Babcock & Wilcox
Refractories Division

Product Information

March 22, 1972

APPLICATION - B&W KAOWOOL CERAMIC FIBER

PETROLEUM REFINING AND PETROCHEM PROCESSES

VARIED INSULATION APPLICATIONS

One of the most frequent and time consuming maintenance problems encountered by chemical and petrochemical plants is the installation and repair of insulation covering irregular shapes such as pumps, meter leads, valves, elbows, and blowers. By using B&W Kaowool ceramic fiber to insulate these odd and irregular shapes a substantial time and labor savings can be realized. B&W Kaowool ceramic fiber is available in a number of forms and can be wrapped, cemented, or sprayed on irregular shapes for insulation. B&W Kaowool ceramic fiber insulation typically reduces downtime and high labor costs associated with installing and repairing rigid or dense refractories.

B&W Kaowool ceramic fiber is now being used extensively by many refining and petrochemical plants. Kaowool ceramic fiber is flexible and retains significant resiliency even at temperatures up to 2100°F. In addition, it is easy to handle, cut and shape for installation on irregular shapes and hard-to-get-to places. It is very easy to coat B&W Kaowool with cement for mechanical toughness.

For irregular shapes the installation of B&W Kaowool can save an estimated 50% in man-hours compared to the hours required to cut and fit rigid insulation for hot tar pumps, valve bodies, meter leads and blowers. Many petrochemical plants have used B&W Kaowool ceramic fiber to insulate piping up to 24 inches in diameter and U bends as small as 1½ inches in diameter for applications where operating temperatures of 900 to 1800°F are encountered.

B&W Kaowool ceramic fiber blanket lends itself for insulation of expansion joints in furnace walls and roofs, around burner blocks, and where tubes run through walls or roofs. Furnace lining repairs can be accomplished without shutdown with the B&W Kaowool installed behind a sheet of stainless steel on vertical walls or unrolled on top of furnace roofs. This covers gaps left by fallen brick until it is convenient to shut the furnace or heater down for relining.

Many insulation applications in petroleum and petrochemical plants do not involve temperatures above the limits of other fiber insulation materials such as fiberglas or mineral wool. B&W Kaowool ceramic fiber is preferred, however, for reasons other than its temperature resistance:

1 - B&W Kaowool in the desired 6 pounds per cubic foot density is not stiff and conforms readily to the shapes being insulated.

(continued)

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APPLICATION - B&W KAOWOOL CERAMIC FIBER

PETROLEUM REFINING AND PETROCHEM PROCESSES

VARIED INSULATION APPLICATIONS

2 - B&W Kaowool successfully resists steam vapor and other conditions which have caused other fibers to deteriorate.

3 - B&W Kaowool resists crumbling and dusting and in general does not have the irritating effect on the skin which workmen often experience with other types of fibers.

4 - The asbestos cement (mud) used for surface coating adheres readily to the Kaowool fiber, probably because B&W Kaowool Blanket does not contain organic lubricants or binders which will burn out at high temperatures.

B&W Kaowool is ideally suited for the majority of high temperature insulation applications at refining and petrochemical plants. The following are typical application areas where B&W Kaowool ceramic fiber has been used successfully with excellent results. Many of these applications are discussed in the attached sheets.

Reformer roof and arch insulation
Tube and support casting insulation
Natural gas reformer linings
Process heater linings
Expansion joint and seal insulation
Packing around tubes
Flare tip insulation
Furnace roof insulation
Crude furnace insulation
Tar pump insulation
Elbow insulation
Furnace lining back up insulation
Header insulation
Heater access door insulation
Hydrocracker insulation
Pig tail insulation
Mufflers and stacks
High temperature ducting and pipe work insulation
Weld stress relieving
Gaskets
Filtering media
Miscellaneous insulation

Supersedes 5 10 - 1 dated January 26, 1965

REFORMER ROOF AND ARCH INSULATION

In virtually every petrochemical plant suspended roofs and arches in reformers are a constant source of trouble. Labor costs for installing these arches and roofs with dense refractories are high and even more so when these roofs or arches fail. When dense refractory roofs and arches fail, there is also a long period of downtime as well as a production loss. By using a new and modern concept which utilizes B&W Kaowool ceramic fiber blanket as a reformer arch and roof lining, an appreciable savings in labor cost, downtime and production loss can be realized.

A recent failure of a dense refractory suspended arch and roof in a reformer at a major petrochemical plant will illustrate the time required and ease of replacement using B&W Kaowool Blanket as the roof and arch lining. This reformer is 80 feet long and 12 feet wide. When the roof failed, the arch also failed.

In order to prepare the reformer for relining the failed brickwork and alloy hanger rods were first removed. At the completion of the clean out a light gauge steel sheet was welded into position using the existing overhead structures as illustrated in Figure 1. In order to hold the B&W Kaowool Blanket in place, 3/16 inch alloy studs were welded to the steel sheet at appropriate intervals as illustrated in Figure 1. Figure 2 illustrates all of the alloy studs welded in place with 3 inches of mineral wool block insulation impaled onto the studs. The hot face layers of B&W Kaowool Blanket with an 8 pound per cubic foot density were then impaled onto the studs. Figure 3 illustrates how the nose arch was installed. Figure 4 illustrates the completed nose arch and a portion of the reformer roof. Figure 5 illustrates the completed reformer roof.

FIGURE 1

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REFORMER ROOF AND ARCH INSULATION

FIGURE 2

FIGURE 3

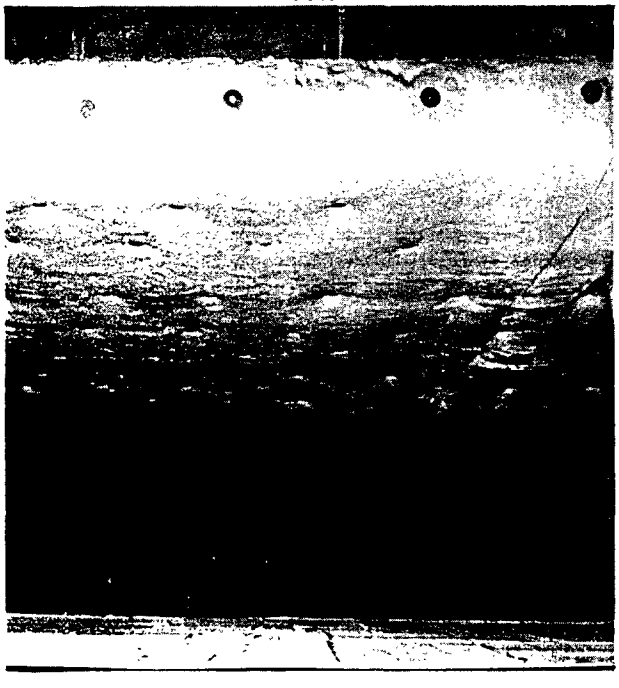

FIGURE 4

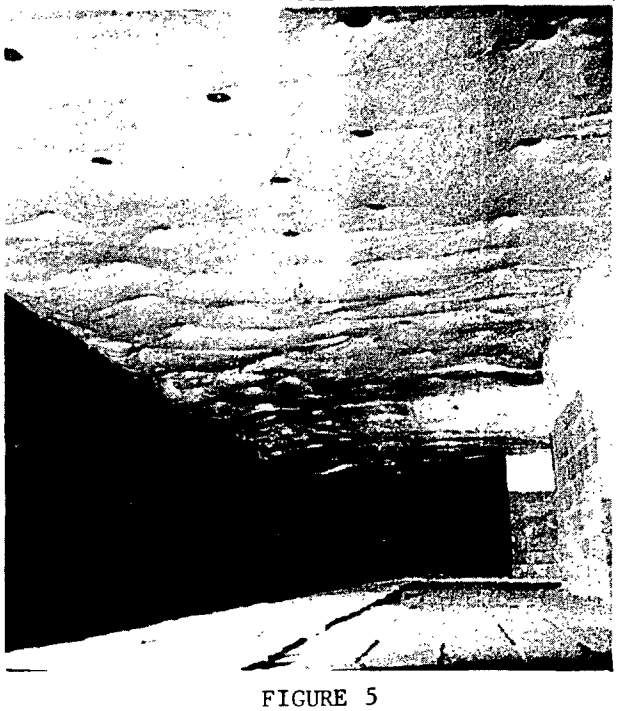

FIGURE 5

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REFORMER ROOF AND ARCH INSULATION

This petrochemical plant had this reformer back on stream in only eight days. In reviewing the work schedule it was determined that six of these days included removing the failed brickwork and preparing the reformer for the installation of the ceramic fiber blanket lining. It is noteworthy that only two days were spent installing the mineral wool block insulation and the layers of B&W Kaowool Blanket on the reformer roof and nose arch.

The importance of getting the reformer back on stream fast is the heart of the B&W Kaowool furnace lining logic. This petrochemical plant now feels that B&W Kaowool Blanket for reformer roof and arch linings is more economical because of their savings in labor installation costs due to the elimination of the use of dense refractories, plus the reduction of costly downtime. It was concluded that B&W Kaowool Blanket was far superior to the dense refractories which had previously been used for the reformer roof and nose arch.

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TUBE AND SUPPORT CASTING INSULATION

Process tube support castings must be protected in order to prevent serious attack from corrosives like sulfur and vandium in heavy oils. Conventional practice at this petroleum plant was to cover the castings with a dense monolithic refractory moldable. In the past a number of dense monolithic refractories had been tried, however, all of these materials had failed. Each time the furnace had to be shut down due to inevitable cracking and spalling which allowed direct flame impingement on the alloy support castings.

This petroleum plant is now using B&W Kaowool ceramic fiber blanket to insulate their process tube support castings. B&W Kaowool is a long staple fiber which can be impaled on 3/16 inch studs welded to the alloy support castings in a fraction of the time required to install dense refractory materials.

A typical alloy support casting is illustrated in Figure 1 and shows the location of the 3/16 inch studs which were welded to the casting. B&W Kaowool 1 inch 8 pound density blanket was impaled onto these studs and wrapped with wire for additional support. Figure 2 illustrates the completed installation of both the top and bottom sections of the alloy support casting.

Figure 2 illustrates how the stud washers were protected from temperatures in the 2200°F range. A 1/4 inch pad of B&W Kaowool 1 inch 8 pound density blanket was folded over the exposed stud washers as is illustrated on the top and bottom sections of the support casting. The B&W Kaowool pad was tucked in a slit below the washer. This installation procedure provides excellent protection for the stud washers against higher operating temperatures.

The two segments of the alloy support castings are insulated separately because of the resiliency of B&W Kaowool at high temperatures. When expansion occurs, fiber comes in contact with fiber and affects a seal which had been impossible to obtain with dense refractories.

After using B&W Kaowool Blanket for over two years, this petroleum plant is more than satisfied with the service life of the ceramic fiber insulation on their support castings. B&W Kaowool Blanket has protected their expensive alloy support castings from the corrosive effects of heavy fuels and have substantially increased the service life of the alloy support castings, as well as reduced the high labor costs previously required with the installation and constant repair of dense refractories.

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TUBE AND SUPPORT CASTING INSULATION

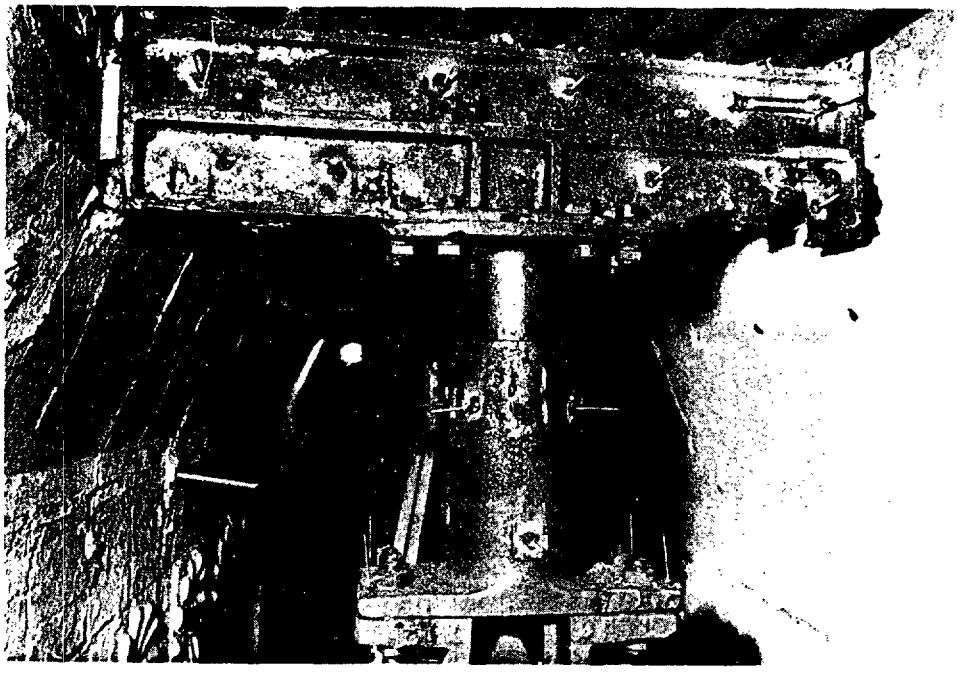

FIGURE 1

FIGURE 2

5 10 - 1

NATURAL GAS REFORMER LININGS

Reformers at petrochemical plants are generally simple heat enclosures, refractory lined with a large number of tubes passing through the combustion area. A typical reformer is illustrated in Figure 1.

This petrochemical plant is now using B&W Kaowool ceramic fiber 1 inch 8 pound density blanket to line their primary reformers. Lightweight B&W Kaowool Blanket is half the thickness of an equivalent lining of insulating firebrick and is one quarter of its weight, resulting in 75% less heat storage than ordinary linings. The low heat storage results in savings in firing and faster cooling when necessary. The use of B&W Kaowool Blanket results in savings in material and installation costs as well as a long service life with minimum maintenance and downtime.

This B&W Kaowool reformer lining is of particular interest because of the method used to protect the studs and washers from high temperatures. Figure 2 shows a workman installing a pad of B&W Kaowool 1 inch 8 pound density blanket over the stud anchor washer. B&W Kaowool Blanket can be cut with a sharp knife or scissors and does not require the use of expensive cutting tools or skilled personnel to do the cutting. In this installation pads of B&W Kaowool Blanket were cut similar to the pad shown in Figure 2. One end of the pad is impaled onto each stud and compressed by the anchor washer. The pad is then folded over and the tapered top is tucked into a slit cut into the ceramic fiber blanket lining. This slit is cut approximately two to three inches below each anchor washer. Figures 3 and 4 illustrate the completed reformer wall and roof with the anchor washers protected with pads of B&W Kaowool Blanket.

This petrochemical plant has standardized on pads of B&W Kaowool Blanket for protection of the stud and anchor washer when reformer operating temperatures are in the 2200°F range.

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NATURAL GAS REFORMER LININGS

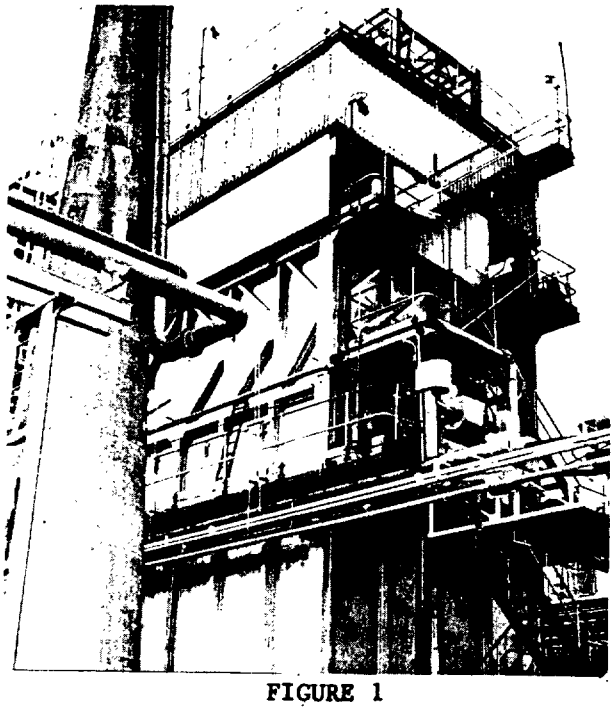

FIGURE 1

FIGURE 2

FIGURE 3

FIGURE 4

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PROCESS HEATER LININGS

This European petrochemical plant has several American designed process heaters which are lined with 1 inch 8 pound B&W Kaowool Blanket. This petrochemical plant has standardized on B&W Kaowool Blanket because of the dramatic labor savings realized during installation and excellent thermal efficiency of B&W Kaowool Blanket linings. Tests at this plant have determined that B&W Kaowool Blanket has reduced noise levels by 20% or more. This installation has greatly contributed to effective noise pollution control.

B&W Kaowool Blanket is half the thickness of an equivalent lining of insulating firebrick and is one quarter of its weight, resulting in 75% less heat storage than ordinary linings. The low heat storage results in savings in firing and faster heating cycles. The longer fibers give B&W Kaowool Blanket high tensile strength and resiliency to withstand vibration and physical abuse encountered in furnace operations.

This European petrochemical plant is more than satisfied with B&W Kaowool Blanket because of savings in installation costs and lower maintenance costs. This plant has proven that B&W Kaowool Blanket linings are more efficient and economical than dense refractory linings.

FIGURE 1

FIGURE 2 5 10 - 1

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EXPANSION JOINT AND SEAL INSULATION

This petroleum producer uses both B&W Kaowool bulk and strips cut from ceramic fiber blanket to pack expansion joints in their furnaces. The resiliency of B&W Kaowool and its ability to take temperatures up to 2300°F give it a definite advantage over lower temperature fibers.

B&W Kaowool Bulk and Strip are packed by hand tightly enough to push it into the full depth of the brick lining. The thermal conductivity through such a packed joint is low enough to reduce a 2200°F hot face temperature to less than 400°F at the metal shell. B&W Kaowool Bulk and Strip are also used around burner blocks, where tubes pass through refractory walls and roofs and other similar type applications.

B&W Kaowool Blanket does not contain organic binders, carrier fiber or other materials that burn out at furnace temperatures. This is a major factor in retention of tight joint packing throughout the furnace life.

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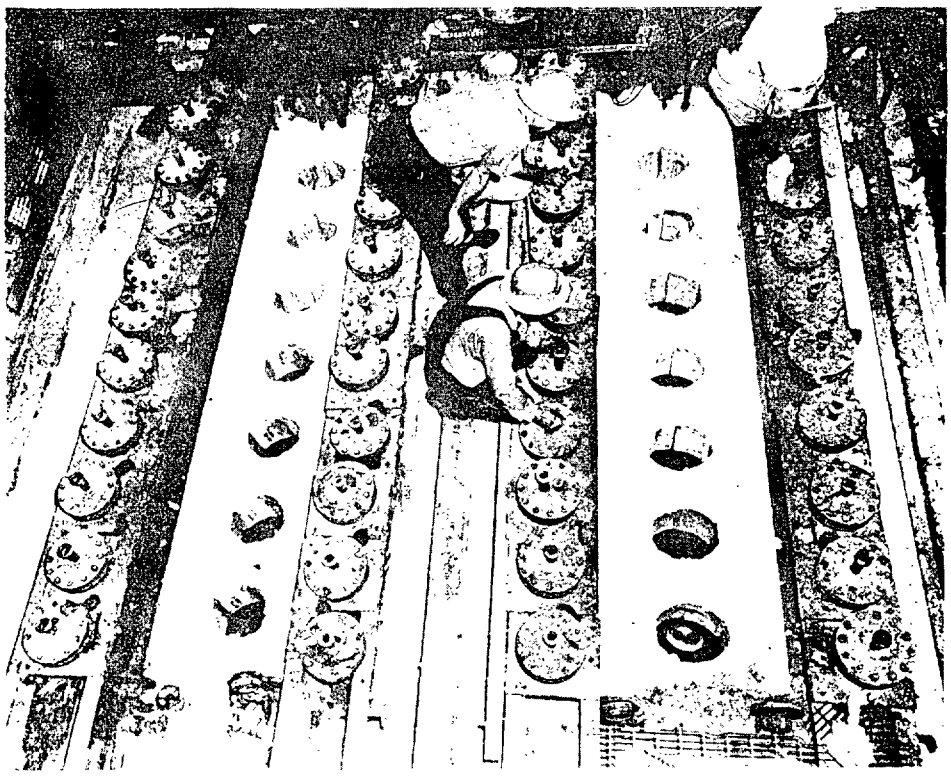
PACKING AROUND TUBES

This petrochemical manufacturer utilizes B&W Kaowool Bulk for packing applications atop the return header box of a new ethylene furnace. This furnace is typical of many types of refinery furnaces having vertical tubes which make their return bends external to the furnace itself. The box, in this case is approximately 2' x 2' x 20' long and is packed full with B&W Kaowool Bulk fiber to minimize heat loss from the tubes.



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FLARE TIP INSULATION

Insulation of the flare tip atop this waste gas burner tower had been a constant installation and maintenance problem at this petrochemical plant. This tower which is illustrated in Figure 1 is used to burn waste gases which are drawn from the plant's catalytic crackers. The temperature at the flare tip is approximately 1800°F. The dense refractory lining previously used was constantly subjected to severe combustion conditions with constant steam injection.

This petrochemical plant now uses B&W Kaowool ceramic fiber wet felt for insulation of the flare tip. Prior to standardizing on B&W Kaowool Wet Felt the flare was lined with castable refractories. This material required installation forms, experienced labor and drying time. In addition, the dense refractory material substantially increased the weight of the tip which resulted in increased installation difficulties at the top of the tower. The service life of the dense refractory material proved to be short because of the severe combustion conditions and spalling which resulted from constant steam injection.

This petrochemical plant, unsatisfied with the dense castable lining began using B&W Kaowool Wet Felt. B&W Kaowool Wet Felt is manufactured by combining Kaowool ceramic fiber with an inorganic bonding agent. B&W Kaowool Wet Felt is very pliable and has good green strength. It can be cut into any size or shape or it can be formed or molded. B&W Kaowool Wet Felt will conform to any surface or contour and when dried or fired it becomes a lightweight resilient insulator which can be sawed, cut, or sanded.

Figure 2 illustrates the completed installation of B&W Kaowool Wet Felt in the flare tip. As can be seen in Figure 2 a close tight seal can be obtained around the steam injection tubes by using B&W Kaowool Wet Felt. After the B&W Kaowool Wet Felt has hardened it forms a lightweight monolithic lining as is illustrated in Figures 2 and 3. Figure 3 illustrates the completed flare tip lining and tip assembly.

This petrochemical plant is very satisfied with the B&W Kaowool Wet Felt lining. The flare tip is much lighter and easier to hoist and install atop the tower. This results in labor savings both during the installation of the B&W Kaowool Wet Felt as well as actual installation of the completed flare tip. The B&W Kaowool Wet Felt has now been in service for three years and has successfully resisted the severe combustion conditions and constant steam injection in the flare tip.

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FLARE TIP INSULATION

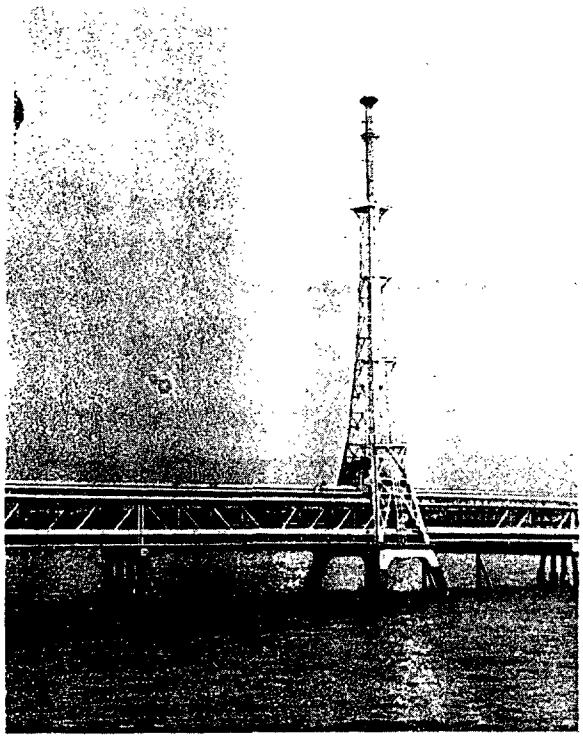

FIGURE 1

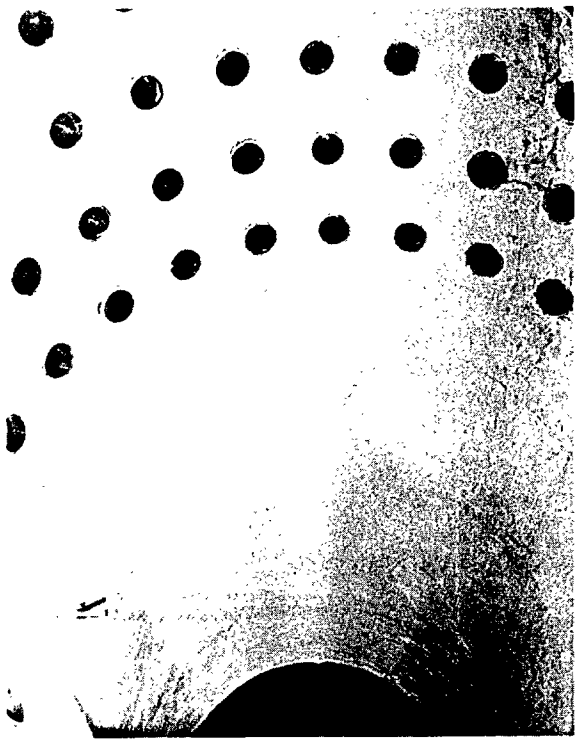

FIGURE 2

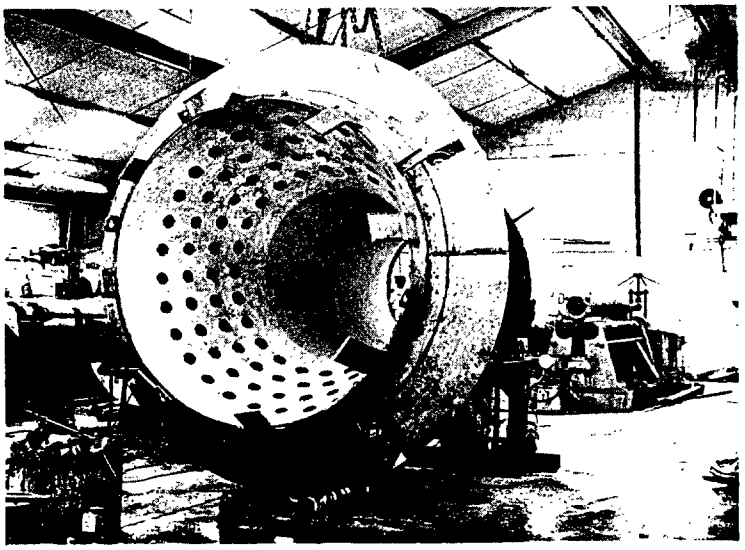

FIGURE 3

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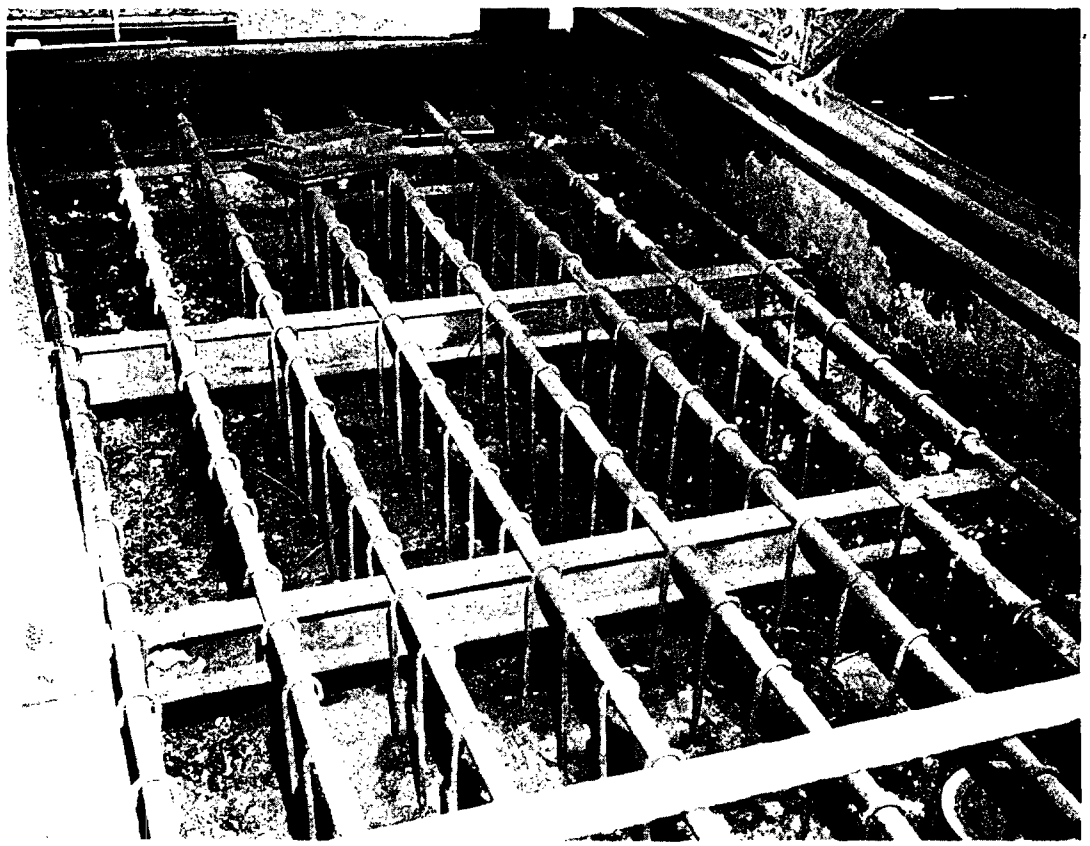
FURNACE ROOF INSULATION

This petrochemical plant faced the problem of brick falling from the flat suspended roof of a pipe still against the upper pipes. The falling brick permitted the loss of hot gasses through the gaps which were created. These gaps were covered with a layer of B&W Kaowool Blanket which was installed through the access openings above the roof. The furnace was not shut down and there were no interruptions in normal furnace operation. A roll of B&W Kaowool Blanket was inserted in the opening by a man in an insulated suit and unrolled across the gap. The ceramic fiber blanket was then covered with a steel plate to compress it at the edges of the gap to form a satisfactory seal.

At another petrochemical plant 2,000 square feet of B&W Kaowool Blanket was installed across the flat roof of a furnace as a preventive maintenance measure. Should brick fall, the ceramic fiber blanket is already in place above the gaps that would be created and, if no brick ever fall or until they do fall, the blanket serves by adding its insulating value to that of the roof brick.



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CRUDE FURNACE INSULATION

In another petroleum plant a typical example of the use of B&W Kaowool Blanket was in a crude furnace where brick fell from a section of vertical wall and from the hip roof above the wall. Repair was made by cutting access openings in the exterior shell and installing a wall of 1/8" 25-20 stainless steel plate backed with B&W Kaowool Blanket insulation. On the vertical section the ceramic fiber blanket was supported by being impaled on welding rod studs attached to the plate. On the 45° hip roof the plate was simply laid on the B&W Kaowool Blanket.

Fires were banked while the repair was being accomplished, but it was not necessary to wait for the furnace to cool. After preparing the repair materials and assembling materials and equipment at the site, actual repair required only 16 hours. In contrast, to have repaired the lining by installing new firebrick, it would have required an outage of two weeks.

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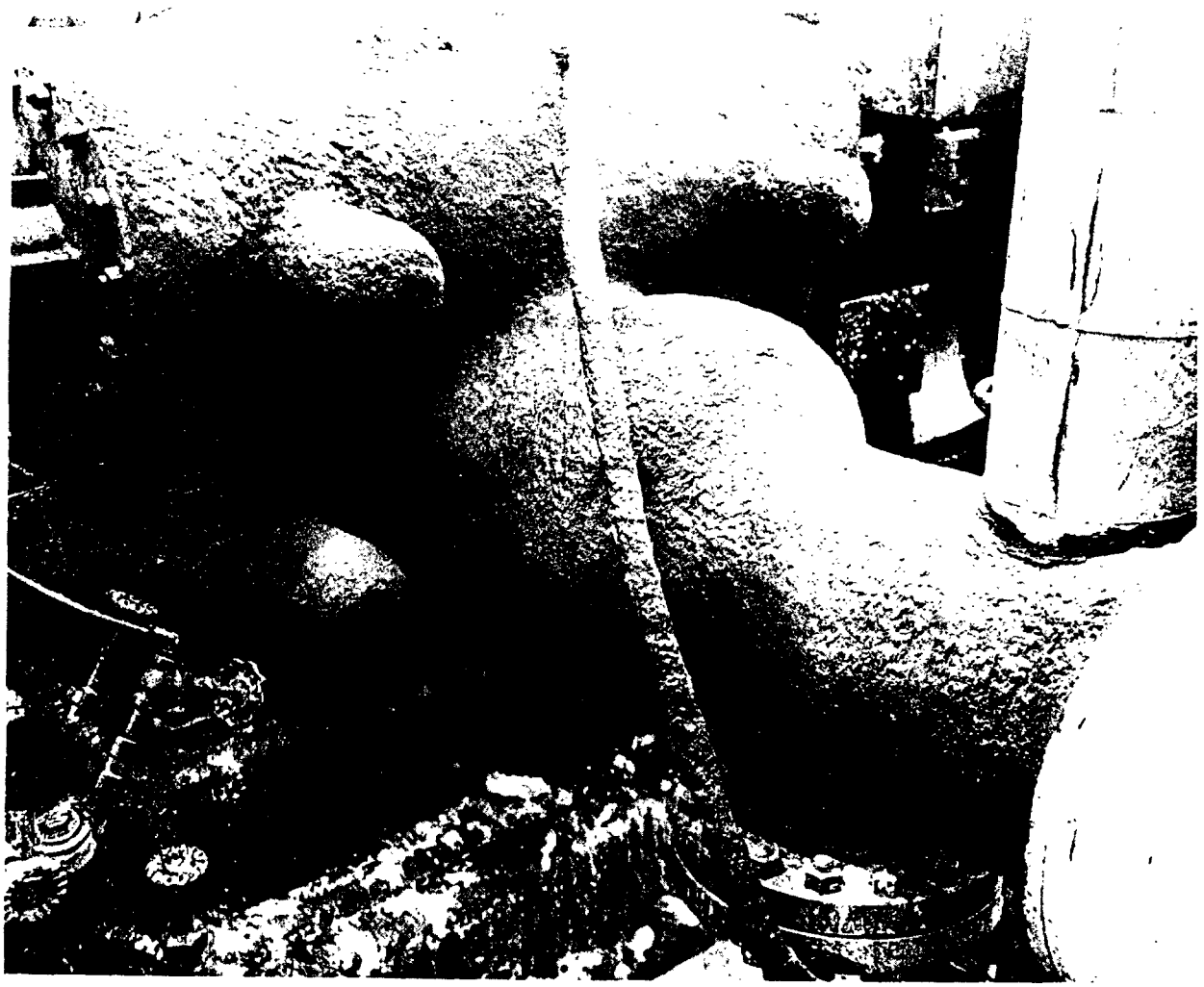
TAR PUMP INSULATION

A typical reciprocating hot tar pump in a petrochemical plant was insulated with B&W Kaowool by two men in six hours. When the same pump was insulated with rigid refractories, the two men needed two days to complete the job. The time savings is especially significant since these pumps have to be torn down and re-assembled and re-insulated several times a year. B&W Kaowool Blanket can frequently be reapplied after equipment repair with little loss of Kaowool in handling.



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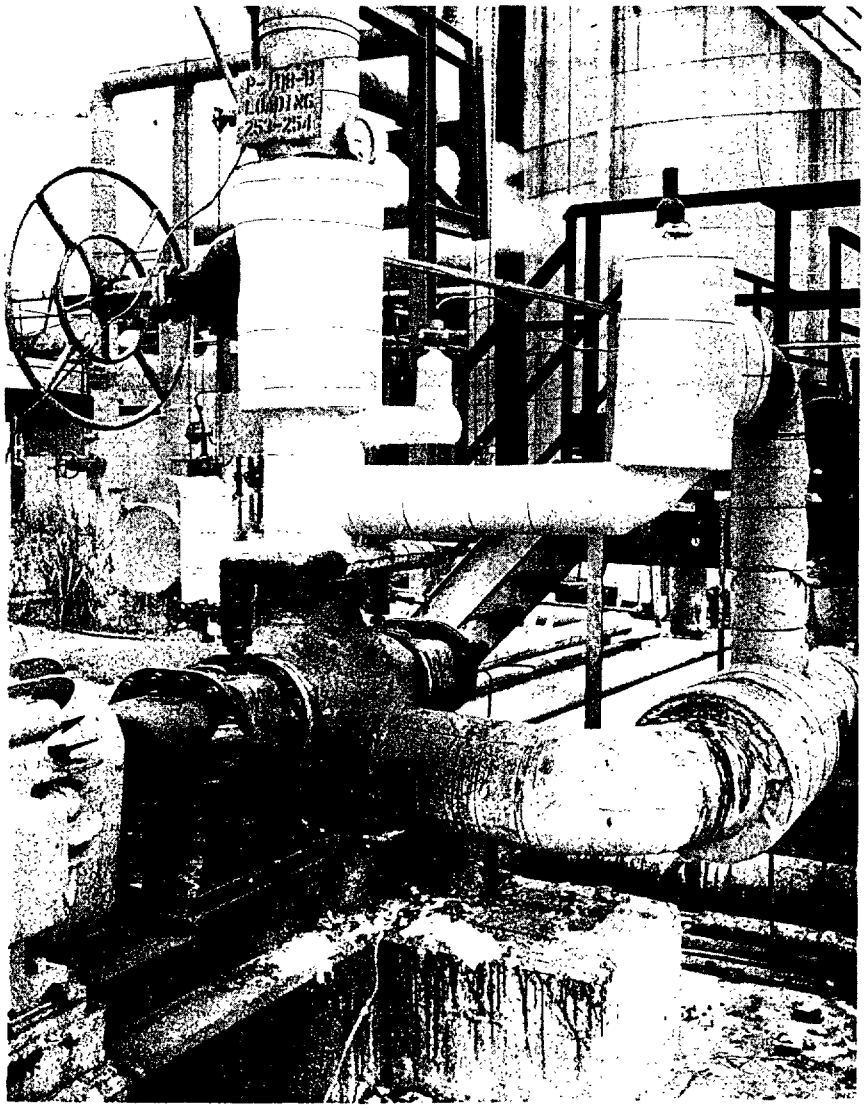
ELBOW INSULATION

This petrochemical plant has realized labor and time savings by insulating meter leads, valves, piping, etc. with B&W Kaowool ceramic fiber. The labor and time savings far offset the higher initial cost of B&W Kaowool. For piping, low cost rigid insulation is easily installed on straight runs. But for elbows, which previously required cutting and cementing tapered sections of rigid insulation, it is far cheaper to use B&W Kaowool ceramic fiber blanket.



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FURNACE LINING BACK-UP INSULATION

A dramatic application at this petrochemical plant is the use of B&W Kaowool Blanket for the replacement of lost furnace lining brick. B&W Kaowool Blanket was installed without a shutdown and was in use for several months until the furnace was shut down for its scheduled relining. It was estimated that this type of repair saved weeks of downtime as well as production loss.

HEADER INSULATION

This petrochemical plant has installed B&W Kaowool Blanket on the flat roof of a reformer to insulate the headers through which the catalyst pipes pass down into the furnace. A conventional insulation material such as asbestos sheet was formerly used for these headers. B&W Kaowool Blanket has proven quicker and easier to install and will last substantially longer.

HEATER ACCESS DOOR INSULATION

This petroleum plant has lined the heater access door panels with B&W Kaowool Blanket instead of firebrick. For most panels this eliminates enough weight so that one man can remove them, thus eliminating the time required for an extra man to make round trips to an upper level solely to help remove and replace the access door panels.

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Flexible Ceramic Fiber Blanket . . .

Solves Hydrocracker Insulation Problem

by David J. Mistrot, *Engineering Editor*

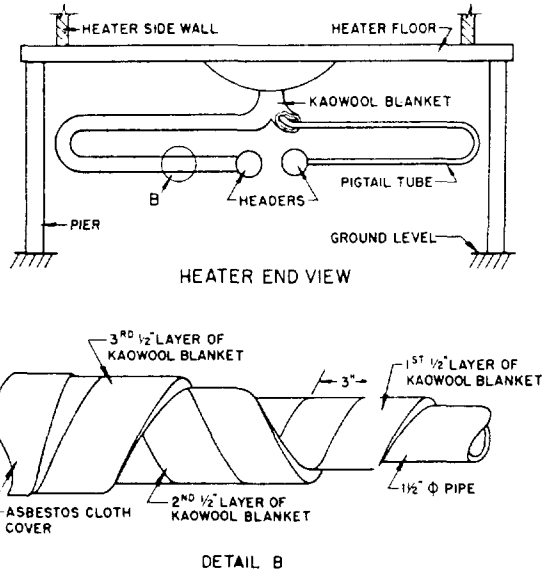

Figure 1. Application of Kaowool ceramic fiber blanket to hydrogen reformer pig-tails.

■ Union Oil Co. of California solved a difficult high-temperature pipe-covering problem on their Wilmington, Calif., hydrocracker with a new type ceramic fiber pipe insulation material made by Babcock & Wilcox.

Hydrogen for the 16,000 b/d Unicracker-JHC unit is produced in a high-temperature reformer furnace. The pig-tail expansion tubing below the reformer furnace posed a problem. The expansion of dozens of these small-diameter alloy pig-tails —which carry high-velocity hydrogen gas at 1400 F—made it difficult to obtain satisfactory thermal insulation.

Conventional insulation materials either would not withstand the high temperatures of the system, or they were rigid and brittle and pulled away from the flexing pig-tails, often in a very short time. The result was either a large and costly heat loss, or lost operating time for shutdown and replacement of the defective insulation.

Union Oil's approach was to cover the pigtails with Kaowool alumina-silica ceramic fiber blanket made by the Refractories Division of the Babcock & Wilcox Co. Flexibility and resiliency of the ceramic fiber blanket assured that tubing expansion would not affect insulating properties.

Cost Analysis Jacketed Kaowool vs. Asbestos Roll Board
(Insulation of 8-in. pressure pipe for weld stress relief)

	Requirement/Weld		Cost Basis	Kaowool Ceramic Fiber	Asbestos
Insulation Material	Kaowool	1 sq ft*	$5/sq ft	$ 5.00	------
	Asbestos	23.0 lb	30¢/lb	------	$ 6.90
Installation Labor	Kaowool	0.2 Manhours	$9/hr	1.80	------
	Asbestos	3.0 Manhours	$9/hr	------	27.00
Cable Insulation Sock	Kaowool	1.80 lb	$1.85/lb	3.33	------
	Asbestos	4.17 lb	$1.85/lb	------	7.70
Cost to insulate weld on 8-in. pipe for stress relief:				$10.13	$41.60

*Based on using 14 sq ft blanket for 14 welds.

Reprinted from Petro/Chem Engineer October 1965

Figure 2. Workmen wrapping jacketed Kaowool ceramic fiber around boiler superheater supply crossover, before installing induction cable for code pressure weld stress relief. The two men can install this blanket in five minutes.

Figure 3. Workmen coiling induction cable around crossover pipe insulated with jacketed Kaowool blanket. The asbestos sleeve insulation on the cable is protected from excessive heat by the blanket.

The Kaowool was spirally wound on each pig-tail. Rolls of blankets ½-in. thick by 24-in. wide and 168-in. long were cut on a band saw into tape-width strips. As shown in Fig. 1 three layers were spirally wound on the pig-tails (the first clockwise the next counterclockwise, and the third clockwise again). Asbestos cloth was wound over-all to improve resistance to mechanical damage.

Other Process Applications

Kaowool ceramic fiber blanket has numerous applications in the HPI. Flexibility and resiliency are claimed for it up to 2100 F. In addition, it is easy to handle and shape, particularly for irregular shapes and hard-to-get-to places. Too, it is simple to surface with cement for permanency.

For irregular shapes, B&W reports a 50% saving in manhours over that required to cut and fit rigid insulation for hot tar pumps, valve bodies, meter leads and blowers. Piping up to 24-in. diam and U-bends as small as 1½-in. diam have been successfully insulated for operation at 900 to 1800 F.

The flexible ceramic fiber blanket lends itself for insulation of expansion joints in furnace walls and roofs, around burner blocks, and where tubes run through walls or roofs. Temporary furnace lining repairs can be accomplished without shutdown with the Kaowool installed behind a sheet of stainless steel on vertical walls, or unrolled on top of furnace roofs. This covers gaps left by fallen brick until convenient to shut down for relining.

Weld Heat Insulation

HPI plants, fabricators and constructors are using ceramic blanket to insulate for piping, tank and vessel welding on preheat and stress-relief. One major fabricator uses the blanket to retain heat during bending. The inch thick reusable ceramic blanket with Inconel mesh jacket is now offered by B&W in a kit including 24 ft of blanket either 24 or 48-in. wide, and sewing materials for closing the mesh jacket at cut ends.

The advantages cited by B&W over using layers of thin-sheet asbestos are: reusability; more weather-proof; ease of handling the 1-in. thick blanket rather than numerous layers of ⅛-in. asbestos; and no disintegration of the Kaowool. It can withstand as high as 2300 F continuously.

A thorough economic evaluation of the blanket was made earlier this year by B&W on the erection of a sub-critical 2,600,000-lb/hr, universal pressure boiler.

Costs were 75% less than usual procedure of using asbestos. As shown in Fig. 2. and 3, the Kaowool was used for stress-relieving some 40 welds on 8-in. and larger piping for the boiler steam circulation system, and more than repaid its higher first cost through multiple reuse. Installation time was cut from more than an hour per weld to a few minutes. Additional savings were realized by prolonging the life of induction cable insulation and eliminating the nuisance of disintegrated asbestos. An average cost analysis for the 40 8-in. welds is shown in the accompanying table. ■