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Prefabricated Refractory Smokestacks

New type, low-cost smokestack does not corrode or require maintenance

PRIOR to World War II the vast majority of smokestacks specified for use with boilers, furnaces, and incinerators were of steel. During the war, the shortage of steel led to the development—under government supervision—of a prefabricated smokestack of refractory materials. It filled the need for thousands of new stacks for military installations and defense plants without using critical steel.

More important, this prefabricated smokestack had other advantages. It was easily and quickly erected and cost no more than the comparable steel stacks previously used. It had many of the advantages of costly brick stacks. In the 15 years since their wartime erection, they have proved to be long-lived—greatly outlasting steel stacks because their refractory material will not corrode. An additional advantage came about in the complete lack of maintenance required.

The pioneer in the manufacture of this new type of refractory stack was the Van-Packer Co., a division of The Flintkote Co. It developed two types of refractory stack—a standard model for boilers and furnaces, and a Hi-Temp stack for incinerators. The two types differ only in the refractory formula used in making the stack sections.

The Van-Packer stack is made of a special mixture of refractory material centrifugally cast into a corrosion-resistant metal jacket. The stack is prefabricated in 3-foot-long sections which are cemented together during installation, with acidproof joint cement that heat sets to form a permanent seal. Joints are further strengthened with tightly bolted, corrosion-resistant metal joint bands.

The stack is made in eight diameters, from 10 to 36 inches in inner diameter. It has many performance and application advantages over other types of stacks, which, combined with its low cost, make it the most economical solution to a variety of stack problems.

Performance Advantages

The noncorrosive feature of the refractory stack assures a long life span. Experience shows that in most applications it will last an average of three times longer than a comparable steel stack. In terms of greater life alone, the economic advantages are readily apparent, as the cost is about the same. An understanding of the causative factors of corrosion in steel stacks will further clarify this important feature.

Corrosion in steel stacks is caused by condensation of combustion gases on the inside stack walls. Sulfuric acid, derived from sulfur in the fuel, rapidly eats away the steel. The rate at which this corrosive action takes place depends on the type of fuel, the type of equipment, and how the equipment is used. Corrosion takes place much faster with coal-fired equipment, for instance, than with gas- or oil-fired equipment. In some applications there is marked deterioration of a steel stack in a matter of months.

Type of Section	Weight in Lbs.	Curing Time in Days	Ultimate Unit Stress in PSI
Straight	205	12	297.9
Straight	206	15	333.9
Average	205.5	13.5	315.9
Tee	184.7	16	210.2
Tee	185.8	17	200.3
Tee	188	18	206.8
Tee	182	19	228.8
Average	185.1	17.5	211.5

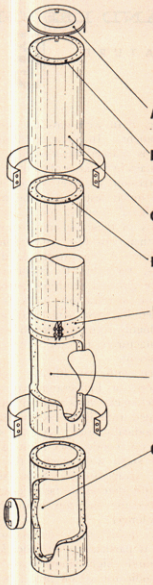
Corrosion of steel stacks takes place much faster with the newer "packaged" boilers, too. The efficiency of these boilers is so great that their exit flue temperature is very low. A "cold stack" condition results, favorable to condensation of flue gas and resulting corrosion. Because a refractory stack is not affected by these acid condensates, it is highly recommended by boiler manufacturers for use with their equipment.

Even with less efficient boilers, furnaces, or incinerators corrosion of steel stacks takes place at an accelerated rate if the equipment is spasmodically used. As the stack heats up, condensates form as the inside stack wall reaches the dew point temperature. Steel stacks generally deteriorate faster near the top because the top sections are cooler longer.

For incinerators, the refractory stack is particularly suitable, for it withstands high temperatures and spasmodic use which produces corrosive acids at an accelerated rate. Most building codes require a steel incinerator stack to be lined with tile because of the intense heat, raising the cost considerably. The Van-Packer stack for incinerators is low in cost and withstands continuous flue gas temperatures up to 2000° F. For incinerator applications a barometric damper is used in the breeching to keep the temperatures within safe limits, protecting both the breeching and the stack. The stack can be fitted with a spark arrester as required.

Application Advantages

In existing construction, it is sometimes necessary to move a boiler or incinerator to a new location, requiring a new stack, as it is rarely practical to move the existing stack. The Van-Packer



Exploded view of Van-Packer prefabricated refractory smokestack shows construction details and product features

A. Corrosion-resistant metal top section cap prevents spalling and provides extra protection for the stack

B. Three-foot sections of insulating refractory material withstand flue gas acids and high temperatures

C. Corrosion-resistant metal outer jacket encases each stack section, eliminates maintenance, painting, tuck pointing

D. Acidproof, high temperature joint cement heat sets to seal joints permanently

E. Corrosion-resistant metal draw-up type joint bands are held securely in place by sheet metal screws, make joint tight and provide additional strength

F. Tee section made of insulating refractory material with opening equal to inner diameter of section. Standard tee section has stainless steel sleeve for breeching connection. Hi-Temp section (not shown) has 6-inch refractory projection for the breeching connection

G. Cleanout section (where required) is made of insulating refractory material with a 10-inch and larger diameter depending on cleanout opening, furnished with corrosion-resistant metal cover

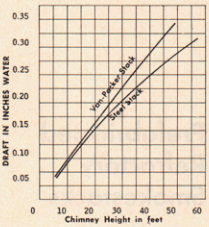
stack is ideal in such cases, because it allows more freedom of location of the boiler or incinerator. It can be installed inside or outside as necessary, and can even be constructed with special fittings which make it possible to divert the flue channel past immovable obstructions. The stack offers the same advantages when expansion of facilities calls for a new boiler or incinerator.

There are several methods of supporting the prefabricated refractory stack to meet varied application requirements. It can be supported on a concrete foundation with or without a cleanout, on a brick pier base, or wall supported on mounting brackets. Or it can be superimposed directly over a boiler or incinerator, with special braces in cases where the equipment is not designed to withstand the weight. Clearance to combustibles for Van-Packer stacks for boilers or furnaces is recommended to be not less than one third the inside diameter of the stack; for incinerators, not less than one half the inside diameter.

The prefabricated refractory stack is also widely used as a replacement for corroded steel stacks. If the old stack gave sufficient draft, it is merely replaced with a refractory stack of the same inner diameter. The corrosion-resistant metal jacket requires no painting or other maintenance, eliminating another expense periodically required with other types of stacks.

Test Data

The results of compressive strength tests made on Van-Packer stack sections are shown in the chart (page 67A). From compressive strength, the height to which a stack may be erected may be determined. On the basis of the average ultimate unit stress, and a safety factor of 5, the tests show that a refractory stack with only straight sections can be erected to 114 feet; with a tee section, to 78 feet. These stack heights are conservative. The curing time for the sections tested was only 12 to 19 days, not the 28 days or more that might be expected between manufacture and erection. Test results indicate that after a longer period of time greater compressive strength may be expected.



Other tests show that the refractory type stack provides more draft than a steel stack for any given height, under comparable conditions. The comparison shown above is for an 18-inch unlined steel stack and an 18-inch Van-Packer stack. Comparison tests with a brick stack showed that a refractory stack of the same height would provide essentially the same amount of draft.

Wind load tests were made on a refractory stack 15 inches in inside diameter by applying a static horizontal force which simulated the thrust exerted by high winds on 7 feet of free-standing sections. Stack failure did not occur until the applied weight was 757 pounds, equivalent to a wind velocity of over 100 miles per hour.

Thousands of refractory stacks are in use today. Perhaps the greatest tribute to the success of this type of stack is the fact that architects and engineers all over the country are specifying them more and more for commerce and industry. Created as a result of a wartime need, they are now universally recognized as an ideal solution to peacetime needs for a low cost, efficient smokestack that affords long life through corrosion resistance.

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