found is that buying from us makes better economic sense than buying direct from the manufacturer.

That's contrary to what many believe—that buying direct from the manufacturer assures them the lowest price.

Total Cost is What Matters, Not Individual Unit Prices

There are two instances when buying direct from the manufacturer is typically going to cost less than buying from a distributor:

- If you're purchasing a very high volume of refractory materials
- If you only need the specific refractory materials made by the manufacturer

The biggest difference between a manufacturer and a distributor like F.S. Sperry is this:

> *Unlike a single manufacturer, F.S. Sperry can procure the entire bill of material including logistics. Most manufacturers can't quote what they don't make.*

Because of our buying power and leverage in our relationships with manufacturers, we can offer the same cost or less *on the entire bill of material* as a single manufacturer.

Don't Forget the Time for Research...

In addition to the out-the-door total cost, most corporate purchasing departments in smaller companies simply don't have the resources to complete the due diligence for the entire list of products in the bill of material makeup.

So, when you factor in people's time and only buying the products you need in the quantities you need them, our customers find that it makes more sense to sole source the procuring of refractory materials from F.S. Sperry.

...And the Freight Required to Receive the Bulk Discounts (and Waste)

In addition, even though you may get a competitive price from an individual manufacturer, when you factor in the freight cost the quantities you have to buy to get the discounts and the waste on the overall product (the overages), you rarely have saved any money.

Your total delivered cost is often times less.

A Real Life Example

Sometimes it helps to take a look at an example. Here's what happened in a recent request for a quote:

1. Many of the companies he went to "no quoted" the items they did not make.
2. He spent a lot of his time going back-and-forth qualifying his RFQ.
3. He did not take into account the freight cost to ship individual items.
4. We asked him to let us quote the entire BOM, including freight. As it turned out our delivered price was lower when he took into account he bought what he needed and let us handle logistics.
5. Although he obtained good prices, for example on the brick, some manufacturers would not cut the brick that were "non-standard" or it was at an additional upcharge that negated the savings he thought he got.
6. He obtained a better price (per foot) for the PTFE than our price; however, his overall cost was more since he had to purchase full quantities as manufactured. When he factored in the waste (material he didn't need), our overall price was lower since we were able to supply in the quantity he needed.
7. He gave such a generic description for his castable the prices were all over the map. He was not in a position to evaluate what was quoted. We able to dial this in for him.

Overall he admitted after it was over when he factored in his time, freight and the overall cost difference, the savings for going "direct" were just not there.

When Refractory Contractors Fail to Bid on Complete Project Requirements

"I love your proposal, but I love the other guy's price."

Have you ever heard that before?

For those of us who are providing complex services and products in the business-to-business market, this is frustrating to hear. Especially when you hear it often.

When I expressed my frustration to another CEO colleague over dinner the other night, he asked me if my price was higher than my competition.

"Sometimes it is," was my response. "But sometimes, it's the same, but the competing contractor didn't bid based on the project requirements, and the prospective client didn't notice."

Sometimes the prospect gives me the opportunity to guide him through the assumptions so he's able to see that he's comparing apples and oranges, and sometime he doesn't.

There's More to Price Than Meets the Eye

Plant engineers and maintenance supervisors at industrial manufacturing facilities have a lot on their plate these days. Many are handling more than their traditional responsibilities (with some carrying the responsibilities of two jobs due to company budget cuts). They don't have time to review the nuances of the refractory contractors'

proposals during a new construction or maintenance project. So they start by looking at the price, and then decide if they need to dig any deeper into the proposal.

Over my career, I can't count how many times we've been called back into a client's office a year or two after we lost a bid and been asked to bid on repair or corrective work because the "low price" contractor they went with didn't bid the job to the specifications.

Fortunately, many companies catch this before the job is complete, so they end up with the right refractory work (but at a much higher price than the original bid).

Very few of our competitors knowingly provide lowball bids that leave out some key project requirements, but it angers me when I see it. It's just unethical in my opinion.

Wouldn't you rather have a partner that helps in writing a job scope and setting a budget? Avoid the common traps and issues on refractory repairs that might end up costing you on the back-end with the common low bidder. Any contractor worth their merit should always maintain 100% transparency.

What to Look For

If you're a plant engineer comparing bids with substantial variations in price, take an extra few moments to make sure each contractor's bid meets all the project requirements.

Here are some things to look for:

- What is the make-up and experience level of the crew working on the job? Ask about the company men, brick-masons and temporary laborers.
- Do the contractor's employees have a vested interest in the work? Or are they simply travelers? Employees with a vested interest in the success of every project will perform higher quality work. Travelers might cut corners.
- How much time does the contractor spend every year to make sure they are up to date on the latest safety protocol? (We spend 1 week per year, which is higher than the typical contractor, but make sure to ask the question.)
- What is the bake-out procedure and who will be performing it?

We don't expect to win every bid, and we don't always have the lowest price on the bid, but we have found that over time, spending a bit more upfront to do the job right lowers the overall lifetime cost of the project.

Preventative Maintenance Checklist for Your Refractory Linings

We all know that it's a good idea to perform routine maintenance on important machinery—both in our manufacturing facility and in our personal lives.

You change the oil in your car, right?

I know that not everybody changes their oil every 3000 miles, but for those of you that were driving back in the 1970ˢ and 1980ˢ, did you change your oil as often as you do now?

Most of us didn't, and a main reason for our change in behavior came from all the advertising reminding us of the importance of changing our oil. Credit some of our improved car maintenance to the Jiffy Lubes and Grease Monkeys of the world who spent the heavy advertising dollars to educate us.

Awareness works.

Whether it's every 3000, 5000 or 10,000 miles, your car needs its oil changed, along with a routine inspection and replacement of a number of the moving and insulating parts. It not only protects the investment you've made in your car, it's a safety precaution.

The same analogy is relevant for the refractory in your industrial furnace.

Recommended Maintenance

Different types of refractory lined equipment require different maintenance schedules. Unfortunately, the recommended maintenance activities and time intervals aren't as simple as the 3 months/3000 miles oil change recommendation.

The best advice is to have a refractory engineer perform a physical inspection of your heat processing equipment and create a customized maintenance plan for your refractory type and installation method.

If it sounds like a lot of work, compare that to the cost of a plant shutdown for emergency repairs! (And, we will be happy to provide free inspections, if you like. Contact us to schedule—it's a small commitment that's worth it ten times over.)

Although some industrial furnace equipment is designed and engineered to stay on-line for longer campaigns, here are some general guidelines for most industrial furnaces.

- If possible, schedule downtime for your refractory-lined equipment to regularly inspect the lining—once per year if possible.

- If you know you're going to take your refractory-lined equipment off-line for other maintenance or repairs, contact us to schedule an inspection of the refractory during this time.
- If your refractory-lined equipment comes down unexpectedly, and you can safely do so, call us to schedule an inspection of the refractory.

Refractory maintenance might not be something your engineering team currently has a detailed plan for, but we can't emphasize its importance enough. We've seen too many instances where a catastrophic failure could have been prevented by routine maintenance.

Again, feel free to contact us to talk about a custom schedule for your facility.

Rebuilding a Bell Kiln

Here at F.S. Sperry, we are very proud of our Resource Center. We've been collecting this vast library of prints, schematics and diagrams since 1946. This wealth of resources often means we have the knowledge to service older heat processing equipment that no other refractory contractor in the country may have!

Some of you have been asking for examples of how we leverage all of those blueprints and schematics on the job. One recent example comes from a customer that has a unique Bell Kiln. Many companies assume, incorrectly, they can only go to the original equipment manufacturer (OEM) for refractory repair service.

This kiln requires specialized high-alumina brick to withstand temperatures that exceed 3000 degrees F. It's also unique in that it contains two different types of mortar in the lining. One can't be substituted for the other, and if it is, the lining will fail.

Because we've worked on this kiln for 25 years, we have developed our own internal notes, procedures and prints on how the construction and rebuilding process works.

Not Just a Contractor, But a Partner

When the customer contacted us to perform a kiln rebuild, we knew exactly what was needed. However, before the project started, the plant engineer with whom we've had a long-standing relationship moved to a different division of the company. His replacement engineer is very bright, but was just getting up to speed about the kiln at the start of the job.

From start to finish, we went over every detail of the kiln with the new engineer, performing brick counts, reviewing inventory and assisting with decisions regarding stock and ordering (as lead times for this brick are significant).

The OEM is typically the only other group that can perform this type of work. Since few, if any, have their own refractory crews in-house, this work is usually sub-contracted out. But our intricate knowledge of industrial furnaces allows our customer to get complex work completed properly for a lower cost than going to the OEM.

The end result is we have brought our customer comfort, security and a partner-like relationship for 25 years.

Refractories are NOT a Commodity

During my career as a refractory contractor, there's been one question that I consistently hear from current and potential clients. It's a question that both excites me and frustrates me at the same time:

"Why is there such a big difference between your price and their price?"

It's true—at times our bids for new construction projects or large repair projects do come in significantly higher than some of our competitors. There's a reason for it—a reason that makes us proud—but if our potential customers don't understand the reason, it makes us frustrated, because they may walk away with the perception that we're just an expensive choice in a commodity business.

And there's no truth to that statement.

The Nuances of Our Craft

Refractories might not be exciting, but they are a vital component of industrial manufacturing; they're used in just about every type of industrial process that utilizes heat.

The tremendous volume of choices for different types of refractories results in a wide range of potential outcomes. The right choice can lead to the safe, low-maintenance and cost-effective protection of vital industrial heat-processing equipment for a 5- to 10-year period. The wrong choice can lead to downtime, equipment failure and accidents that place our friends and colleagues in harm's way.

Understanding the difference between the two isn't something you learn overnight. Yet as the years pass, I'm finding that we're encountering more competitors who don't have the proper expertise and experience to do the job "the right way."

Today's industrial manufacturers are production-driven and often place demanding schedules on their engineers and staff. Many times these engineers and maintenance people lack the time to research what the right decision in material and contractor might be. They may even make the assumption that all bidders on a refractory job are relatively equal in their expertise, so it's just a matter of getting the best price.

This couldn't be farther from the truth. Refractories are not a simple commodity.

Our Dwindling Fraternity

Refractories are a complex field, heavy on both science and art. And it feels like our "fraternity" of experienced refractory contractors is shrinking as time marches on. There seems to be a dwindling understanding of the important elements of our craft. Maybe the universities are shifting ceramics from an entire course to a chapter in a book? Or maybe corporate budget cuts have eliminated this type of training?

As a group of people that are proud of our craft and doing things "the right way," this saddens us.

Maybe it's natural to feel this way as we get older. Maybe I'm overly sentimental. But even if both are true, I'm passionate about what I stand for. And I'm passionate about what our small fraternity (which includes the people in our company, numerous clients, many of our suppliers, and a few of our competitors) stands for:

- Understanding the proper refractories to use for any given situation

- Understanding the correct way to install them
- Performing the work in a safe and effective manner
- Adhering to proper refractory maintenance procedures

Knowledge and Experience Makes a Difference

The above list is my answer to the question “Why is your price higher?” It’s because we have the knowledge and experience that makes all the difference in a complex field.

We love talking about our craft, because it’s more than just a job to us. We take pride in our work, and are excited to use this blog to share our ideas, tips and feedback to a wider audience.

We are opinionated, so at times we might rub some the wrong way. Our goal isn’t to offend, but it’s important for us to “tell it like it is.” We won’t shy away from sharing ideas about how “not” to perform certain types of work.

I hope that you find our posts valuable and interesting. We love talking about refractories, so if you have questions or comments, please participate in the conversation.

R. Barry Cox

CEO—F.S. Sperry

A One Stop Shop

Most of our blog posts focus on the specifics of our industry—installation methods, materials, case studies and refractory product discussions. Our main goal is to educate and allow our readers to learn more about how we think and approach specific jobs and situations.

We try not to use our blog as a shameless self-promotional platform, but we're bending the rules a bit on this post because it focuses on something that we feel is unique to us and provides a specific benefit to our customers. It's about providing solutions instead of just materials and labor.

Products, Services and Solutions

As a refractory contractor, we're in the services business.

As a refractory distributor, we're also in the product business—we stock the largest inventory of refractory materials with 500 miles of Memphis, and are the sole supplier of Plibrico products within a 4-state area.

We also design and build custom products. (We're in the process of installing a very unique solution that we will talk about in a future post.)

Over the years, as we've learned about our customers businesses and what they are truly looking for, we've innovated and changed our business to provide the solutions that they need. For example, many new facilities don't have the space to allow them to fabricate parts. So we handle the work in our shop - fabricating steel and applying anchors, creating doors, form casting and precast shapes, and creating panels. We even stock the inventory and deliver it according to our customer's production and maintenance schedules.

The One-Stop Shop

Our customers have continually asked us how we can help them innovate using the equipment they already have in place. And almost every new potential customer tells us they're looking for a *one-stop shop* that can handle numerous issues, instead of simply a refractory installation or repair.

There are certainly some great specialty refractory contractors who focus on one or two installation methods or offerings. But we're a bit different in that we've shaped F.S. Sperry to focus on providing a comprehensive solution instead of focusing on a single task.

Being a comprehensive solution provider requires an array of skills, both deep and wide, across the entire company. And those solutions have to be designed around what our clients are looking for, *so they solve real problems.*

From our experience, these are the 5 things that our current and potential clients most commonly tell us they're looking for:

1. **Get here quickly.** They want a crew who is available in case of an emergency situation (refractory lining fails, etc.) with guys who can review the damage,

assess the situation and provide a very good idea of repair time and costs. This allows them to decide if they need to jump on it quickly or plan for it at a later point in their process cycle.

2. **Get in and get out.** When onsite, they want guys to come in and get the job done right as efficient as possible, and then get out. Most don't mind paying for quality work, as long as you come in with a sense of urgency about what you're doing. Nobody wants to pay labor costs for people who waste time.

3. **Communicate.** When new things are uncovered, for example, a tear out is needed, they want us to clearly articulate a step-by-step approach—*this is what we see initially, this is what we see now and this is a short-term fix/long-term fix with shutdown.*

4. **Understand and recommend.** Their existing team of maintenance managers and technicians want to be able to work with a team who can help them identify the best and most economical solution price wise, time wise, application wise for the particular problem they have. This requires the ability to listen, understand the true problem, and to have the experience to provide the right recommendation.

5. **Provide versatile expertise.** They want us to be flexible and have a strong knowledgebase to provide solutions that span multiple scenarios or equipment (e.g. working on situations with a tunnel furnace, a melt shop, a kiln and a galvanizing line); they want an expert who can answer questions across all areas and address issues. They want to be able to call you, talk about issues and have you provide a creative solution.

Over the years we've evolved our businesses to do our best to meet these client needs. It's an internal focus of ours—providing a solution instead of a material—and building strong relationships with clients.

While common in other industries, we think that that is unique in the refractory contracting world; we've seen some real characters in our industry come and go over the years.

Being a true solutions provider requires more than just product expertise. It requires creativity and the ability to see the situation from your vantage point.

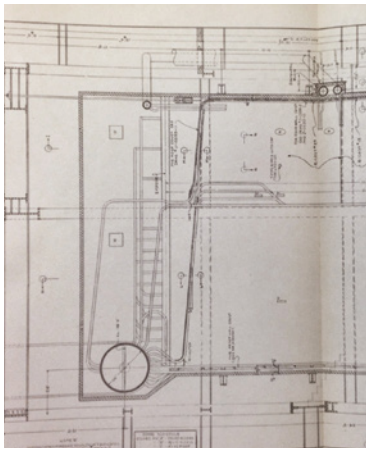
It's been a focus of ours for a number of years, and we look forward to showing you some examples of our innovation in the coming months.

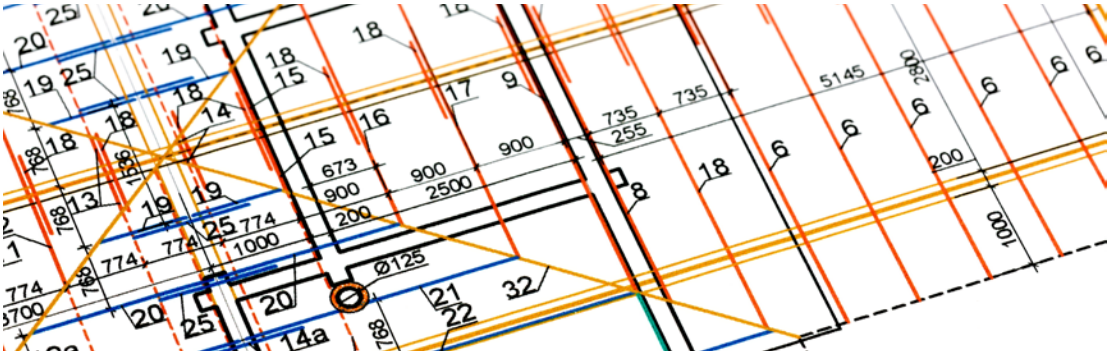
Schematics for Your Heat Processing Equipment

F.S. Sperry's Resource Center contains a tremendous volume of blueprints, diagrams, equipment specifications, and schematics for all kinds of industrial process equipment—industrial furnaces, ovens, boiler, kilns, RTOs, heat treating equipment, gasifiers and incinerators.

We started our Resource Center in 1946. Some of the process equipment currently in operation in facilities in the Mid-South has been out of production for decades. The manufacturer has gone out of business, and the schematics are no longer in print or available on the Internet.

But they're in our Resource Center, and our team of engineers might be the only ones left who understand them.





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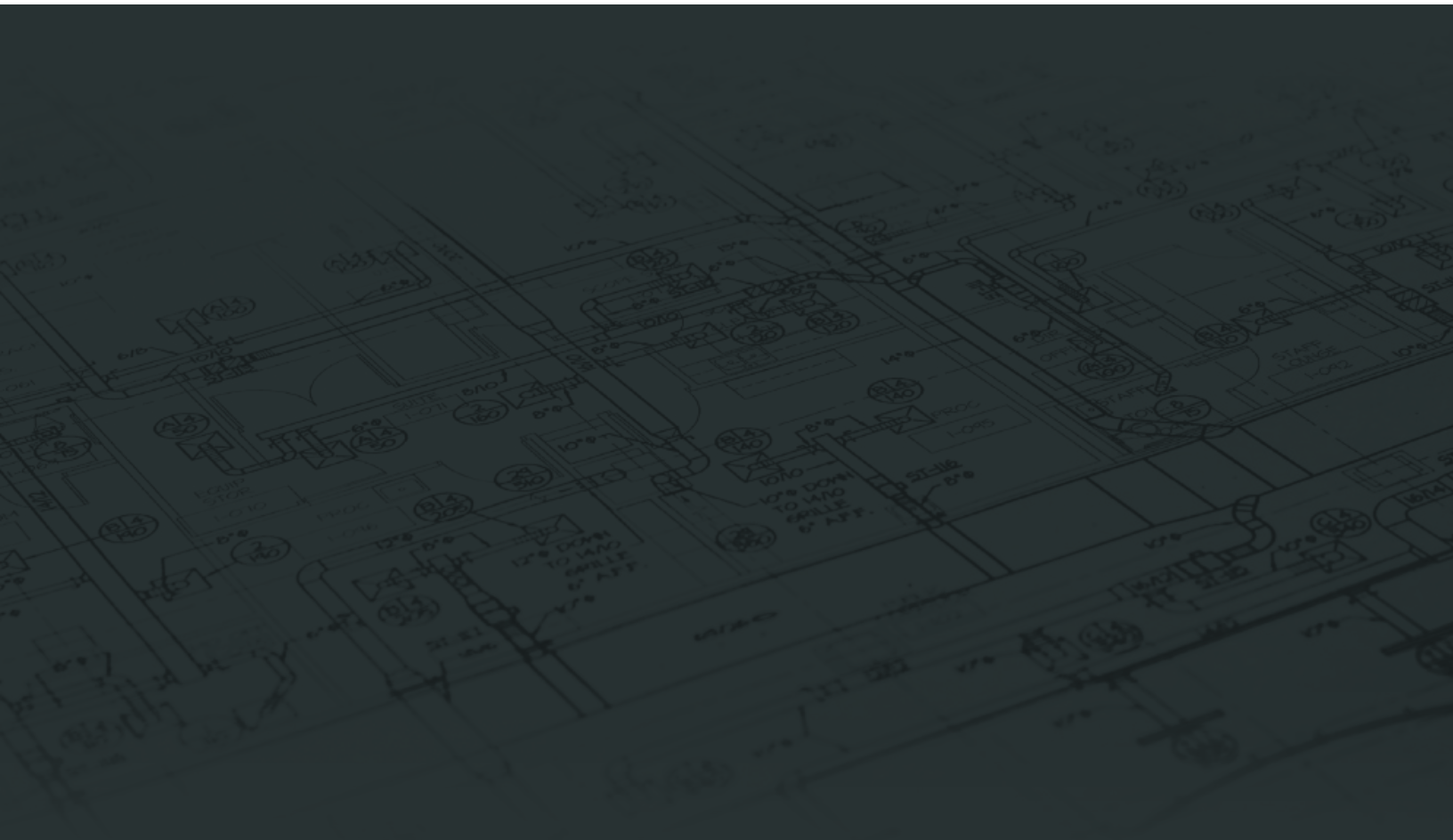

www.fssperry.com

Connect with us to start a discussion
about how to maximize the value
of your heat processing equipment