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INSULATION
in
INDUSTRY

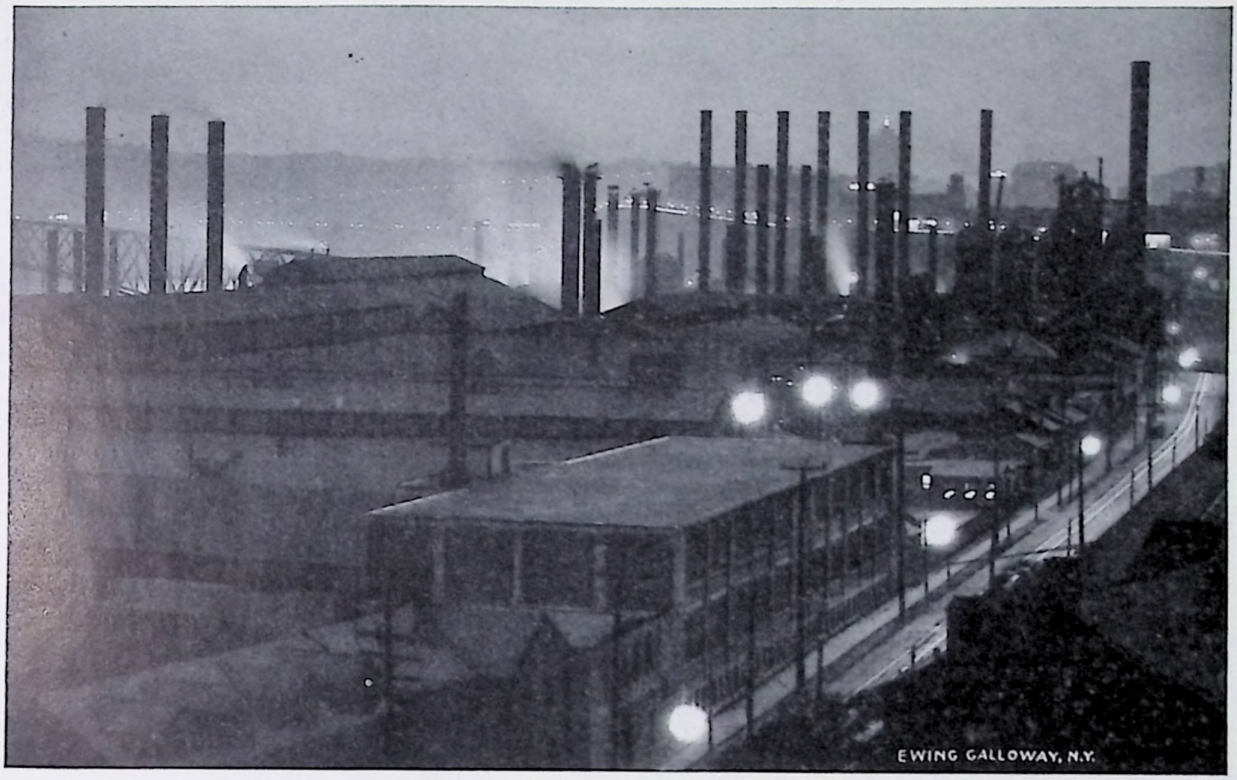
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Consolidation of information included in the individual Industrial Application Books (DS Series 600 to 616)

Johns-Manville
Offices in all the Larger Cities

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Insulation



J-M Industrial Insulating Materials reduce operating costs and improve performance wherever heated or refrigerated equipment is used

INSULATION is used to retard heat flow where it is desired to maintain a temperature either higher or lower than that of the surroundings. Whether heating or refrigerating is involved, insulation is essential to economical operation.

Heated Equipment:

In industrial furnaces, while fuel saving is the principal advantage of insulation and the one most readily convertible into dollars and cents, there are other attendant advantages which in many classes of work are considered to be at least as important as the saving of fuel. First among these is the improvement in the quality of heat-treated products which is brought about by the more uniform heat distribution and more accurate temperature control which is possible with insulated equipment.

Other advantages of industrial furnace insulation are increased capacity of the equipment; protection to brickwork from rapid temperature changes; reduction of internal strains and cracking; and an improvement in working conditions about the equipment.

In the case of boilers, insulation over bare metal surfaces is even more essential than over brickwork. Steam pipe insulation reduces condensation, permitting the delivery of drier steam, and through heat saving pays for itself several times each year.

Refrigerated Equipment:

From the standpoint of economical operation, insulation of low temperature equipment and structures is especially important. A ton of refrigeration, which is equivalent to the removal of 288,000 B.t.u. per 24 hours, costs approximately ten times as much as the equivalent number of B.t.u. when produced for heating purposes. The necessity for much heavier insulation on low temperature work than is customary for high temperatures is, therefore, immediately apparent. Furthermore, many forms of cold storage demand that temperatures be controlled within a narrow range, a condition equally common in the cold processing of oils and chemicals. Such close temperature control cannot be maintained without adequate insulation to reduce heat transfer where necessary.

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Thickness of Heat Insulation

The economical thickness of insulation depends primarily upon the temperature and the cost of heat. The thickness is ordinarily computed on the basis of fuel costs and operating conditions so the heat which passes through the insulation is only that portion which may not economically be saved. Sometimes special conditions require thicker insulation than would be warranted by fuel saving.

The economical thickness of pipe insulation also depends on the pipe size. While it is a fact that small pipes would have to be more heavily insulated to give the same saving of heat, it is nevertheless true that the larger pipes should be provided with thicker insulation in order that the maximum net saving be realized. A 1″ pipe with 1″ thick insulation will lose heat more rapidly per sq. ft. of pipe area than a 10″ pipe with the same thickness of insulation; because the outside surface of the insulation on the 1″ pipe is nearly 200 percent greater than that of the pipe, while the outside area of the insulation on a 10″ pipe is less than 20 percent greater. As a result of the greater area of material through which heat may flow, the losses from the 1″ pipe must be greater.

The matter of net saving takes into account both the saving per year and the cost per year of effecting that saving. Therefore, since the insulation on a 1″ pipe costs from 1½ to 3 times as much per square foot of pipe surface as on a 10″, and since each inch of thickness on a 10″ pipe saves more heat than the same on a 1″, it is at once evident that it pays to put a thicker insulation on a 10″ than on a 1″ pipe.

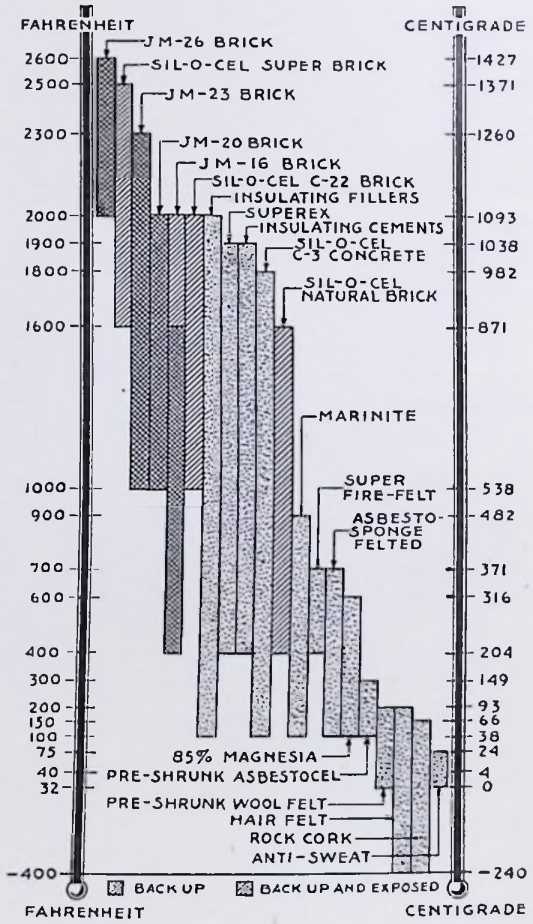
Selection of Insulation

To be adaptable, insulation must be of such form as to be easily applied. It must have heat-resisting qualities sufficient to withstand successfully the highest temperatures to which it will be subjected. It must be sufficiently strong and durable to assure long life. Adaptability also depends upon many other conditions incidental to the particular application.

The efficiency of a commercial insulation depends primarily upon the small voids which it contains. In order to be most effective, the voids must be enclosed and so small that circulation within them and radiation across them will be at a minimum. Small void size is particularly important at high temperatures because of the rapid increase in convection and radiation with rise in temperature.

From the four mineral products—asbestos, magnesium carbonate, diatomaceous silica (Celite), and mineral wool—Johns-Manville furnishes insulation in the forms of sectional pipe covering; insulating sheets, blocks, bricks and blankets; insulating cements, fillers and finishes; insulating papers and felts; as well as a light-weight aggregate used with portland or lumnite cement for making insulating concrete. A wide range of refrigeration products such as hair felt and Rock Cork complete the line.

There is a J-M product for every heat-insulating purpose. Materials are available for use throughout the entire range of temperatures used in industrial processes, from the extreme sub-zero temperatures used in the treatment of oils, chemicals, etc., to 3000 deg. F. and more, used in many modern industrial plants. The temperatures below are those applied to the insulation, rather than process temperatures.



J-M Insulating Materials cover the entire range of industrial temperatures

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J-M Brick, Sheet and Block Insulation

Insulation in the shape of bricks, sheets and blocks is generally most suitable for flat or moderately curved surfaces. Brief descriptions of some of the J-M materials available are given in the following paragraphs:

Insulating Brick

J-M Insulating Fire Brick (Temperatures to 2600 deg. F.) Made from refractory clay and a carefully graded organic filler for use as a refractory lining. Four types are available: JM-16 to 1600 deg. F., exposed and 2000 deg. F., back up; JM-20 to 2000 deg. F.; JM-23 to 2300 deg. F.; and JM-26 to 2600 deg. F. All four brick are moulded, fired and accurately ground to size.

	JM-16	JM-20	JM-23	JM-26
Densities, lb./cu. ft.	22	31	38	44
Cold Crushing Strengths, lb./sq. in.	70	125	170	165

The brick are furnished in standard fire brick size, 9″ x 4½″ x 2½″ (packed 25 per carton) and in other fire brick shapes.

Sil-O-Cel C-22 Brick (Temperature limit, 2000 deg. F.). A moulded and calcined diatomaceous silica (Celite) brick for use behind a refractory. Cold crushing strength, 700 lb. per sq. in. Furnished 9″ x 4½″ x 2½″, and in other fire brick shapes. The 2½″ brick, 2¼ lb. each, are packed 25 per carton.

Sil-O-Cel Natural Brick (Temperature limit, 1600 deg. F.). Natural diatomaceous silica (Celite). The most efficient insulating brick obtainable. Cold crushing strength, 400 lb. per sq. in. Furnished same as C-22 Brick. Weight: 2½″ brick, 1¾ lb.

Sil-O-Cel Super Brick (Temperature limit, 2500 deg. F.). Moulded and calcined diatomaceous silica (Celite). This brick is used as back-up insulation. Cold crushing strength, 300 lb. per sq. in. Furnished same as C-22 Brick. Weight: 2½″ brick, 2¼ lb.

Sheets and Blocks

Asbesto-Sponge Felted (Temperature limit, 700 deg. F.). Constructed from felts composed of asbestos fibre so combined to give a spongy laminated material. Withstands rough usage; can be removed and replaced without injury. Furnished 36″ long by 6″, 9″, 12″, 18″, 24″ and 36″ wide, from ½″ to 4″ thick. Weight approximately 2½ lb. per board foot. It is often used as a second layer outside Superex.



Breeching being insulated with 85% Magnesia. Block sizes are convenient in applying insulation over metal surfaces

Asbestos Fire-Felt (Temperature limit, 1000 deg. F.). Except for greater mechanical strength, made and furnished like Super Fire-Felt, following. Weight per board foot approximately 3.3 lb.

Banroc Board (Temperature limit, 225 deg. F.). A blended mineral wool formed with a moisture-resisting binder into rigid sheets. Used in heating, ventilating and air-conditioning ducts and equipment. Also for oil storage tanks, dryers and general moderate temperature service, especially where moisture prevails. Furnished, 24″ x 36″, in thicknesses of ½″, 1″ and 1½″. Weight approximately 1½ lb. per board foot.

Asbestocel (Temperature limit, 300 deg. F.). Manufactured of built-up layers of alternate plain and corrugated asbestos felts. Used on medium and low temperature boilers, warm air ducts, etc. Furnished with 4 plies per inch of thickness in sizes 6″, 9″, 12″, 18″ and 36″ wide by 36″, 48″, 72″ and 96″ long from ½″ to 4″ thick. Weighs approximately 1 lb. per board foot. Fine Corrugated Asbestocel, manufactured with 6 plies per inch of thickness, is furnished in the same sizes as the 4-ply material and weighs about 1.3 lb. per board foot.

85% Magnesia Blocks and Lagging (Temperature limit, 600 deg. F.). One of the most efficient commercial insulations. Made of hydrated basic carbonate of magnesia bonded with asbestos fibre. Blocks are furnished 3″, 6″, 9″ and 12″ wide by 18″ or 36″ long. Other sizes and lagging supplied on special order. Thickness of flat blocks, 1″ to 4″; maximum thickness

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of curved blocks is that which can be cut from a 4"-thick block. Radius of curvature must be specified. Weight is about 1.4 lb. per board foot.

Marinite (Temperature limit: Type A, 900 deg. F.; Type B, oil-treated, 250 deg. F.). A light-weight homogeneous sheet made of asbestos fibre with an inorganic binder. Suitable for ovens, marine joiner work, lehrs, boiler walls and bases, boiler-room walls and ceilings and for fire-proofing structural steel. Standard sizes are furnished 36", 42" and 48" by 96", in thicknesses of ½", ¾", ⅞" and 1". The density of Marinite is 34 to 38 lb. per cu. ft.

Pan-O-Cel Sheets (Temperature limit: Type A, 500 deg. F.; Type B, 250 deg. F.). Made of finely corrugated asbestos felts, sealed within plain asbestos felt coated with a refractory solution. Used in the construction of drying rooms, low temperature ovens, etc. Type B is used when a more moisture-resistant material is required. Both types furnished 36" x 36", 36" x 72", 36" x 84" and in special sheets up to 68" x 100". Thicknesses from 1" to 4". Weight of 2" thickness approximately 3 lb. per sq. ft.

Rock Cork Sheets, Lagging and Discs (Temperature limit, 100 deg. F. or 150 deg. F. in ducts). A highly efficient material for refrigerating equipment. Made from mineral wool with a waterproof binder. Sheets are 18" x 36" in 1", 1½", 2", 3" and 4" thicknesses. Weight approximately 1.25 lb. per board foot. Discs are furnished from 1½" to 4" thick up to 18" dia.; in two pieces, to 36".

Super Fire-Felt (Temperature limit, 700 or 900 deg. F.). Formed of asbestos fibre and a binder for use where a light, strong material is required. Furnished, 24" x 36" and 6" x 36", from ½" to 4" thick. Also supplied on order in curved or special shapes for irregular surfaces. When installed between metal or brick linings, it may be used for temperatures to 900 deg. F. Weight per board foot, approximately 1.7 lb.

Superex Blocks (Temperature limit, 1900 deg. F.). Made of specially selected diatomaceous silica, blended with other insulating materials and bonded with asbestos fibre for insulating boiler walls, furnaces, etc. Blocks are 3", 6", 9" and 12" by 18" and 36". Other lengths on order. Thicknesses from 1" to 4" for flat blocks; maximum thickness of curved blocks is that which can be cut from a 4"-thick block. Radius of curvature must be specified. Weight per board foot approximately 2 lb.

Blankets, Paper, Millboard

Asbestocel—Flexible Roll Form (Temperature limit, 300 deg. F.). Made of a plain and corrugated asbestos felt, cemented together, about ¼" thick; also fine corrugated, 1/6" thick. Used for heater or furnace pipes. At least two layers should be used. Furnished 36" to 37" wide in 125 or 250 sq. ft. rolls.

Asbestos Blankets (Temperature limit, 950 deg. F.). Flexible insulation made of quilted asbestos cloth, filled with asbestos fibre. For irregular surfaces, such as paper digesters and steam turbines, where removable insulation is desired. Furnished to order in 1½", 2" and 2½" thicknesses in single layer and 3", 4" and 4½" thicknesses in double layer.

Asbestos Paper and Roll Board. Used where insulation of minimum thickness is required, principally as a protection against heat and as a fire-retardant. Paper is furnished 18", 24" and 36" wide in thicknesses from 0.015" to 1/16". Roll Board (heavy asbestos paper) is furnished 18" and 36" wide in 3/32" and ⅛" thicknesses. Both are supplied in standard rolls weighing 50 or 100 lb. Special widths and cut sheets supplied on order. A 12-lb. Asbestos Paper Tape is available in rolls 84 ft. long and 2" and 3" wide, packed 18 and 12 per package, respectively.

Asbestos Sheet Millboard. Recommended where relatively thin sheets or boards are required for protection against fire, heat, and acid fumes. Used as a fireproof lining for partitions, etc. Also used in ranges, stoves, etc. Made in various densities and fire-resisting properties. Furnished 1/32" to ¾" thick in standard sheets 42" x 48" or in cut pieces.

Asbestos Roll Fire-Felt (Temperature limit, 1000 deg. F.). A soft, flexible asbestos felt that may be folded, bent or wrapped around pipes and heated surfaces. Furnished ⅛" and ¼" thick in rolls 3 ft. wide, containing approximately 100 sq. ft.

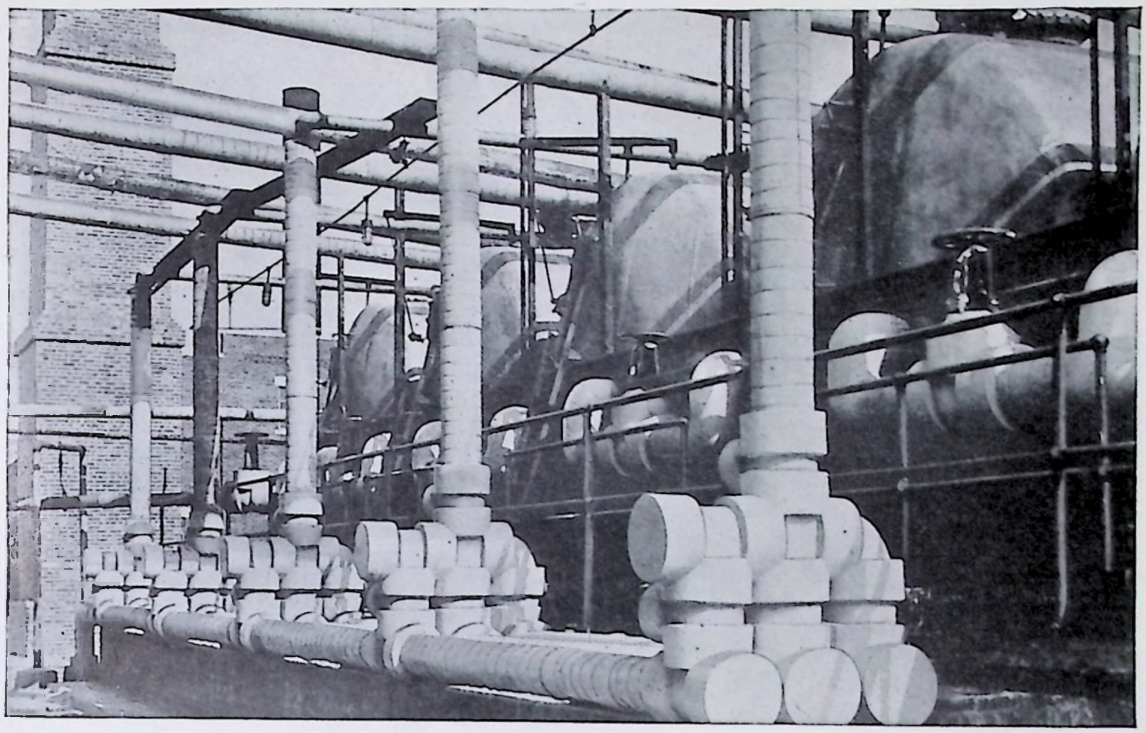
Banroc Blankets. A flexible insulation used for baking ovens, dryers, etc. Composed of Banroc (mineral wool) felted between galvanized wire netting, metal lath, rib lath, or fly-screen wire. Also furnished with asbestos paper both sides. Standard sizes for most types of Banroc blankets are 24" x 96" and 24" x 48", from 1" to 6" thick.

Standard Hair Felt (Temperature limit, 200 deg. F.). Made from 100% cattle hair and widely useful at low or moderate temperatures. Furnished from ¼" to 2" thick in bales 6 ft. x 50 ft., 3 ft. x 100 ft., 3 ft. x 50 ft., 9 ft. x 50 ft. and in cut pieces.

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J-M Pipe Insulation



An effective installation of J-M pipe insulation on heated lines exposed to all kinds of weather

Johns-Manville furnishes many kinds of insulation in a form suitable for insulating pipes conveying hot or cold fluids. The insulation which should be selected for a particular application depends on the requirements of the individual job.

Asbesto-Sponge Felted is the most efficient commercial insulation for pipes conveying hot liquids and vapors at temperatures not exceeding 700 deg. F. Its laminated construction gives sufficient mechanical strength to withstand severe usage and vibration, which makes it particularly desirable where the insulation is subjected to rough treatment. Another advantage is the fact that it can be taken off and placed on other pipe of the same size without deterioration from the consequent handling and transportation.

J-M 85% Magnesia is extensively used for steam line insulation requirements where the insulation is not subject to mechanical injury and where the temperatures do not exceed 600 deg. F. It is light, efficient and slightly lower in price than Asbesto-Sponge Felted, but it will not stand rough treatment as well.

In the range of temperatures so high that Asbesto-Sponge Felted or 85% Magnesia should not be used, Superex Pipe Insulation is the proper material. Sometimes Asbesto-Sponge Felted is used outside of Superex for mechanical protection of the Superex and to increase insulating efficiency. Magnesia is also often used as an outside layer where the insulation is not subjected to abrasion, because it is a little more economical in first cost and is a slightly better insulator than Superex. These combinations of Superex and Asbesto-Sponge Felted or 85% Magnesia are known as Superex Combination Insulation.

Generally speaking, Asbesto-Sponge Felted, 85% Magnesia, or Superex will solve any ordinary insulation problem on heated pipes, but other materials are available and frequently may be used to advantage.

Complete information on these materials and on Rock Cork, Built-up Brine and Ammonia, Anti-Sweat and other pipe insulation for cold work appears in the insulation data sheets. Brief descriptions of all these materials are given on the reverse of this sheet.

J-M PIPE INSULATION
April, 1942 (Cancelling sheet dated February, 1940)
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Brief Descriptions of J-M Pipe Insulating Materials

Anti-Sweat Pipe Insulation: Made of laminated insulating felts protected inside and out with waterproofing felts. Used to insulate cold water pipes and to prevent condensation. Furnished in 3-ft. sections, to fit standard pipe sizes and straight runs of copper tubing, in thicknesses of ½" and ¾", solid construction, and 1", 1½" and 2" double layer. Waterproofing felts protect inner and outer surfaces of each layer of double layer construction.

Asbesto-Sponge Felted Pipe Insulation: Made of felts composed of asbestos fibre so combined to give a spongy laminated material. Withstands rough usage, and can be removed and reapplied without loss of efficiency. Furnished for standard pipe and copper tubing in 3-ft. sections from 1" to 3" thick. On special order it is supplied with integral waterproof jacket or waterpermeable jacket. The 3" thickness is furnished double layer unless solid construction is specified. Temperature limit 700 deg. F.

Asbestos Fire-Felt Pipe Insulation: Moulded from felted asbestos fibre. Used where insulation must resist vibration or motion without fracture. Furnished in 3-ft. sections, 1" to 3" thick, to fit standard pipe sizes. Temperature limit 1000 deg. F.

Asbestos Pipe Blankets: For pipes, fittings and flanges where inspection is made frequently and necessitates removal of the insulation. Made of asbestos cloth, filled with asbestos fibre and quilted. Furnished 2" or 3" thick in single layer, and each layer 1½" or 2" thick, in double layer. Made in 3-ft. sections with 1-ft. sections for breaking joints on double-layer construction. Temperature limit 950 deg. F.

Banroc Pipe Insulation: Made of mineral wool in two types: Style No. 25, with metal lath inside and outside for use where a cement finish is desired; Style No. 65, made with a 24-ga. rust-resisting iron outer casing, with 2" end lap, to provide a waterproof and fireproof jacket. Furnished in 2-ft. sections, 1" to 4" thick, for pipe sizes of 2" and larger. Temperature dependent upon usage.

Built-up Brine and Ammonia Pipe Insulation: Built-up on the job by using several layers of 1" hair felt thoroughly sealed with a waterproof membrane. Used on pipes carrying low temperature liquids.

Built-up Hair Felt Pipe Insulation: Built-up on the job by using the required number of layers of 1" hair felt secured to the pipe with jute twine and each layer finished with a waterproof jacket. Used to prevent water lines from freezing.

85% Magnesia Pipe Insulation: One of the most efficient commercial insulations. Made of 85% basic carbonate of magnesia bonded with asbestos fibre. Furnished to fit standard pipe and tubing in 3-ft. sections or segments in the following thicknesses: Standard, 1½", 2", 2½", Double Standard, and 3" (double layer). Temperature limit 600 deg. F.

Pre-Shrunk Asbestocel Pipe Insulation: Made of plain and corrugated asbestos felts with cross corrugations at regular intervals, built up to the required thickness. Furnished in 3-ft. sections in standard thicknesses of two to eight ¼" plies to fit standard steam and hot water piping. The sections are surfaced with asbestos paper or canvas. Fine Corrugated Pre-Shrunk Asbestocel is furnished six plies to the inch with canvas cover, in thicknesses of four to nine plies. Temperature limit 300 deg. F.

Pre-Shrunk Wool Felt: Used for hot or cold water pipes. It is made of wool felt, indented by a special process and furnished in sections 3 ft. long, in thicknesses of ½", ¾", 1", Double ½" and Double ¾", for pipe sizes from ½" and up. Made with a dual-service liner for hot or cold water lines. Available with a canvas finish.

Rock Cork Pipe Insulation and Lagging: An efficient cold storage and refrigerated equipment material made of mineral wool and a waterproof binder. Pipe insulation is furnished for standard pipe sizes in 3-ft. sections with integral waterproof jackets. Supplied in Ice Water, Brine and Heavy Brine thicknesses. Fittings are insulated with Zerotex. Lagging is furnished for diameters up to 20 ft., 18" or 36" long, 1½", 2", 3" and 4" thick and from 2" to 5" wide depending upon cylinder diameter.

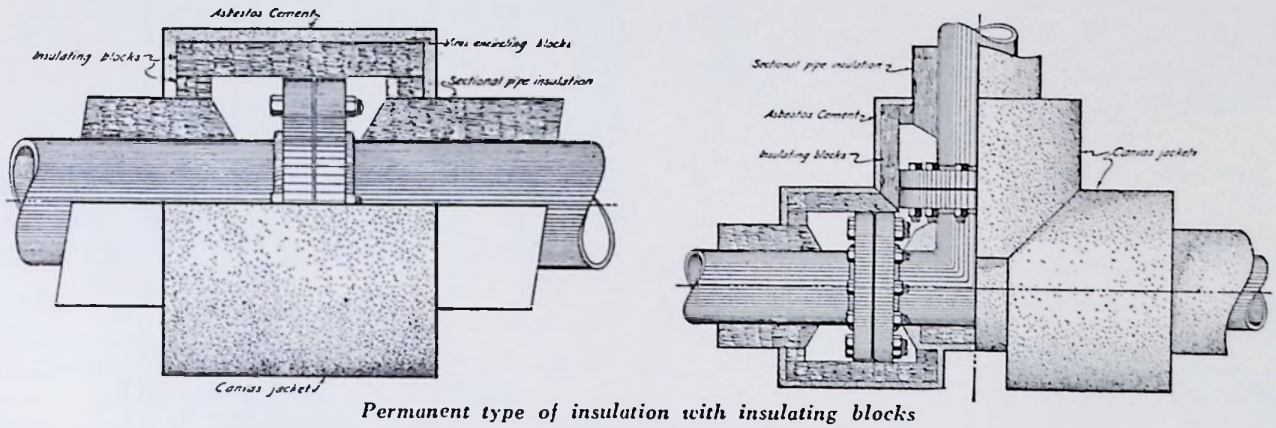
Superex Pipe Insulation: A bonded combination of diatomaceous silica and asbestos fibre. Furnished for standard pipe sizes in 3-ft. sections or segments, up to 3" thick. The 3" is supplied in two layers. Temperature limit 1900 deg. F.

Zero Pipe Insulation: Composed of layers of hair felt and wool felt, with a layer of saturated wool felt inside. Used to prevent water pipes from freezing under ordinary conditions. Must be weather-proofed when used outdoors. Furnished in 3-ft. sections, 1¼" thick only, for standard pipe sizes.

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Insulation Specifications for Flanges, Fittings and Valves



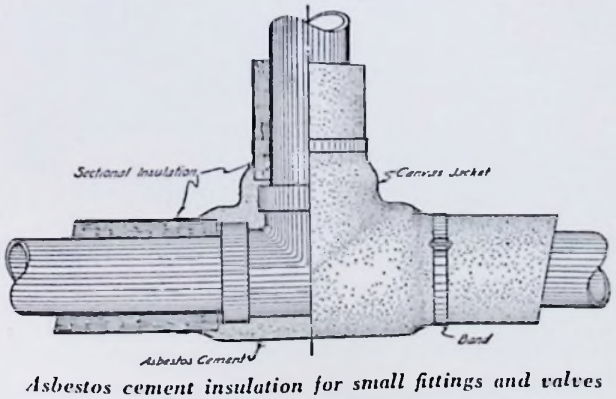
Permanent type of insulation with insulating blocks

Insulation:

All flanges, fittings and valves shall be insulated with the same materials as the adjacent piping.

On piping 4″ and larger, the bodies of flanged fittings and valves, the entire surface of screwed fittings, the entire surface up to the bonnet of screwed valves, and flanges of all pipe sizes where flange insulation is to be of the permanent type, shall be insulated with block insulation to a thickness ½″ thinner than the insulation on the adjacent piping. Hard finish Asbestos Cement shall then be applied to make the total thickness of insulation on the valve or fitting equal to that on the adjacent piping. Pipe insulation should be stopped short of all flanges, and beveled off to permit removal of flange bolts when necessary.

In the case of flanges the insulation of which is to be of the removable and replaceable type, all flanges shall be insulated with sectional pipe insulation to a thickness equal to that of the insulation on the adjacent piping or with block insulation to a thickness ½″ thinner than the insulation on the adjacent piping, covered with ½″ hard finish Asbestos Cement. Removable flange insulation is applied as described on the next page.



Asbestos cement insulation for small fittings and valves

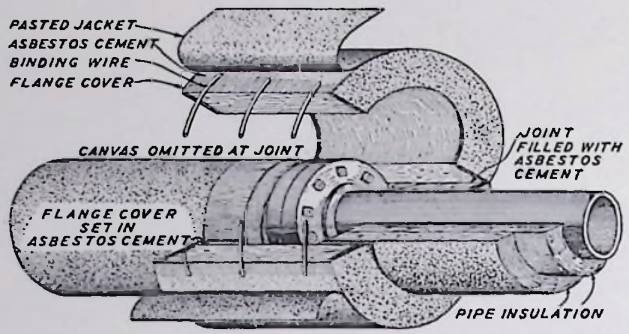
On piping 3½″ and smaller, in place of blocks and cement as mentioned above, the entire insulation of flanged and screwed fittings and valves shall consist of hard finish Asbestos Cement to a total thickness equal to that of the adjacent pipe insulation.

Application—Permanent Type:

The block insulation on the body of 4″ or larger fittings and valves and on all flanges to be insulated with permanent type insulation, shall be securely wired in place with No. 16 gauge annealed iron wire. On flanges the insulation shall be of such length as to extend not less than 2″ over the adjacent pipe insulation on each side of the flange and the space between filled with insulation and thoroughly sealed with hard finish Asbestos Cement. Hard finish Asbestos Cement shall then be applied in two coats to bring the total thickness of the insulation up to that on the adjacent piping. The first coat of cement shall be allowed to dry thoroughly before the second is applied and the second coat shall be troweled to a smooth, hard finish.

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Removable and replaceable block type of insulation

Application—Removable and Replaceable Type:

On all flanges which are to be insulated with a removable and replaceable type of insulation, where the flange insulation consists of sectional covering, it shall be of suitable size to encircle the flange and of such length that it will, when applied, overlap the adjacent pipe insulation on each end, not less than 2". This sectional covering shall be securely wired in place on the flange and the annular space, if any, between the flange insulation and the insulation on the pipe, shall be filled and thoroughly sealed with hard finish Asbestos Cement. A thin layer of hard finish Asbestos Cement shall then be applied over the entire surface of the flange covering to present a smooth, even finish.

On all flanges which are to be insulated with a removable and replaceable type of insulation, where the flange insulation consists of blocks, they shall be securely wired to a frame made of ½" square mesh, 19-gauge galvanized wire cloth. This frame shall be made in two parts and of such size and shape, as to encircle and enclose the blocks on the outside. At the ends of the blocks the wire mesh shall be split and bent down to enclose the hard finish Asbestos Cement used to fill up the annular space between the block insulation and the pipe insulation. The wire frame, with its attached blocks and cement, shall then be wired in place on the flange and the entire cover finished with ½" of hard finish Asbestos Cement. The cement shall be applied in two coats, the first of which shall be allowed to dry thoroughly before the second is applied. The second layer shall be troweled to a smooth, even finish.

* A durable, easily applied, weather-proof coating for insulated surfaces. Furnished in 50-lb. pails and in 150, 300 and 500-lb. drums. Applied ¼" thick, the covering capacity is approximately 45 sq. ft. per 100 lb.

Application on Fittings 3½" or Smaller:

On 3½" or smaller valves and fittings, hard finish Asbestos Cement shall be applied to the surface, in layers not thicker than ½", to equal the total thickness of insulation on adjacent piping. Each layer of cement shall be allowed to dry thoroughly before the succeeding layer is applied and the final layer shall be troweled to a smooth, hard finish.

Finish:

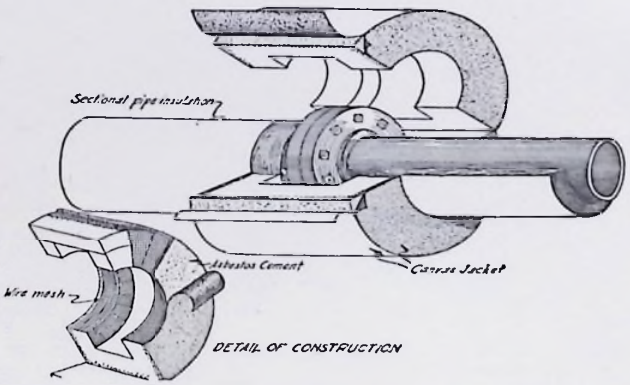
Indoors: The insulation on flanges, fittings and valves located indoors shall be finished with 8-oz. canvas stretched tightly over the surface of the insulation and held in place by paste throughout its entire surface. The canvas shall be so cut and stretched that it covers the entire surface of the fitting and presents a smooth, even surface.

Outdoors: All flange, fitting and valve insulation located outdoors shall be finished with J-M Insulkote,* applied ¼" thick, in place of the final outer coat of asbestos cement. The cement coat, over which the Insulkote is applied, shall be mixed with portland in the proportions of two parts asbestos to one part portland cement by weight and shall be scored and allowed to dry before applying the Insulkote. The Insulkote shall be troweled to a smooth, even finish.

Painting:

All flanges, fittings and valves, finished with a jacket of 8-oz. canvas, shall be finally painted with first one coat of glue sizing and then not less than two coats of first quality lead and oil paint, of a color selected by the purchaser.

All of the above insulation shall be applied by the manufacturer of the materials used, or the manufacturer's technical service unit.



Removable and replaceable sectional type insulation

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J-M Insulating Cements



The various J-M Insulating Cements possess excellent insulating properties and provide a cement for every purpose

J-M Insulating Cements are well known for their excellent coverage, good finish and insulating properties. There is a cement for every purpose.

Asbestos insulating cements are generally used as a surface finish over block or sheet forms of insulation to seal all joints between the blocks and to provide a smooth, attractive finish or a surface to which canvas may be applied if desired.

J-M Insulating Cements are also especially suitable for insulating irregular surfaces such as valves, flanges and other pipe fittings, heating furnaces, kettles, etc., where it would be impracticable to apply sectional insulation, sheets or blocks.

No. 302 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 302 Cement, made of asbestos fibre and binding materials, is a high-grade finishing cement. It is easy to mix and apply, and sticks readily to hot surfaces.

It produces a hard, durable and attractive surface which does not crack, break or peel off.

No. 500 Insulating Cement
(For temperatures to 1800 deg. F.)

No. 500 is an expanded vermiculite base insulating cement. It has exceptionally high covering capacity, combined with good working qualities and insulating value. It has good adhesion and can be applied in thick coats to irregular surfaces on which block and sheet insulation are not adaptable.

No. 450 Insulating Cement
(For temperatures to 1500 deg. F.)

No. 450 is a mineral wool base cement with good covering capacity and excellent adhesion to both hot and cold surfaces. It is a very good insulator compared with other cements. Its excellent adhesion permits it to be readily applied in thick layers to surfaces too irregular to insulate with sheet and block forms.

No. 400 Insulating Cement
(For temperatures to 700 deg. F.)

No. 400 Cement is a smooth-finishing product of good insulating value. Not quite as hard as No. 302.

No. 352 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 352 Cement is the general utility short fibre, quality cement used in large quantities by the plumbing and steamfitting trade for insulating heating boilers and pipe fittings.

No. 0352 Insulating Cement
(For temperatures to 1000 deg. F.)

No. 0352 Cement is a factory-made, inexpensive cement suitable for many of the requirements of the plumbing and steamfitting trade.

J-M 85% Magnesia Cement
(For temperatures to 600 deg. F.)

This material is similar to J-M 85% Magnesia sectional and block insulation except that it is in powdered or cement form.

Compared with other cements, its insulating efficiency is high but it is not ordinarily recommended as a finishing cement.

No. 678 Semi-Refractory Cement
(For temperatures to 1900 deg. F.)

No. 678 Cement is a combined finishing and semi-refractory, hydraulic-setting cement for use as a protective coating over block insulation linings exposed to the erosive action of moving gases in flues, breechings and stacks. No. 678 is an air-setting cement.

No. 319 Semi-Refractory Cement
(For temperatures to 1600 deg. F.)

No. 319 is a combined finishing and semi-refractory cement for use in setting and sealing Superex Blocks in rotary kilns, sealing Vitribestos sheets in stacks, and similar uses. No. 319 requires the immediate application of heat to obtain maximum hardness.

Superex Insulating Cement
(For temperatures to 1900 deg. F.)

Superex Insulating Cement is Superex Insulation in powdered or cement form for use on irregular or small surfaces where the application of blocks or sectional pipe covering is impractical.

For data on packaging, mixing, etc., see table on reverse.

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Data on Johns-Manville Insulating Cements

Designation of Product	Use of Product	Character or Base	Temp. Limit, deg. F.	Covering Capacity, Applied and Dried, 1" Thick		Approx. lb. of Water to mix 100 lb. Cement	Packaging, lb. per Bag
				Sq. ft./100 lb.	Sq. ft./Bag		
No. 302	Finishing	Asbestos	1000	25	25	175	100
No. 400	"	"	700	25	25	150	100
No. 352	"	"	1000	19	9½ or 19	100	50 or 100
No. 0352	"	"	1000	19	19	100	100
Superex	Insulating	Diatomaceous Silica	1900	45	34	250	75
No. 500	"	Expanded Vermiculite	1800	78	39	300	50
No. 450	"	Mineral Wool	1500	50	25	250	50
85% Magnesia	"	Magnesium Carbonate	600	58	35	450	60
No. 678	Finishing	Semi-Refractory	1900	20	10	75	50
No. 319	"	"	1600	15	7½	60	50

J-M Fibrous Adhesive

In the application of sheet, block or brick insulation to flat surfaces, as well as to curved surfaces of large diameters, it is necessary, in a majority of cases, that the insulation be temporarily held in place until the application of the outer binding support and final finish.

J-M Fibrous Adhesive successfully takes the place of other temporary binding methods, being applied easily and rapidly and yet furnishing a moderately strong and effective support for the insulation until the permanent panel or finish is applied which secures the insulation in place.

Fibrous Adhesive is recommended for use where insulation is applied to brick, concrete, metal or other surfaces, and is also a satisfactory adhesive for binding insulating blocks together in multiple layer construction.

Where temperatures do not exceed 500 deg. F., Fibrous Adhesive may be used as the principal means of attachment of insulation directly to the surface of ducts, flues, etc. In such cases, however, a secondary support should always be provided, such as cables or mesh wire, tightly laced over the surface of the blocks.

Fibrous Adhesive is applied to the face of the insulating material, which is then pressed in place against the surface to be insulated. It is not necessary to coat the entire face of the insulation if only temporary support is required, as spotting of the adhesive is usually sufficient.

Only a sufficient thickness of the adhesive to obtain a thin film for bonding need be used; however, the thickness required depends largely upon the smoothness of the surface. Bare metal surfaces require less adhesive than is necessary for application of insulation to brick or concrete or to other insulation.

All paint *must* be removed before insulation can be applied by Fibrous Adhesive, or the insulation will loosen after the adhesive dries out.

In estimating requirements, the following covering capacities may be used: For sticking insulation to metal surfaces, 50 lb. of Fibrous Adhesive will cover approximately 100 sq. ft. of surface. For sticking insulation to brick, concrete or other insulation, 75 lb. of Fibrous Adhesive will cover about 100 sq. ft.

Fibrous Adhesive is supplied ready for use, in 75-lb., 175-lb., 350-lb., and 550-lb. containers.

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J-M Insulating Fillers

Sil-O-Cel C-3

For temperatures to 2000 deg. F.

Sil-O-Cel C-3, a semi-refractory insulating product, is made from the mineral Celite, calcined in order that it may withstand temperatures as high as 2000 deg. F.

Sil-O-Cel C-3 is a coarsely ground, granular material with a sufficient proportion of fines to insure a uniform mass without large voids. It may be used alone as a granular filling material, or in combination with portland or lumnite cement to form Sil-O-Cel C-3 Concrete as described on another data sheet. Sil-O-Cel C-3 will not shrink and, for a material which can be used at so high a temperature, is a remarkably efficient insulator.

Sil-O-Cel C-3 is used for insulating tops and for filling walls of heated equipment operating at extremely high temperatures or in equipment where lack of space prohibits the use of any but relatively thin fire brick linings and where the insulation is therefore subjected to very high temperatures. A typical application of this material in dry form is in the bases of oil-fired marine boilers.

Sil-O-Cel C-3, loose, weighs about 26 lb. per cu. ft. When rammed into place moist, without the addition of any bonding material, it weighs approximately 31 lb. per cu. ft. Packed in bags of about 100 lb.

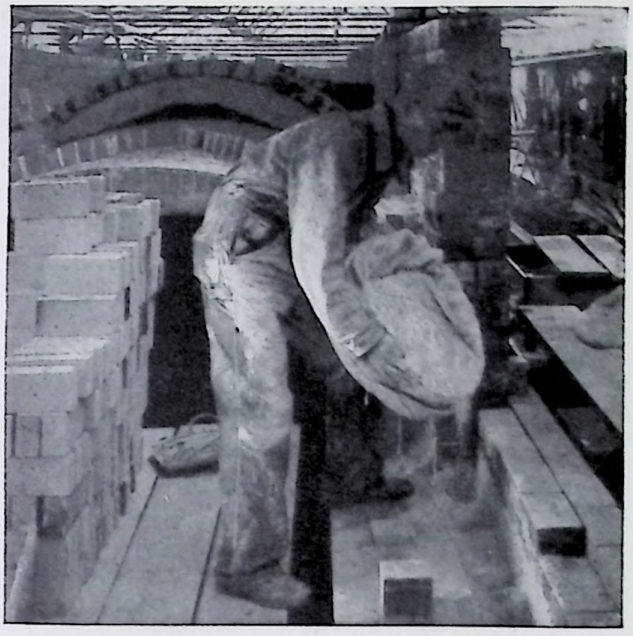
Sil-O-Cel Insulating Powder

For temperatures to 1600 deg. F.

Sil-O-Cel Insulating Powder is manufactured from the pure mineral Celite, milled to a high degree of fineness. Milling is very carefully done in specially designed equipment to preserve the natural cellular structure of the material. Sil-O-Cel Powder is furnished in bags of approximately 50 lb.

This material has an exceptionally high insulating value. It can be used where it will be subjected to temperatures as high as 1600 deg. F. When loosely poured, Sil-O-Cel Insulating Powder weighs about 10 lb. per cu. ft., and when packed in place to the proper density (15 to 17 lb. per cu. ft.) will retain its effectiveness indefinitely.

The high insulating efficiency of Sil-O-Cel Insulating Powder makes it ideally adapted for use where structural strength and rigidity are not required of the insulation. When used to cover the tops of furnaces, tunnel kilns and similar equipment, the material should be lightly tamped to a density of about 15 lb. per cu. ft. Tamping is facilitated by moistening. A convenient method of moistening the insulating powder is to sprinkle the material in the bags the day before it is to be used.



Installing Sil-O-Cel Coarse Grade in wall of a tunnel kiln. Sil-O-Cel Coarse Grade is also used on the top

To prevent dusting when Sil-O-Cel Insulating Powder is used over the top of heated equipment, a lime or cement slurry is often used to form a top crust.

For packing in walls of ovens, furnaces, kilns, etc., it should be tamped to about 17 lb. per cu. ft.

Sil-O-Cel Coarse Grade

For temperatures to 1600 deg. F.

Sil-O-Cel Coarse Grade is a material very similar to Sil-O-Cel Powder, excepting that, as its name implies, it is not milled to such fineness as the powder. Shipped in bags of approximately 100 lb. It should be packed to a density of about 22 lb. per cu. ft.

Sil-O-Cel Coarse Grade is particularly adapted for insulating the walls of such equipment as lime kilns, vertical boilers, etc. Because of its coarser nature, it is easier to pack than Sil-O-Cel Powder.

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Fil-Insul

For temperatures to 1000 deg. F.

Fil-Insul is used as an insulating filler in irregular spaces where insulation in block or brick form is not practical and where a resilient high-grade filler is needed. It will permit considerable expansion and contraction because of its fibrous nature which also serves to prevent any settling or sifting through cracks. Weighs about 17 lb. per cu. ft. packed to proper density. Furnished in 80-lb. bags.

Fibro-Cel

For temperatures to 1800 deg. F.

Fibro-Cel is a mixture of diatomaceous silica and long fibre asbestos. Due to the asbestos fibre, this material has certain characteristics different from the ordinary powdered fillers. The fibres offset any tendency to settle or filter through cracks, which makes the material well adapted for use as a filler on gas generator sets, etc. Approximate weight, 18 lb. per cu. ft. when packed in place. Furnished in 80-lb. bags.

Granulated Rock Cork

For temperatures below 100 deg. F.

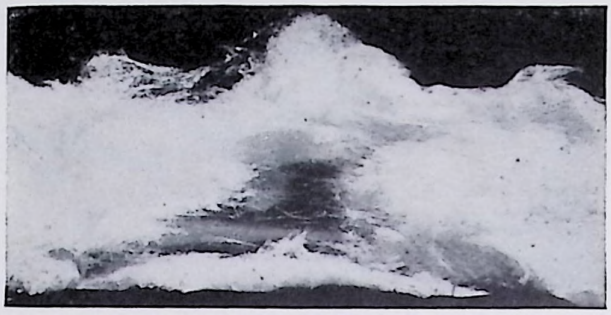
Granulated Rock Cork, a mineral wool product treated with a bituminous binder, is used where a loose, moisture-resisting filler, which can be poured into place, is required for low temperature service. It weighs 12 to 14 lb. per cu. ft., packed to the proper density. Unless otherwise specified, furnished in paper bags weighing approximately 35 lb.

Zerofil

Zerofil is an asphalt-impregnated loose mineral wool (not granulated), designed for use as a low-temperature insulation where a hand-packed type of insulation must be used to fill irregular spaces. It is highly resistant to moisture. Zerofil weighs loose about 7 lb. per cu. ft. and should be packed to a density of about 10 lb. per cu. ft. Unless otherwise specified, furnished in paper bags weighing approximately 35 lb.

Zerotex

Zerotex is a felted mineral wool which is combined in production with a water-resistant binder and surface-coated to increase handling strength and flexibility. It is used to insulate fittings on cold pipe lines. Zerotex is furnished in blankets 20″ wide by 48″ in length with a nominal thickness of 2″. During application the thickness is reduced somewhat as the material is secured in place. The blankets of Zerotex are supplied in cartons containing 40 sq. ft. and half cartons of 20 sq. ft.



Banroc Loose, pulled apart to show its texture, has been found suitable for many uses as an insulating filler.

Banroc (mineral wool)

Banroc is a lightweight, effective insulating material produced from high silica minerals. Being noncombustible, it is also useful as a fire retardant.

This material has been found suitable for use as an insulating filler in the hollow walls of baking ovens, fireless cookers, domestic hot water heaters and for similar purposes where a loose bulk insulation is required.

Banroc is furnished in two grades: Banroc Loose and Banroc Granulated.

Banroc Loose:

Banroc Loose may be packed to various densities but usually 12 lb. per cu. ft. is recommended. Unless otherwise specified, carload quantities are shipped in paper bags of approximately 40 lb.

Banroc Granulated:

Banroc Granulated is made from regular Banroc Loose and is used primarily for hand-packing and pouring. It may be placed at various densities, but when the material is loosely poured into position, 9 to 10 lb. per cu. ft. is recommended and when hand packed, 10 to 12 lb. per cu. ft.

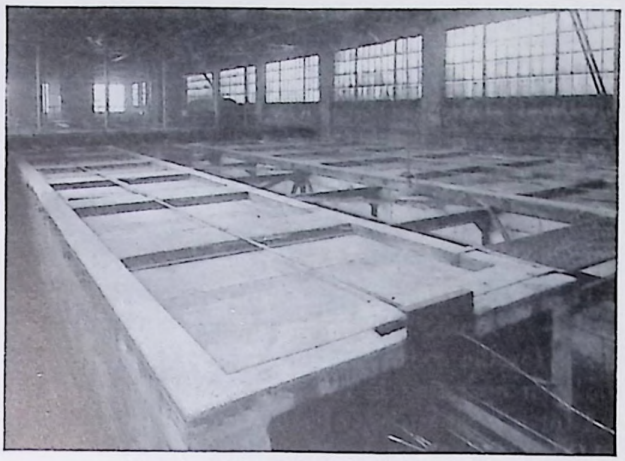
Unless otherwise specified, carloads of the material are shipped in paper bags weighing approximately 40 lb.

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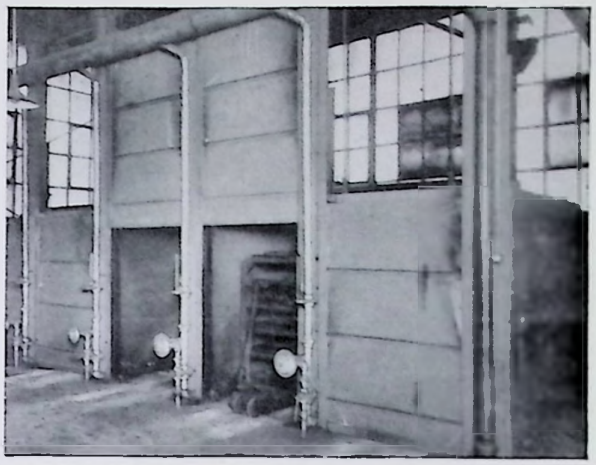
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Sil-O-Cel C-3 Insulating Concrete

For temperatures to 1800 deg. F.



The efficient performance of these large japanning ovens is assured through the use of Sil-O-Cel C-3 Concrete with 9" thick walls and tops. Size of ovens 9 ft. wide, 22 ft. high, 50 ft. long



Battery of four monolithic gas-fired core ovens, constructed throughout of Sil-O-Cel C-3 Concrete with 12" thick walls and tops. The doors were built of Sil-O-Cel C-3 Concrete 9" thick

Sil-O-Cel C-3 in the form of insulating concrete, can be cast into any shape desired. This has made it possible to utilize insulation where previously it had been impossible to do so for structural reasons. Sil-O-Cel C-3 can be easily cast in monolithic form for the construction of doors, baffles, dampers, etc., and, when suitably reinforced, may be moulded into large units for such purposes.

Sil-O-Cel C-3 Insulating Concrete is made by mixing four parts of Sil-O-Cel C-3 and one part of portland or lumnite cement, by *volume*, with sufficient water to form a plastic, coherent mass. Care should be taken to avoid excess water. For this purpose approximately 28 lb. of Sil-o-Cel C-3 are required per cu. ft., when rammed into place and dried.

Sil-O-Cel C-3 Concrete can be applied very satisfactorily to steel surfaces, such as stacks, by means of a cement gun. It can also be applied with a cement gun to the brick walls of existing equipment, such as open-hearth regenerators.

Sil-O-Cel C-3 Concrete is over three times as effective as fire brick in preventing heat penetration. Made in accordance with specifications, the material sets up into a strong, durable concrete weighing approximately 60 lb. per cut. ft. and with a crushing strength of about 1,000 lb. per sq. in. (72 tons per sq. ft.). It has a high degree of refractoriness for an insulating material and can be used without other refractory protection where it may be subjected to direct heat as high as 1800 deg. F.

Suitable reinforcing, such as would be used in ordinary concrete, and provision for expansion joints are important in the case of Sil-O-Cel C-3 Concrete as with any other monolithic material.

For monolithic construction of ovens, etc.:

Such equipment as japanning and enameling ovens, core ovens, etc., where the heating operation is carried on at a comparatively low temperature, are in many cases now being constructed entirely of Sil-O-Cel C-3 Concrete.

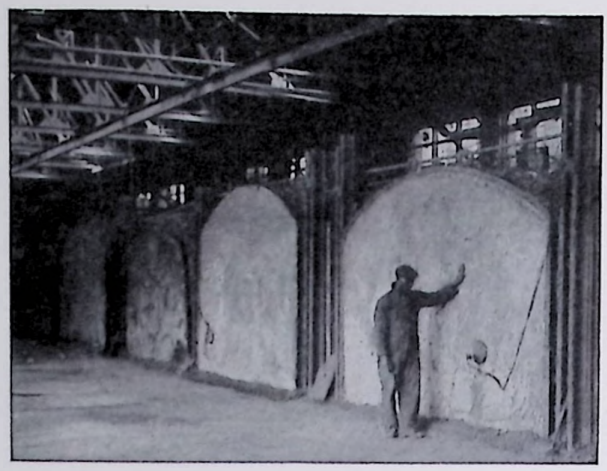
Ovens of this type can be constructed and operated at very great savings over the ordinary type of masonry construction. Due to the insulating properties of Sil-O-Cel C-3 Concrete and the fact that all masonry joints are eliminated, fuel consumption is surprisingly low. This construction can be satisfactorily employed for many types of equipment.

For foundations and bases:

Sil-O-Cel C-3 Concrete is an ideal material for insulating the bases of heated equipment. In fact, the practice of insulating bases can be said to have originated with the introduction of this material. It is used for base insulation in various types of heat-

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Sil-O-Cel C-3 Concrete is ideally adapted to the construction of monolithic furnace doors. The C-3 Concrete doors on this battery of malleable annealing ovens are 9" thick

treating furnaces, kilns, oil still furnaces, hot blast stoves, open-hearth furnace regenerators and flues, and in many other types of high temperature equipment where heat transmission through the base would otherwise amount to a considerable loss.

Insulation of the bases of such equipment is now recognized as being essential, not only because of the fuel saving, but also because it insures more uniform heat distribution within the equipment and protects the foundations from excessive heat.

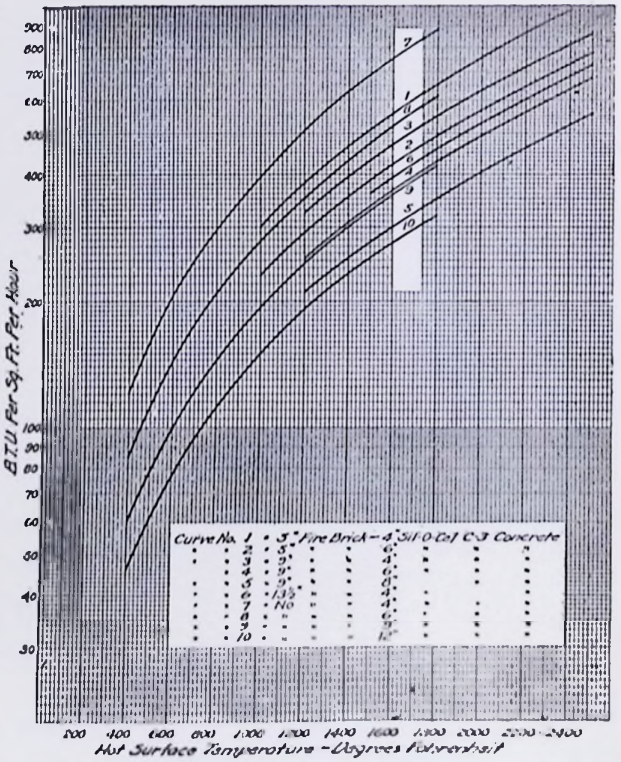
Sil-O-Cel C-3 Concrete doors:

Sil-O-Cel C-3 Concrete is the principal material in use today for furnace door construction. Fire brick doors, as formerly used, are highly conductive of heat. Such heat waste is costly, reduces the output of the furnace, disturbs temperature uniformity, makes close control impossible, and causes unsatisfactory conditions for the operators. Since fire brick weigh about 130 lb. per cu. ft., fire brick doors also have the disadvantage of great weight, which makes them hard to handle, and elaborate counterbalancing devices are often required. Sil-O-Cel C-3 Concrete weighs less than half as much as fire brick, conducts less than one-third as much heat and costs less per door installed.

On doors where the temperature is too high for Sil-O-Cel C-3 Concrete or where there is trouble due to erosion or abrasion, a protective facing* of Firecrete Refractory Cement, 1½" thick, is very effective. The C-3 Concrete is tamped into the door frame to a level approximately 1½" below that desired for the finished lining. While the concrete is still fresh, ½" of Firecrete is applied and rodded sufficiently to obtain a mixing of the Firecrete and C-3 for a depth of an inch or more below the surface of the mixture. Immediately thereafter, before the concrete has set, an additional 1" of Firecrete is applied without rodding, and troweled to a smooth finish level with the inside of the door.

Other uses:

Sil-O-Cel C-3 Concrete is an excellent material for making up special shapes such as baffles, dampers, etc. It is also cast into covers for wheel annealing pits; used as an insulating lining for hot metal cars in steel mills; for the construction of fire screens to protect workmen operating in front of open furnace doors; and for a great variety of other uses. In many cases Sil-O-Cel C-3 Concrete is particularly adapted for insulating on the outside of walls of equipment previously constructed without insulation. Application is effected through the use of wood or sheet metal forms or by means of a cement gun.



Heat losses through Sil-O-Cel C-3 Concrete, with and without fire brick linings

*U. S. Patent No. 2,042,870.

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Insulkote

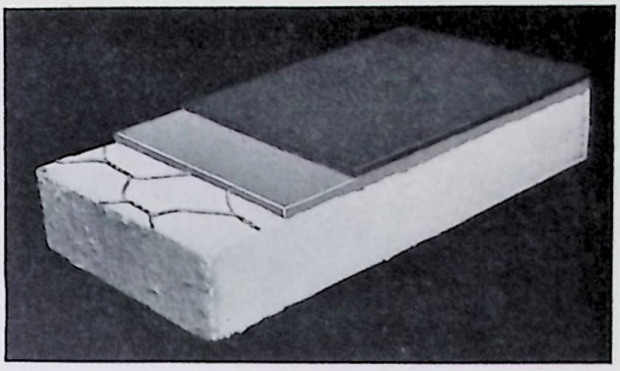
Insulkote is a durable, easily applied, weather-proof coating for insulated surfaces. The finished surface may be painted with aluminum paint if desired. The temperature limit is 400 deg. F.

Insulkote is particularly applicable for the protection of insulation on large tanks and vessels, and for insulated equipment, such as smoke breechings and ducts. Advantages of Insulkote include the following:

1. Durability under extreme weather conditions.
2. Elasticity which prevents its cracking under changes in atmospheric temperature.
3. Smooth surface finish.
4. Easy application.
5. Non-inflammable. Will not carry flame.
6. Retains initial black color. Will not fade.
7. Furnished ready for application.

Insulkote is furnished in ready-mixed, plastic form and of correct consistency to apply with a trowel. It can be applied as received; no additional treatment is necessary. Insulkote is a jet black material as received, and will not fade after it is applied. Consequently, any future patches will not contrast with the weathered material. Orders shipped between October 1 and May 1 are filled with "Winter Insulkote," for use when the temperature of the air is below 45 deg. F. and above 15 deg. F.

Insulkote, applied in one coat ¼" thick, will cover approximately 55 sq. ft. per 100 lb. Furnished in containers weighing approximately 50, 150 and 450 lb.



Insulating block with reinforcing hexagonal mesh wire, insulating cement and a finish of Insulkote

Application

Insulkote should be applied as follows: Stretch the necessary reinforcing hexagonal mesh wire netting over the insulation. Then apply a ¼" coat of insulating cement consisting of two parts by weight of J-M No. 302 Insulating Cement and one part portland cement. The portland cement is added to provide a suitable bonding surface. This coat should be scored and allowed to dry before applying the Insulkote.

Over the cement apply Insulkote approximately ¼" thick in one layer, troweled to a smooth finish. If Insulkote is applied directly over wire mesh, an excessive quantity must be used.

When applied on the type of surfaces recommended, the linear shrinkage of Insulkote is negligible. After drying, a coat applied ¼" thick will be approximately ⅛" thick. Coatings should not be applied less than ¼" thick. The shrinkage is due to dehydration, which imparts the desirable features to the Insulkote.

When Insulkote is to be applied over the insulation of heated equipment, best results will be secured by applying the insulation and insulating cement while the apparatus is hot. If possible, the Insulkote should not be applied until the equipment has reached its approximate maximum temperature. Otherwise, expansion may cause cracking of the Insulkote. In the case of apparatus with a wide range of operating temperatures or frequent shut-downs, some form of expansion joint in the insulation is needed to prevent cracking of the finish.

While J-M No. 302 and portland cement provides the best base for Insulkote, other hard-finish asbestos cements may be used if mixed, two to one by weight, with portland cement.

Insulkote Primer

When Insulkote is applied over hard-finish asbestos cements, such as J-M No. 302, no priming coat is required. However, if the materials are applied over highly absorptive surfaces such as ordinary brick walls, concrete, Sil-O-Cel C-22 Brick, or non-absorptive surfaces such as steel, a priming coat of Insulkote Primer should be applied before trowelling on the Insulkote. The primer should be thinned to the proper paint-like consistency by adding clean water in the ratio of approximately 3 parts by volume of water to 2 parts of primer as received.

For best results, the Insulkote should be applied while the Insulkote Primer coat is still tacky. This can best be accomplished by one man applying the primer followed by a man trowelling on the Insulkote. The primer is furnished in 5, 25 or 30, and 55-gal. containers. If the Insulkote Primer, applied to absorptive surfaces, dries out before the Insulkote is applied a vapor proof seal will result, defeating the purpose of the primer.

INSULKOTE
February, 1943 (Cancelling sheet dated February, 1942)
IN-480

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Aertite Coating

Aertite is a tough, rubbery asphaltic-asbestos coating in plastic form which is sometimes used instead of Insulkote for waterproofing insulation on tanks, pipe line flanges and similar surfaces exposed to the weather. The temperature limit is 250 deg. F.

It is applied over insulation in a thin troweled coat to approximately 1/8" thickness. If the material has partially dried in the container, it can be brought to the proper consistency by adding a small amount of gasoline. When applying, a rag saturated with kerosene is handy for keeping the trowel clean.

Aertite is black in color but can be painted with aluminum paint. If some other color is wanted, the Aertite should first be painted with aluminum paint and the other color then applied.

Aertite is furnished in 25, 50, 150, 300 and 500-lb. containers. The covering capacity depends somewhat upon the character of the surface. For a 1/8" coating, from 50 to 80 lb. per 100 sq. ft. of surface area, will be required.

Soft or dusty surfaces should be primed with J-M Concrete Primer before the Aertite is applied. Concrete Primer ordinarily covers about 100 sq. ft. per 1 to 2 gal., depending upon the surface.

In addition to its use as a weather protection for insulation, Aertite Coating is quite generally applied to the outside of boiler walls to eliminate air infiltration. It provides a tough, rubbery, air-tight blanket over the entire boiler setting which remains tight because of its adhesive and ductile qualities and prevents imperfect combustion due to air leakage through the setting.



A coat of Aertite effectively seals boiler wall cracks and stops the infiltration of cold air. This increases CO_2 content in the back passes and improves heat absorption because of higher gas temperatures

Application of Aluminum Paint*

Preparation of Surface to be painted:

Insulkote shall be allowed to dry thoroughly before application.

Aertite shall be subjected to service conditions for about ten days before applying paint, to allow excess solvent to dry out.

Where paint is to be applied to roofing felts, it is only necessary that the surface be dry and clean.

Preparation to Paint:

The aluminum paint shall consist of one of the following: 2 lb. of the Aluminum Company of America's Extra Brilliant Varnish Powder and one gallon of DuPont Company's VO-129 Mixing Varnish, or its equal; Valdura Asphalt Aluminum Paint made by the American Asphalt Paint Company, Chicago, Ill.; or, Bituseal Exterior Aluminum Paint manufactured by the Cheeseman Elliot Company, Brooklyn, N. Y.

The paint shall be mixed immediately before using and in no case shall more paint be made up than can be used the same day.

Application:

The paint shall be applied in two coats, the first of which shall be allowed to stand not less than 24 hours or longer as required to dry thoroughly, before the second coat is applied.

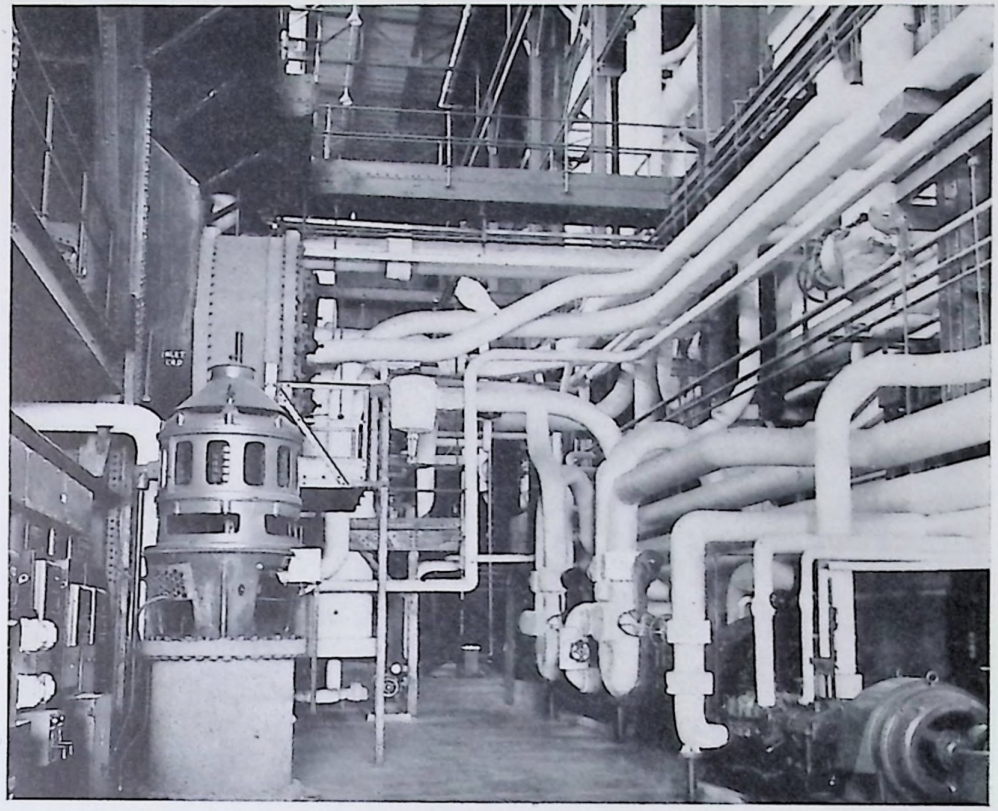
The paint can be applied by brushing, but a spray will give a quicker, and possibly slightly smoother, job than can be obtained by means of a brush.

* If Aluminum Paint is not available for use over Insulkote, ordinary lead and oil paint can be used if the Insulkote has been properly sealed with shellac.

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Insulation of Power Plant Equipment



Equipment and piping in this power station are fully protected against heat waste with J-M Superex and 85% Magnesia blocks and pipe insulation

Johns-Manville furnishes a wide variety of power plant materials for improving performance, increasing capacity and reducing operating costs. Fuel cost is one of the principal items of expense wherever heat is generated, and the problem of fuel conservation is a matter of major consequence. Insulation, therefore, is particularly important in insuring economical operation. A complete line of insulating materials in all forms is available to save heat otherwise dissipated from boiler settings and drums, economizers, breechings and stacks, turbines, pumps, feed-water heaters, piping and other locations where heat is being wasted.

Pipe Insulation

The insulation of bare metal surfaces where steam or hot water is in contact with the metal is even more important than insulation over brickwork. Asbesto-Sponge Felted in sheets or pipe sections is recommended up to 700 deg. F. where the insulating material will be subjected to rough usage. Moulded blocks or pipe sections of J-M 85% Magnesia are also highly efficient in the temperature range below 600 deg. F. At higher temperatures, Superex or Superex Combination Insulation should be used.

The term Superex Combination refers to the use of Asbesto-Sponge Felted or J-M 85% Magnesia outside of Superex, which is placed next to the heated surface. This construction is slightly more efficient than Superex used alone, and in the case of Asbesto-Sponge Felted, more resistant to hard usage. Other materials for special conditions are available to meet every requirement.

The tables of thicknesses which follow represent standardized practice in general use on heated lines. Exceptional conditions may make necessary thicker insulation. Where piping is located outdoors, it is customary to use insulation ½" thicker than that used on the lines indoors.

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Asbesto-Sponge Felted or 85% Magnesia for temperatures to 700 deg. F.

Thickness of insulation, J-M 85% Magnesia			Temp., deg. F.	Thickness of insulation, Asbesto-Sponge Felted		
Pipes larger than 4"	Pipes 2" to 4"	Pipes smaller than 2"		Pipes larger than 4"	Pipes 2" to 4"	Pipes smaller than 2"
Std.	Std.	Std.	Below 212	1"	1"	1"
Std.	Std.	Std.	212 to 266	1"	1"	1"
1½"	Std.	Std.	267 to 337	1½"	1"	1"
2"	1½"	Std.	338 to 387	2"	1½"	1"
Dbl. Std.	2"	1½"	388 to 499	2½"	2"	1½"
3"	Dbl. Std.	2"	500 to 599	3"	2½"	2"
*	*	*	600 to 700	3½"	3"	2"

* 85% Magnesia not recommended over 600 deg. F.

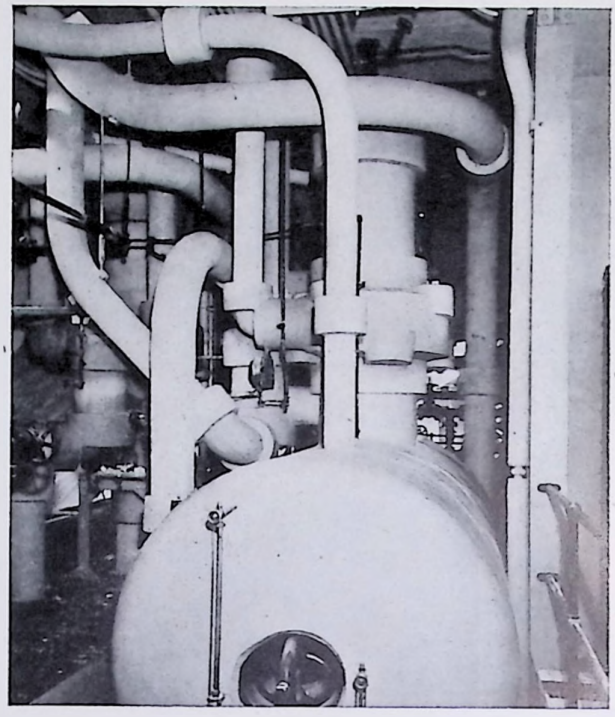
Superex Combination Insulation for temperatures above 600 deg. F.

Pipe size, inches	600-699 deg. F.†		700-799 deg. F.		800-1000 deg. F.	
	Thickness of insulation		Thickness of insulation		Thickness of insulation	
	Superex, in.	85% Magnesia, in.	Superex, in.	Asbesto-Sponge Felted, or 85% Magnesia, in.	Superex, in.	Asbesto-Sponge Felted, or 85% Magnesia, in.
1½ or less	2	....	2	....	2	....
2	1¼	1½	1¼	2	2½	1½
2½	1⅝	1½	1⅝	2	1 13/16	1½
3	1⅝	1½	1⅝	2	2⅛	1½
3½	1⅝	1½	1⅝	2	1 13/16	1½
4	1⅝	1½	1⅝	2	2⅛	1½
4½	1⅝	2	1⅝	2½	1 13/16	2
5 or more	1½	2	1½	2½	2††	2

† Asbesto-Sponge Felted may be used alone. See table above.
†† Approximate; varies from 2" to 2⅛" according to pipe size.

Pipe insulation is securely fastened in place with not less than three loops of 16-gauge annealed iron wire on pipes up to and including 6", and with not less than four loops on larger sizes. In double layer work both longitudinal and circumferential joints are staggered and each layer is wired separately. Inside piping is finished with 8-oz. canvas sewed over a layer of asbestos paper or rosin-sized paper. Where similar pipes run close together they may be insulated as a unit, using block insulation and half sections of pipe insulation, finished with canvas the same as a single pipe.

Fittings and valves are insulated with blocks and J-M No. 302 Insulating Cement to a thickness equivalent to the adjacent pipe insulation. No. 302 Cement is often used alone on screwed fittings or over the bodies of small flanged fittings or where the total thickness of insulation is less than 1½". In any case the customary finish is 8-oz. canvas, pasted smoothly to the surface of the cement.



J-M- 85% Magnesia blocks and pipe insulation applied over evaporator and piping in the power plant of a public utility

Pipe insulation is stopped at a sufficient distance from a flange or flanged fitting to allow free removal of the bolts, and blocks are wired around the flange to extend not less than 2" over the adjacent pipe insulation. The cement finish is applied in two coats to a total thickness of ½", the first or rough coat being allowed to dry before application of the smooth finish coat.

Instead of blocks around a flange, it is frequently convenient to use short sections of pipe insulation of a size which just fits snugly against the periphery. These flange covers are wired in position and finished the same as in the other method, except that the cement may be applied in a thinner coat.

On outdoor lines protection of the insulation from the weather is afforded by a flexible waterproof jacket, carefully sealed to shed the rain and held in position by non-corroding wire on 4" centers.

Outdoor valves and fittings are weather-proofed by replacing the final ¼" coat of cement with Insulkote, care being taken effectively to seal the joints between the pipe insulation jacket and the Insulkote over the valve or fitting. Lines subject to mechanical injury are usually protected by a sheet metal casing.

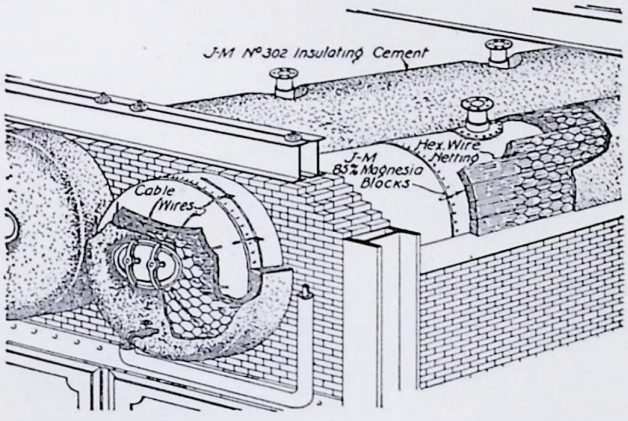
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Boiler Room Ceilings and Walls

To confine heat and prevent excessive temperatures in adjacent spaces—boiler rooms, steam distribution rooms and pipe corridors should be insulated with 2″ thick J-M 85% Magnesia Blocks. These are adhered to the treated surface by means of J-M Fibrous Adhesive and are butted closely and pressed firmly into place. The blocks are further secured, on new construction, by means of ½″ x .020″ metal straps, set in the concrete forms on 12″ x 36″ centers, or, on existing construction, with 16 ga. annealed iron wire, stapled to 2″ x 2″ wood strips. The insulation is then finished with reinforced absbestos cement.

An insulated ceiling may also be constructed entirely of a 1″ thickness of J-M Marinite, a light-weight structural insulating material furnished in 4 ft. x 8 ft. sheets. This construction is most effective when suspended from the underside of the floor slab and the intervening air space ventilated.



Method of insulating drums and drum-heads

Boiler Shells and Drums, Turbines, etc.

In power plant work the exposed steam and water surfaces of boilers, feed-water heaters, steam pumps and turbines are insulated with blocks of the proper thickness depending on temperature. H.R.T., fire-box type and cast-iron sectional boilers and the drums of water-tube boilers are insulated with J-M 85% Magnesia Blocks, 1″ thick, for steam pressures up to 25 lb.; 1½″ thick for pressures up to 100 lb.; 2″ thick for pressures up to 200 lb.; and 2½″ thick for pressures over 200 lb. Steam turbines at temperatures below 300 deg. F. are insulated with J-M 85% Magnesia Blocks 1½″ thick; at temperatures from 300 to 400 deg. F., 2″ thick; and at temperatures from 400 to 600 deg. F., 3″ thick. Turbines at temperatures between 600 and 700 deg. F. are insulated with 1½″ Superex and 1½″ J-M 85% Magnesia Blocks. Recommendations for higher temperatures may be secured from Johns-Manville. Feed-water heaters are insulated with 1½″ J-M 85% Magnesia. On pump cylinders and chests, 2″ Magnesia Blocks are used.

Two coats of J-M No. 302 Inulating Cement of a total thickness of ½″, reinforced with hexagonal mesh wire, are applied over the blocks, the first coat being left to dry with a rough surface and the second troweled smooth and hard. A suitable metal jacket is provided where the insulation is likely to be damaged, as on a steam pump or turbine.

Brickset Boiler Insulation and Casing

Insulation over boiler brickwork saves fuel, provides closer temperature control, reduces air infiltration and assures better working conditions. Added to this is the decrease of internal strains and reduction in spalling because of the smaller temperature differential between the inside and outside of the refractory. Insulation placed over exterior brickwork promotes heat flow along the walls, and the back passes are raised to a higher temperature. Wall cracks, caused by uneven expansion and contraction, are fewer and smaller.

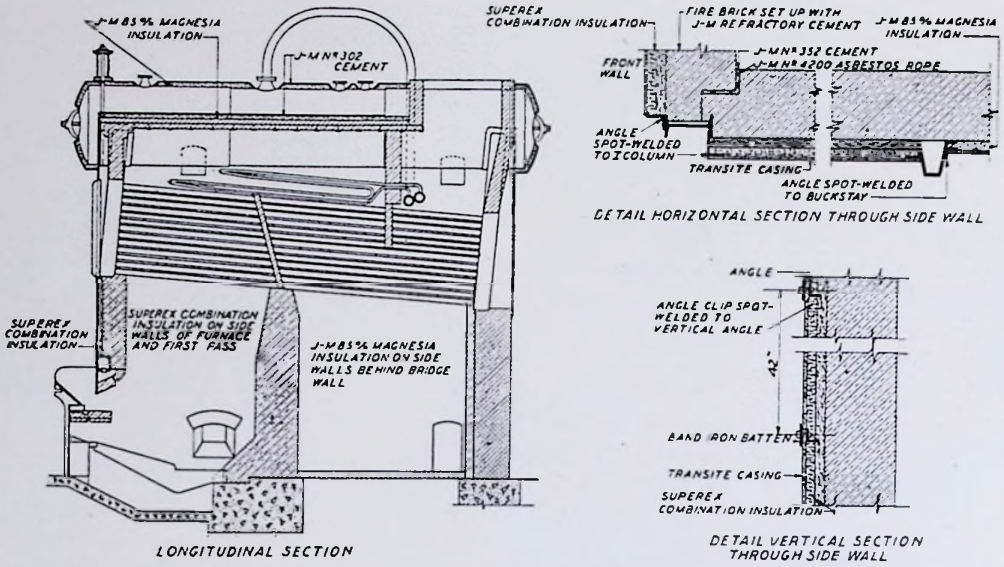
A veneer layer of Superex or Magnesia Insulation or Superex-Magnesia Combination Insulation of a thickness depending on the design of the boiler is applied over the brick and, preferably, finished with flat Transite. The insulation may be applied behind or between the buckstays. If brick shapes are preferred, Sil-O-Cel or JM-20 Brick are laid up, either bonded or unbonded, behind the refractory lining.

Block Insulation Recommendations for typical water-tube boilers

Type of boiler	Front Wall	Side Walls		Rear Wall	Top
		From front wall to bridge wall	To rear of bridge wall		
B & W	3″ Superex-Magnesia Combination	3″ Superex-Magnesia Combination	1½″ Magnesia (1 layer)	None	2½″ Magnesia (1 layer)
Stirling	3″ Superex-Magnesia Combination	3″ Superex-Magnesia Combination	3″ Magnesia (2 layers)	1½″ Magnesia (1 layer)	3″ Superex-Magnesia Combination
Springfield	None	3″ Superex (2 layers)		3″ Superex (2 layers)	3″ Superex-Magnesia Combination

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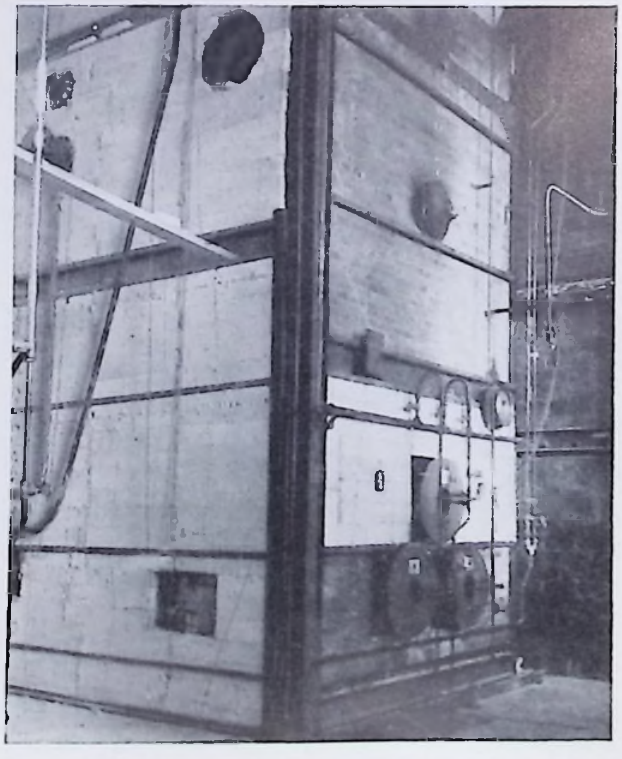
Typical block insulation and Transite casing on horizontal, longitudinal drum boiler (Erie City boiler with Elesco superheater)

If block insulation is placed between buckstays, light angles may be clipped or spot-welded to the buckstays and punched so that insulation may be secured in place by lacing wires. These angles also serve as support for the Transite casing. Transite has a much lower conductivity than most casing materials, is lighter in weight and makes a better appearance. It is light gray in color, very resistant to corrosion, and when put up in panel type construction with steel battens over the joints is easily removed and replaced.

A reinforced asbestos cement finish may be used over those portions of the insulation not subject to mechanical damage, but the Transite affords better protection and will present a good appearance after years of usage.

On new settings a veneer of 4½" JM-20 or Sil-O-Cel C-22 Brick may be bonded into the outside of the fire brick every fifth course vertically. On old settings, spikes or expansion bolts with wires attached may be driven into mortar joints on 2-ft. centers and 4½" Sil-O-Cel Natural Brick laced to the brickwork without bond of any kind. Both JM-20 or C-22 Brick present an attractive and durable surface as laid but if desired they may be coated with Insulkote Primer and Insulkote to prevent air infiltration. The Natural Brick are finished with two ¼" coats of cement, reinforced with wire netting.

On new settings of H.R.T. boilers and small water-tube boilers, a "core wall" of 4½" Sil-O-Cel Natural Brick is often laid between fire brick and red brick and bonded every fifth course vertically. Opposite the furnace and first pass of water-tube boilers, JM-20 or Sil-O-Cel C-22 Brick are used.



Progress photograph showing the erection of Superex blocks over a brickset boiler, before the application of Transite casing (lower half) and asbestos cement finish (upper half)

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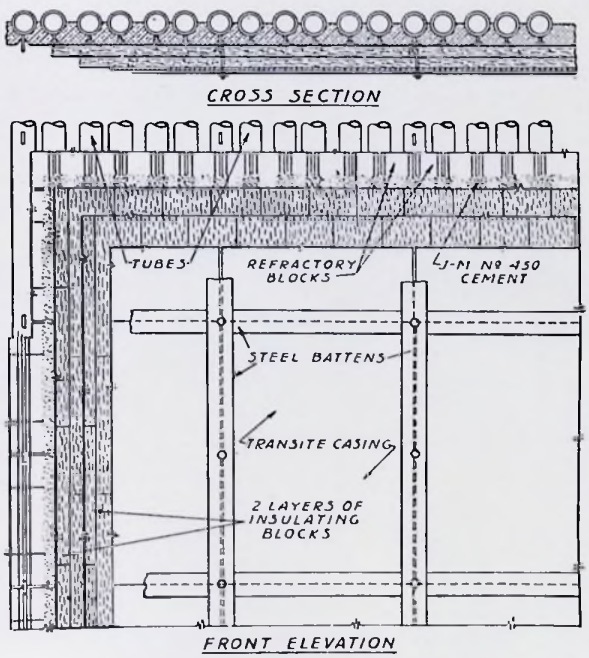
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Water-Wall Insulation and Casing

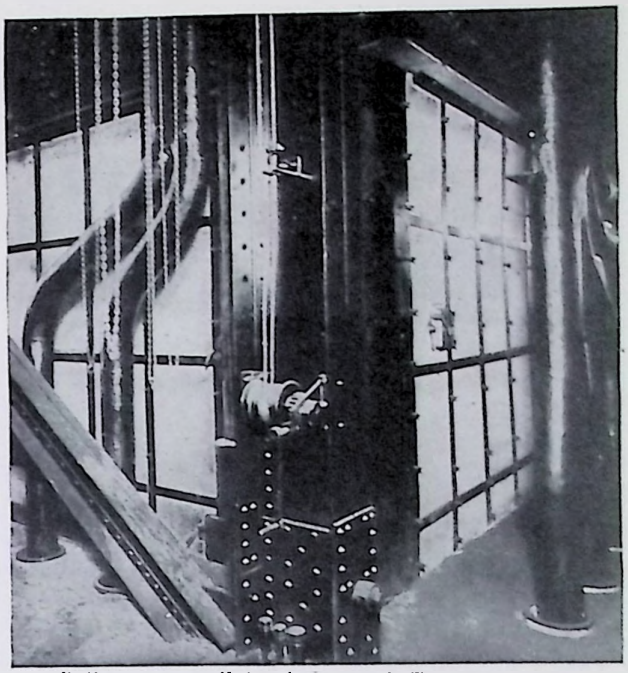
Boiler water walls are insulated with about 4″ of J-M 85% Magnesia Blocks, or, if the temperature is high, with Superex alone or in combination with J-M 85% Magnesia. The insulation is cased with 3/8″ Transite panels, battened with steel strips, which makes a neat removable and replaceable casing of great durability. This construction results in a heat saving of more than 90 percent of the uninsulated loss.

If the exterior of the wall surface is uneven, a filler coat of J-M No. 450 Insulating Cement is first well pressed onto the surface in a thickness just sufficient to provide a flat surface. Then two layers of insulating blocks are applied with the lengths of the blocks running vertically and with all joints broken. The outside layer is pointed up with J-M No. 302 Insulating Cement and all joints are closely butted.

Casing bolts or studs protrude through the insulation and serve to support flat Transite panels which are usually fitted against the wall in vertical rows between the bolts, beginning at the bottom. Each panel has a flat steel batten bolted to its top edge, behind which the next higher panel is slipped in the course of erection. The panels are secured against the wall by continuous steel battens pressed firmly over their vertical edges and held in place by the wall bolts or studs. Pliable gaskets of J-M Asbestos Roll Fire-Felt may be used under all battens to seal the casing against air infiltration.



General method of providing for water-wall insulation and casing



Bailey water-wall insulation with Transite casing

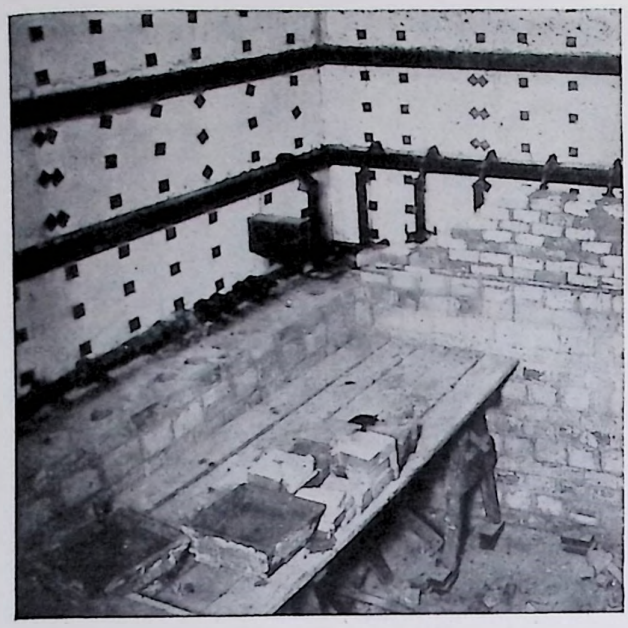
No cables or mesh are used with the panel type casing and the construction permits access to the tubes without disturbing the insulation anywhere on the wall except that portion which it is desired to remove. Because of weight, it has been found advisable to support steel casings, where used, independently of the water wall. Cables and lacing wire must then be employed to hold the insulation, which cannot thereby be secured as snugly against the wall as with an integral casing. Flue effect between separate casing and insulation increases loss but creates a false impression of efficiency because the casing is cooled by the air flow. Transite casings have none of these disadvantages.

If reinforced hard finish cement is used instead of Transite, the disadvantages of wire and mesh are present but there are better possibilities of an air seal than with an independently supported steel casing. The cement finish should not be used where it will be subjected to hard wear.

Sometimes No. 450 Insulating Cement is used not merely to level the surface to be insulated but is made thicker to serve as complete insulation either by itself or with a hard reinforced cement finish. The plastic insulation is less efficient than the blocks and the construction in general is less desirable.

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Interior of insulated Transite casing erected outside air-cooled walls. Brickwork is laid after casing is completed

Air-Cooled Wall Insulation and Casing

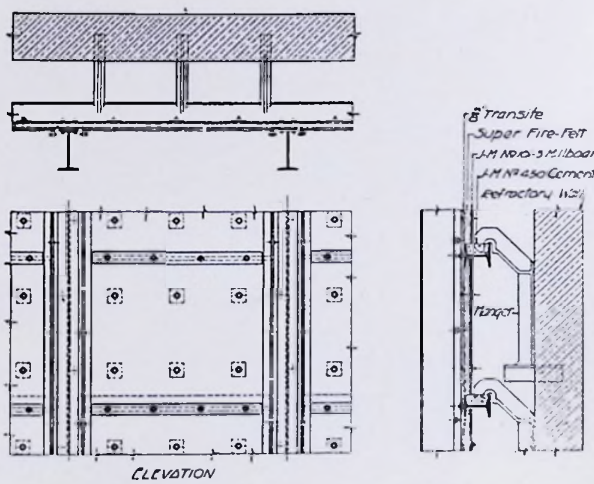
In all designs of ventilated boiler walls air is drawn over exterior brick surfaces (suspended or otherwise) either by fans, by natural draft or by burner induction. The circulation varies in the different designs, but in all designs the function of the casing over the air passages is to retain the heat recovered by the air, furnish a suitable clearance for air travel so that adequate scrubbing action is combined with the elimination of undue friction loss, and prevent leakage of air which would interrupt the flow over surfaces to be cooled. The construction should be fireproof and able successfully to withstand abrasion, ordinary mechanical impact and high temperature.

Very practical casings may be made of J-M Marinite, a structural insulating material furnished in 48″ x 96″ sheets. The 1″ thickness is usually recommended. Joints are covered with steel battens applied over gaskets of J-M No. 106 Asbestos Sheet Millboard. The outer surface of the casing is painted, if desired.

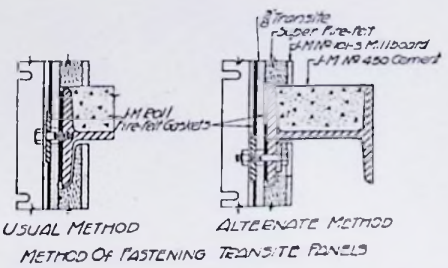
Another casing construction is ⅜″ Transite, lined with Super Fire-Felt Sheets (usually 1″ thick). A protective surface, next to the air space, is provided by ¼″-thick J-M No. 101-S Asbestos Sheet Millboard. This casing, erected between the buckstays, gives superior insulation with minimum thickness. The panel construction is tight, sectionally removable and replaceable, and economical of floor space.

The materials which go to make up the panels are fabricated as units by means of through bolts with nuts on the inside, bearing on large washers pressed against the furnace surface of the millboard. Behind each buckstay the insulation and millboard may be held in place by bolts passing through the flange of the buckstay. If horizontal H-beams are used, their upper half is filled with J-M No. 450 Insulating Cement before the casing is erected.

The usual practice is to complete the application of insulation and casing prior to the erection of the brick furnace walls. In one method of application the panels are maintained in position by steel battens fastened to the horizontal H-beams. In this construction the buckstays are backed up with channels so applied that the legs of the channels extend forward from the casing. Vertical joints along the buckstays, between the buckstays and the casing panels, are sealed by light angles, slotted for bolting to the legs of the channels backing the buckstays and pressed firmly against the panels as a final operation. All joints subject to air leakage are gasketed during erection with ⅛″ J-M Asbestos Roll Fire-Felt.



Insulated casing construction over air-cooled walls



Methods of fastening panels to horizontal beams

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Boiler Bases

The bases of boilers should ordinarily be insulated under fire brick with at least 4″ of Sil-O-Cel C-3 Concrete. Sil-O-Cel Brick of the proper type to withstand the temperature may be applied where the use of brick shapes is advantageous.

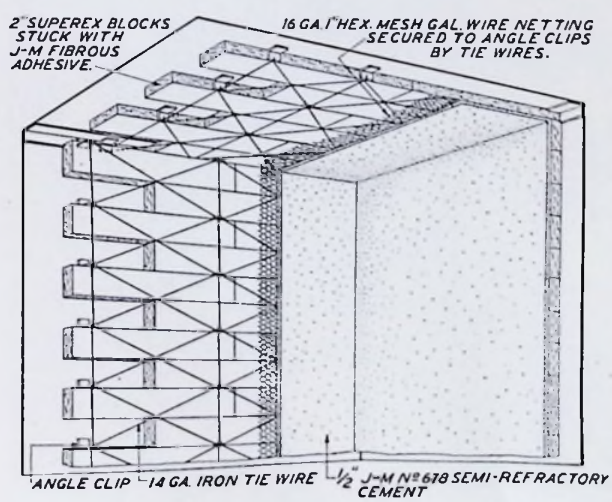
Expansion joints in the brickwork of the base are perhaps even more essential than in the walls, if a satisfactory life is to be obtained. Where improper joints are provided the fire brick will arch and expose the insulation.

In some cases where inadequate insulation is used over a cinder fill, heat has been known to work down into the foundation and ignite the cinders if they are not burned out properly. Where boilers are set over wood piling, etc., where fire hazards are present, particular care is essential in insulating the bases.

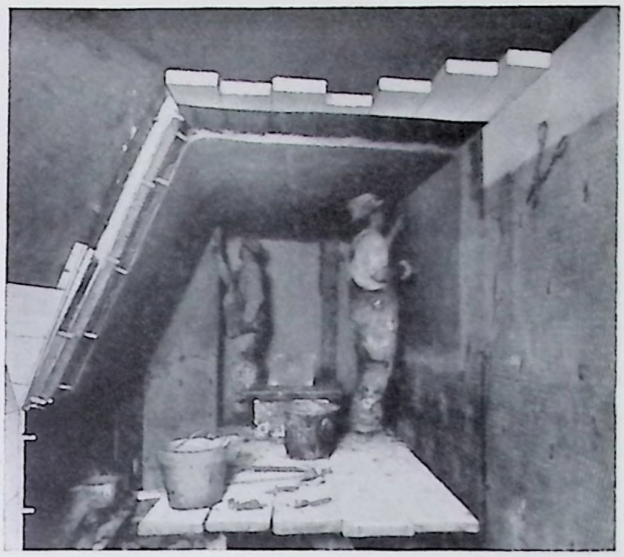
Boiler Tube Doors

Boiler tube doors should be thoroughly insulated to protect the steam surfaces immediately behind. These doors are insulated with 2″ Super Fire-Felt Sheets, protected on the surface with ¼″ J-M No. 101-S Asbestos Sheet Millboard, the whole being held in place by bolts and plate washers. All joints between the sheets and around the edges are pointed up with J-M No. 319 Semi-Refractory Cement.

If the doors are insulated before they are hung, they may be laid flat and filled with Sil-O-Cel C-3 Concrete rammed in between reinforcing bolts which extend through the door.



Breeching lined with Superex Blocks



Boiler breeching lined with 2½″ of Superex Blocks and Semi-Refractory Cement

Breechings and Stacks

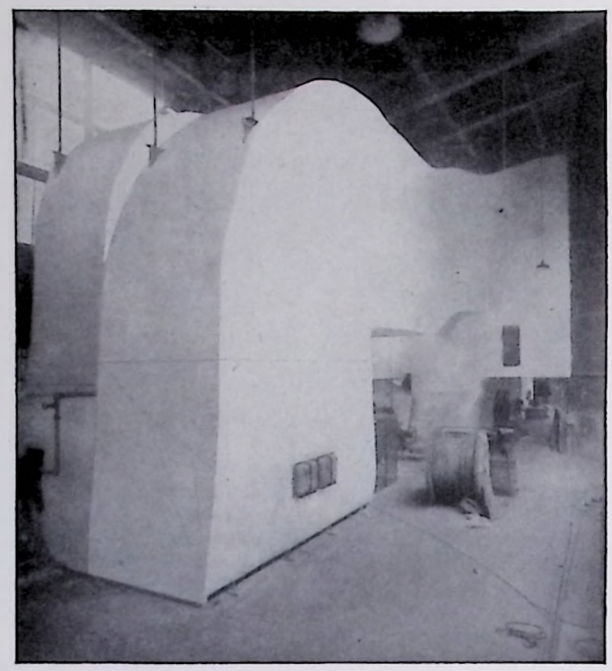
No one doubts the advisability of insulating smoke flues and breechings but there is some difference of opinion as to whether the insulation should be external or internal. Often the size and location of the flue will eliminate one possibility, as where a man cannot work inside and the insulation is necessarily placed outside. Outdoor ducts, on the other hand, should usually be insulated inside. Where low gas temperatures and conditions inducing condensation prevail, exterior insulation is preferred. The special circumstances of the individual installation usually indicate the better kind of construction.

In applying interior insulation, drilled angle clips or other suitable fasteners are spot-welded to the interior of the breeching on convenient centers. Tie wires are twisted through the hole in each clip and the insulation (2½″ Sil-O-Cel Natural or JM-20 Brick or 2″ Superex Blocks) stuck to the shell with J-M Fibrous Adhesive. The insulation is securely laced in position and reinforcing mesh tied tightly over the surface. After moistening the insulation thoroughly, J-M No. 678 Semi-Refractory Cement is applied in one coat to a thickness of ½″. The cement is worked well into the mesh and troweled hard and smooth. This finish protects the insulation from abrasion.

In erecting outside insulation, J-M 85% Magnesia or Superex Blocks may be stuck to the shell, wired in position, and finished with No. 302 Insulating Cement reinforced with wire mesh. In a Connery breech-

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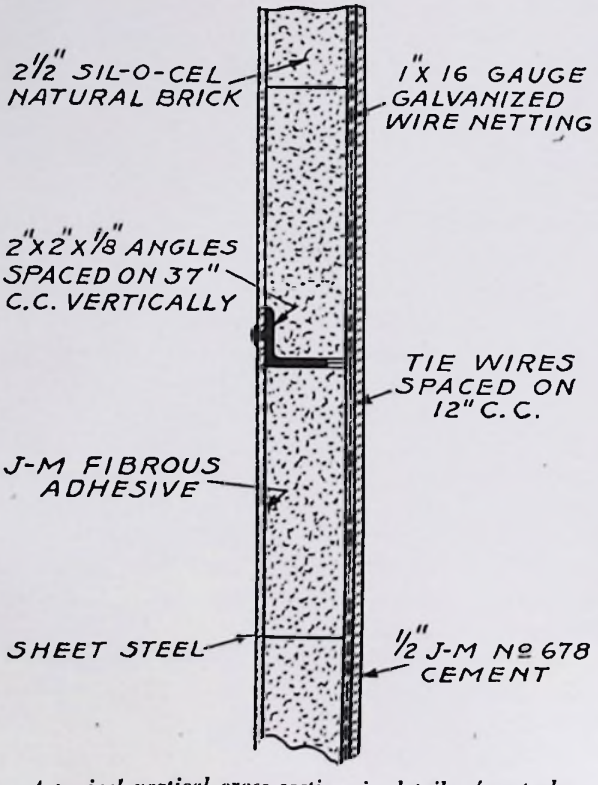
Connery flue insulated with Superex Blocks with cement finish

ing, however, this type of construction has the disadvantage of leaving the expansion stiffness uninsulated.

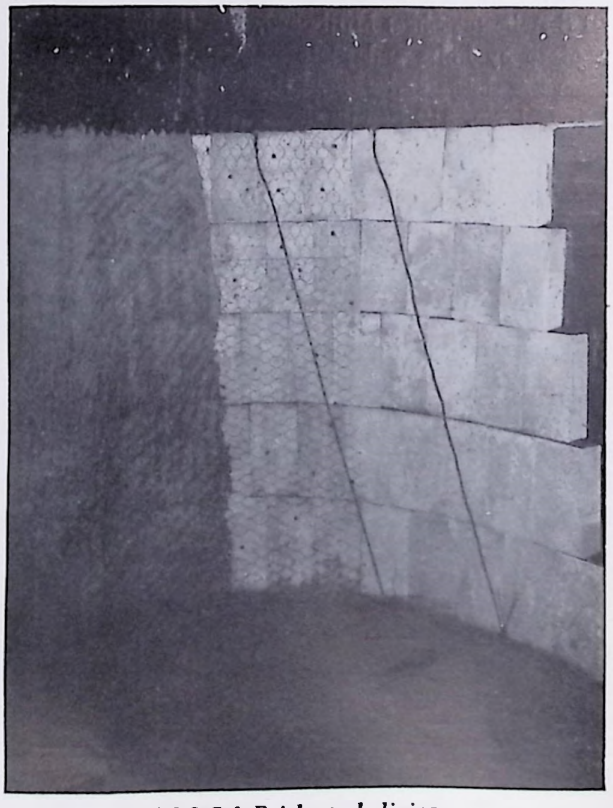
Another method for outside work is to apply 6″ square mesh 6-gauge wire fabric over the stiffener angles or V-ribs. On Connery flues it is spot-welded to the V-ribs and on other flues it is securely laced to the stiffening angles. The insulating blocks are laced firmly to the fabric with wire and cables, and reinforced No. 302 Cement applied. Where stiffening angles are widely spaced or where there are no projecting stiffeners, V-rib lath with 1″ ribs may be used to form the air space over which block insulation may be applied.

Stacks are insulated in much the same manner as breechings. Blocks are used for outside insulation and blocks or brick where interior insulation is desired. The recommendations of materials and thicknesses are the same as for breechings. One type of construction is indicated in the drawing.

Vitribestos Sheets, 2″ thick and curved to fit, are also used for stack insulation where temperatures do not exceed 700 deg. F.



A typical vertical cross section, in detail, of a stack lined with Sil-O-Cel Natural Brick

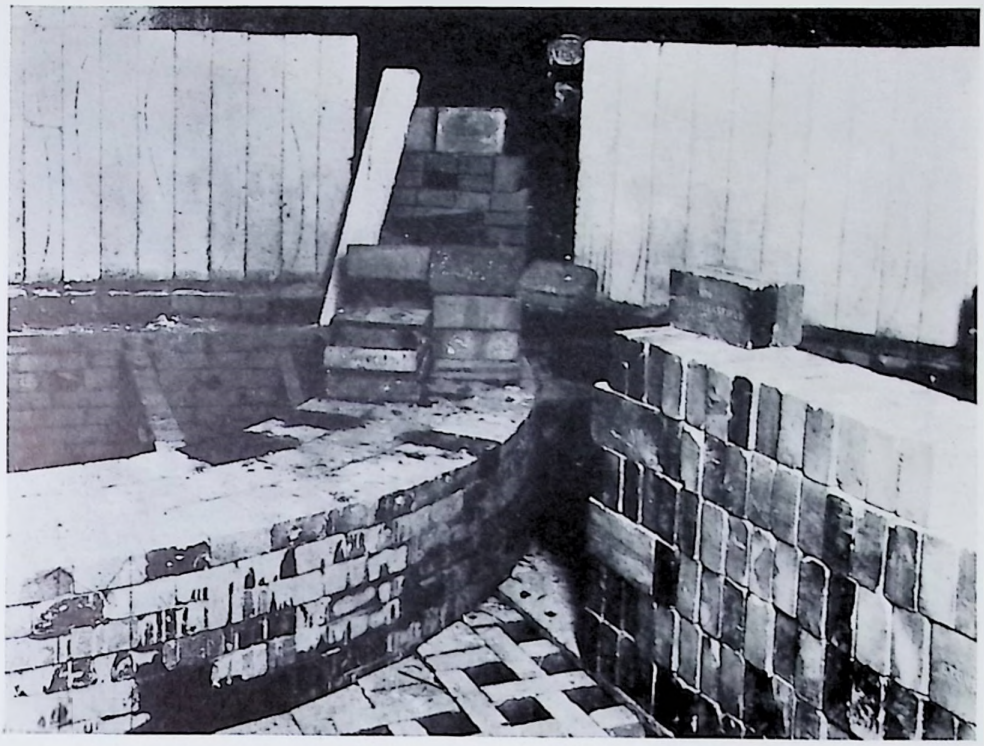


Sil-O-Cel Brick stack lining

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Insulation of Steel Making Equipment



J-M insulation being applied behind refractory in a side combustion hot blast stove

Many J-M insulating products find wide application in steel mill equipment for improving performance, increasing production and lowering operating costs. The more important of such applications are discussed in the following pages.

Blast Furnace Stack

The blast furnace stack is insulated with 2½″ to 4″ of Sil-O-Cel Coarse Grade, extending from the mantel to the bottom of the wearing plates. The coarse powder is densely packed between the shell and the in-walls as the brickwork progresses.

Hot Blast Stoves

Current practice for the insulation of hot blast stoves uses 2½″ of Superex Blocks next to the shell, followed by 4½″ of Sil-O-Cel C-22 Brick. Domes are insulated with 4½″ of C-22 Brick and 2″ of Superex Blocks. In both locations, the insulation is protected by fire brick lining.

Since the development of the 1900-deg. Superex Blocks, it is now possible to replace the 4½″ of C-22 Brick with 1½″ to 4″ of Superex, and obtain not only more efficient operation but also an increase in checker area due to an increase in inside diameter.

In either of the above constructions, the insulation pays for itself in a few months' operation, stove capacity is increased and checkerwork lasts longer. Base insulation consists of a minimum of 4″ of Sil-O-Cel C-3 Concrete.

Hot Blast Mains

The generally recommended insulation for hot blast mains and bustle pipes is a 3″ layer of Superex Blocks or a 4½″ course of Sil-O-Cel C-22 or JM-20 Brick behind a 4½″ course of fire brick. These constructions reduce radiation loss 60 to 70 percent compared to that from an uninsulated 9″ fire brick lining. Alternate specifications make use of C-22 or JM-20 Brick laid 2½″ thick, or Superex Blocks 2″ thick. protected by at least 6″ of fire brick.

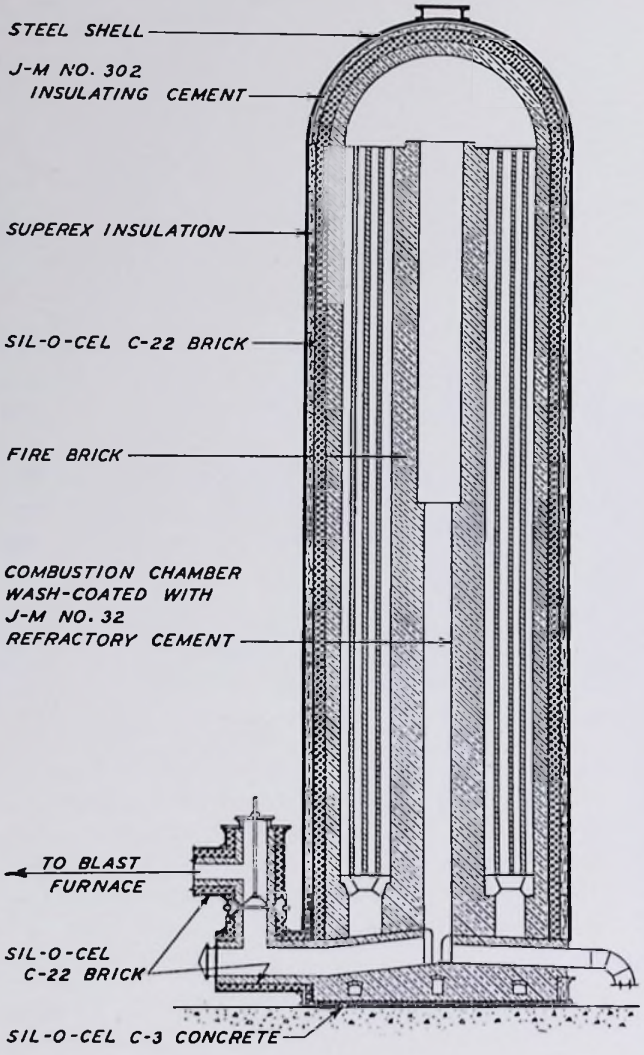
Open Hearth Furnace Hearths

The entire hearth and sloping back wall of the open hearth furnace is insulated with 5″ of Sil-O-Cel C-3 Concrete, making proper provision for expansion. Immediately above the supporting steel work in the pan of the hearth, the C-3 Concrete is placed in mono-

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lithic construction. Sil-O-Cel C-3 Concrete is made in the usual way and tamped into place after thorough mixing. The usual brick hearth construction pro-

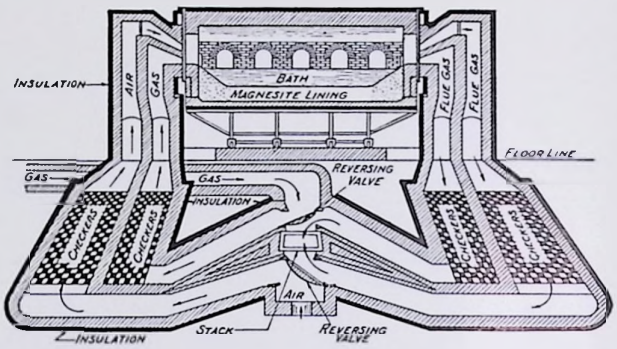


Method of insulating hot blast stoves and mains

ceeds after the C-3 Concrete has set. In certain instances it may be preferable to use 5″ of Sil-O-Cel C-22 or Super Brick instead of the C-3 Concrete.

Open Hearth Regenerators

The walls of new open hearth regenerators are insulated with 4″ of Superex Blocks or 4½″ of Sil-O-Cel Natural Brick, inside the steel casing. Roofs are insulated with 2″ of Superex or 2½″ of Sil-O-Cel Natural Brick. Sections below ground are insulated with 4″ of Sil-O-Cel C-3 Concrete. Existing regenerator walls are also insulated with 4″ of Sil-O-Cel C-3 Concrete, and Sil-O-Cel C-3 (granular) is spread 2½″ thick on the roof surface. It is not unusual for insulation on regenerators to repay its cost in a year's time through heat saving, not to mention improved operation through minimized air infiltration.



Perspective cross-section of the open hearth system showing location of insulation. The many steel plants operating completely insulated open hearths report faster heats and greatly reduced operating costs. In a properly controlled insulated furnace, refractory life is also appreciably lengthened

Open Hearth Furnace Roofs

Recommendations for insulating open hearth furnace roofs are made to suit the individual conditions of the installation. For this purpose, the following J-M materials are being used with satisfactory results: Sil-O-Cel Coarse Powder with a binding ingredient to give a monolithic slab insulation; J-M No. 500 Insulating Cement; vermiculite granules, covered with a coating of No. 500 Cement; Superex Blocks; Sil-O-Cel C-22 Brick; and Sil-O-Cel Super Brick. J-M No. 500 Insulating Cement is also used for insulating side walls above the charging floors.

Fan-tails, Slag Pockets and Flues

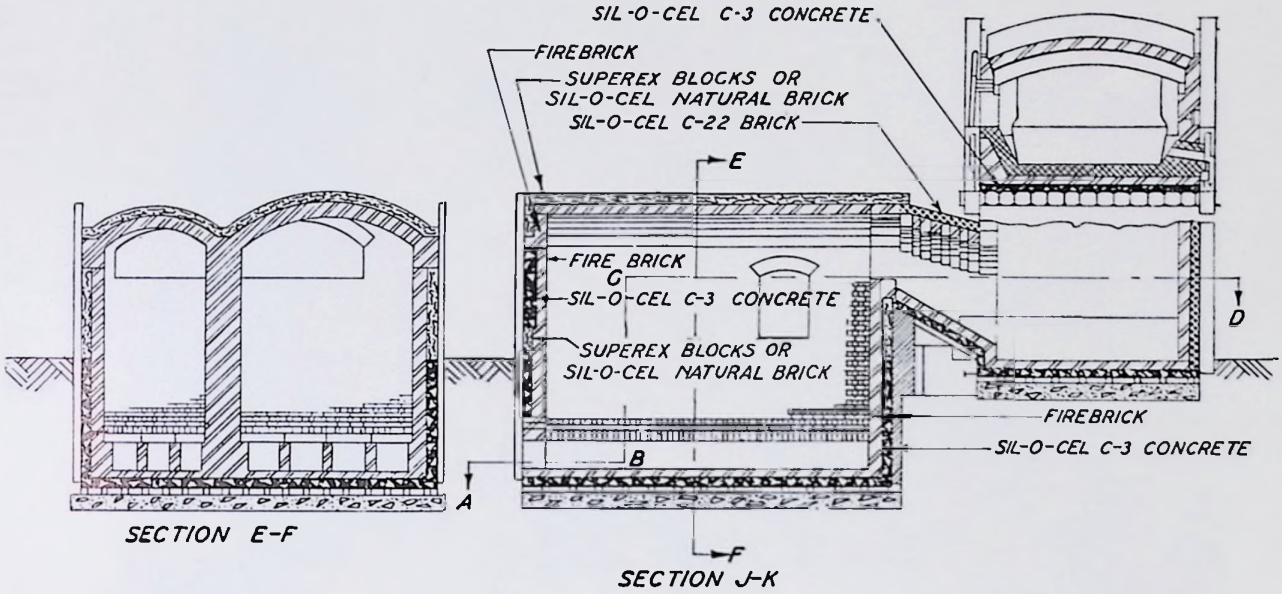
The bases of fan-tails and slag pockets are insulated with a minimum of 4″ of Sil-O-Cel C-3 Concrete. Walls are insulated with Sil-O-Cel C-22 Brick, or C-3 (granular), 4½″ thick. Fan-tail roofs are insulated with the same materials 2½″ thick.

Open hearth flues are completely insulated in base, sides and over the top with at least 4″ of Sil-O-Cel C-3 Concrete, outside the fire brick lining.

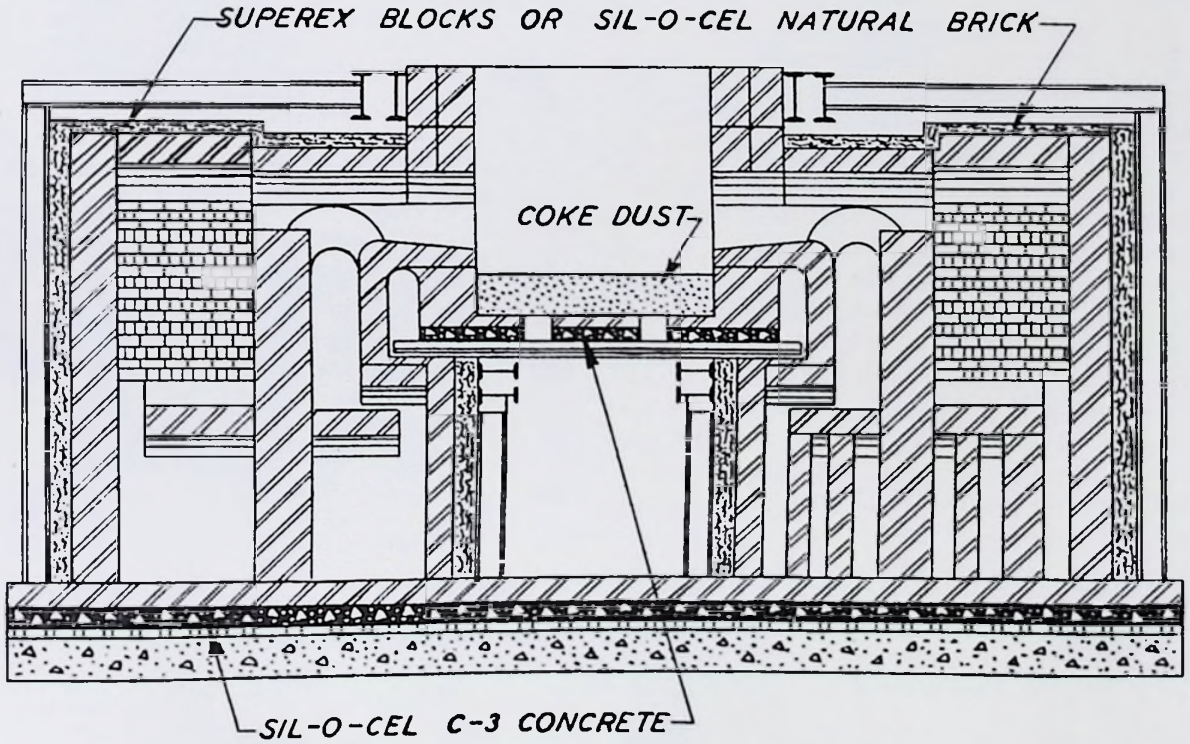
Soaking Pits

Soaking pits are insulated in much the same manner employed for open hearth regenerators. Four approved methods of insulating involve the use of Superex Blocks, Sil-O-Cel Natural Brick, JM-20 Brick, and Sil-O-Cel C-3 Concrete.

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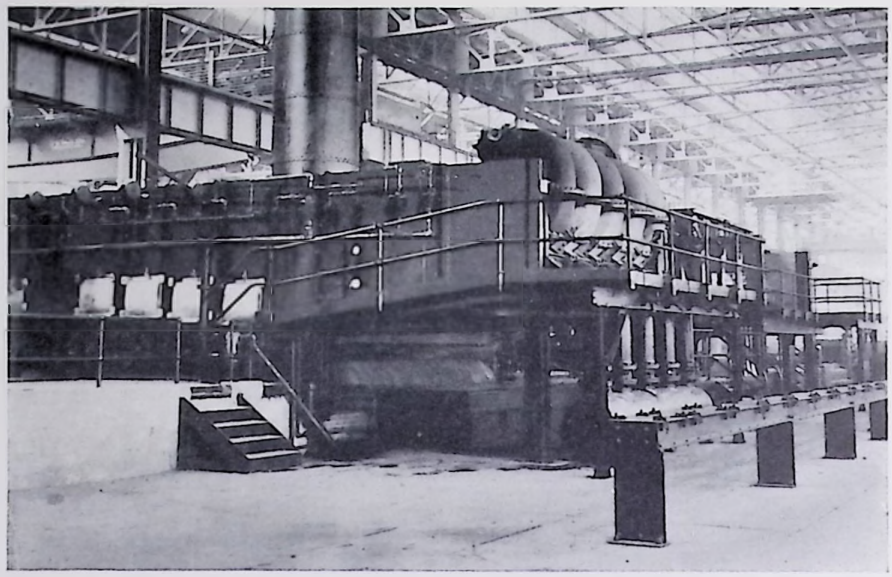
J-M insulation recommendation for new open hearth construction. Fan-tail and slag pocket walls are insulated with Sil-O-Cel C-22 Brick or C-3 (granular). Flues are insulated, base, walls and top, with Sil-O-Cel C-3 Concrete outside the refractory



J-M insulation recommendation for new soaking pit construction. Existing pits are completely insulated with Sil-O-Cel C-3 Concrete applied on the outside of the walls and C-3 (granular) over the top

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Morgan continuous billet heating furnace (oil-fired) with side walls insulated with Superex Blocks

Heating and Treating Furnaces

Insulation on heating and treating furnaces saves fuel, provides closer temperature control, reduces air infiltration and assures better working conditions. Added to this is the decrease of internal strains and reduction in spalling because of the smaller temperature differential between the inside and outside of the refractory. Wall cracks, caused by uneven expansion and contraction, are fewer and smaller.

Superex, Superex-Magnesia Combination Insulation, JM-20 or Sil-O-Cel Brick are usually applied between or behind the buckstays, next to the refractory lining, to the required thickness. At places of unusual thrust, such as opposite a sprung arch, or where castings and steel work are hung into the brickwork, the fire brick is carried through the insulation to the outside of the furnace. The thickness applied may vary from 2″ on billet heating furnaces to 20″ or more on electric oven furnaces. Furnace bases should be insulated under the refractory with a minimum of 4″ of Sil-O-Cel C-3 Concrete.

Sil-O-Cel as a Combination Insulation and Refractory

While in most cases Sil-O-Cel is used as an insulating material behind fire brick linings, its use as a combination refractory and insulation in certain types of equipment has been attended by great success.

Sil-O-Cel C-22 Brick are useful to 2000 deg. F. because they have been calcined at high temperatures, are semi-refractory and serve very well without fire brick protection when not subjected to erosion or abrasion. The great advantage of such construction lies not only in excellent insulating qualities but also in marked reduction in heat stored in the furnace lining and time required to reach operating temperatures.

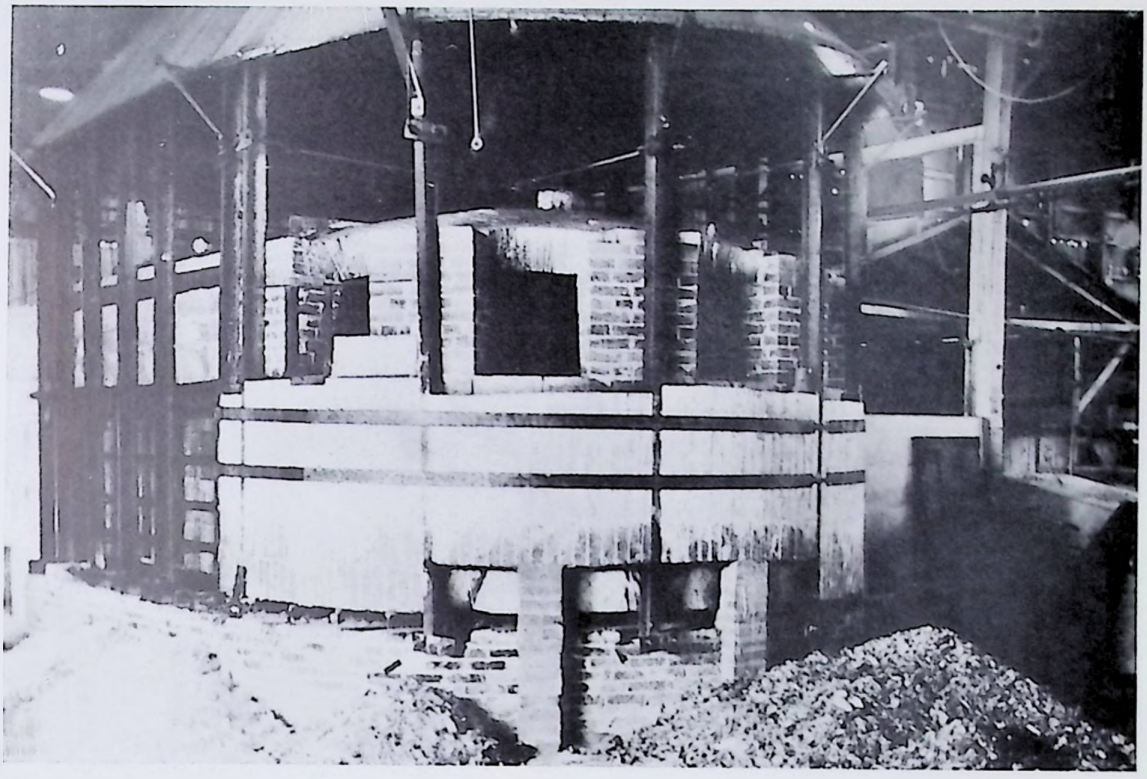
Ovens and furnaces operated at moderate temperature are in many cases now being constructed of Sil-O-Cel C-3 Concrete. Fuel consumption is surprisingly low, due to the insulating properties of C-3 and the fact that all masonry joints are eliminated. This insulating concrete is over three times as effective as fire brick in preventing heat penetration. Made in accordance with specifications, the material sets up into a strong durable concrete with a crushing strength of about 1000 lb. per sq. in.

Producer Gas Mains

Producer gas mains are insulated between refractory lining and steel shell with 2½″ to 4″ of Superex Blocks. Sil-O-Cel Natural Brick are similarly used in 2½″ or 4½″ thickness. Such insulation reduces tar deposition, keeps the gas of higher heat value and makes fewer burnouts necessary. Superex Blocks, 2½″ thick, save in heat over four times their cost in a year of operation, assuming 1400 deg. F. gas, and sensible heat worth $0.25 per million B.t.u.

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Insulation of Glass Making Equipment



Sil-O-Cel C-22 Brick as a veneer course on the nose of a continuous tank

The application of insulation to continuous glass tank furnaces and pot furnaces offers such attractive possibilities of heat saving that much attention has been given in recent years to its potential use under the hearths and on walls and crowns. A special study of the particular refractory conditions in the individual furnace is the only method of evolving insulation recommendations for this type of equipment. However, insulation has been utilized on the refining chamber of continuous tanks for a number of years with very satisfactory results.

Day Tanks

In day tanks also, insulation has been used with uniformly beneficial results. Melting time has been shortened, fuel consumption reduced, troubles due to devitrified or cordy glass minimized, and the life of the flux blocks increased. Insulation has usually consisted of a 4½" course of Sil-O-Cel C-22 Brick outside the flux blocks on the sides, and a 2½" course of C-22 Brick over the silica brick crown. In the bottom, 2½" Sil-O-Cel Natural or C-22 Brick are laid, covered with one or two layers of fire brick and the regular bottom blocks.

Regenerators

Standard insulation specifications have long been used for regenerators and up-takes. The heat conserved by reducing radiation losses may be evidenced by a direct saving in fuel, by increased production or by greater speed in making the heats. Losses incidental to shut-downs are decreased, and improved conditions result from the reduced leakage through insulated regenerator walls. Refractory loads are lightened, more uniform temperatures exist throughout the checkers, and maintenance charges are smaller. Through fuel saving alone the expense of insulating is returned well within the first year.

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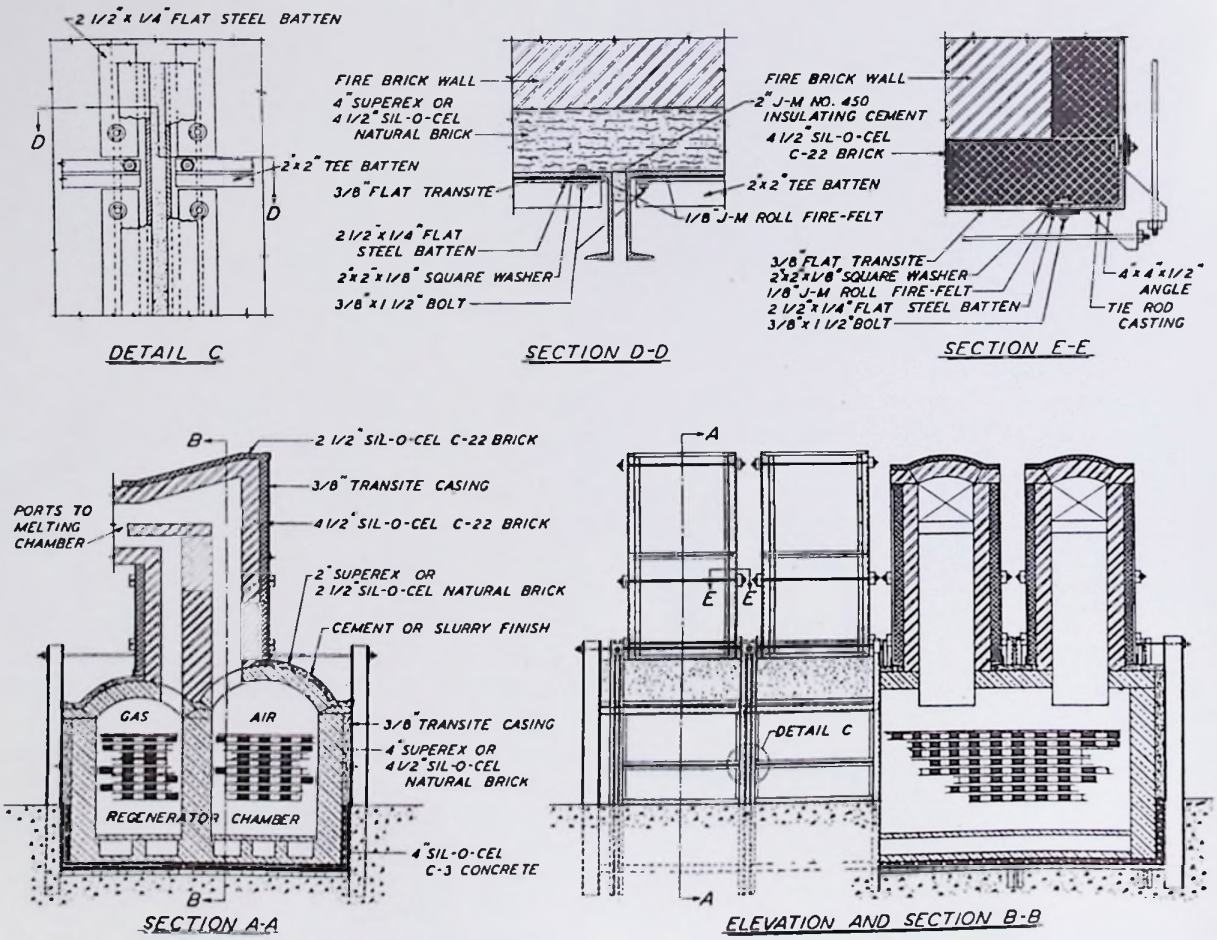
On new regenerators, with solid fire brick walls not less than 13½" thick, all exterior brickwork in the sides above ground is insulated with 4" Superex Blocks or 4½" Sil-O-Cel Natural Brick, placed behind the brickwork, and preferably finished with a Transite casing. At the arches, the fire brick is carried through to the supporting steel members. Regenerator roofs, consisting of fire brick at least 9" thick, are insulated with 2" Superex Blocks or 2½" Sil-O-Cel Natural Brick. A cement finish is troweled over the surface of the Superex, and the Sil-O-Cel Brick are finished with a slurry of Sil-O-Cel Mortar.

Wall sections of new regenerators below ground are insulated with a minimum of 4" of Sil-O-Cel C-3 Concrete, tamped into forms outside of the brickwork. The base is insulated with 4" of Sil-O-Cel C-3 Concrete covered with two 2½" courses of fire brick.

Wall sections of existing regenerators above ground are insulated with a minimum of 4" of Sil-O-Cel C-3 Concrete, applied to the clean regenerator wall and suitably reinforced. This application may be accomplished either by the use of a cement gun or by suitable forms. The roofs of such regenerators are insulated with Sil-O-Cel C-3 (granular) spread over the roof surface to an even thickness of 2½".

Flues and Up-takes

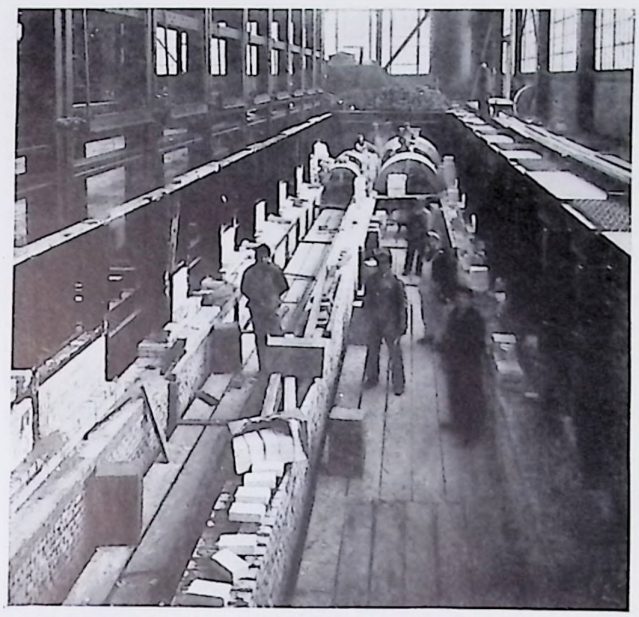
The walls of the tank furnace flues and up-takes, consisting of solid silica brick not less than 9" thick, are insulated with Sil-O-Cel C-22 Brick, 4½" thick, cased with Transite. The crowns of ports and up-takes are insulated with Sil-O-Cel C-22 Brick laid over the roof in a single layer, 2½" thick and finished with a slurry of Sil-O-Cel Mortar.



J-M insulation recommendation for glass tank furnace regenerators and up-takes

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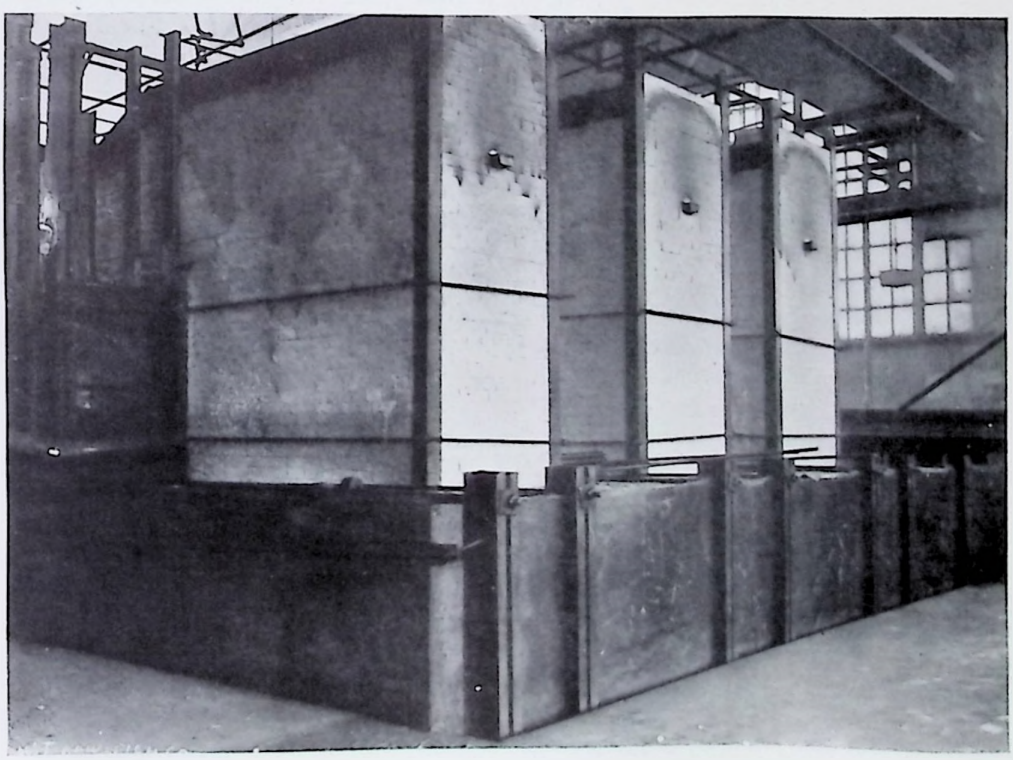
Lehr being insulated with 4½" Sil-O-Cel Natural Brick in core wall construction at the plant of the Mississippi Glass Co., St. Louis, Mo.

Annealing Furnaces and Lehrs

The insulation of lehrs does not readily lend itself to a standard specification, chiefly because of variations in design, fuel costs, hours of operation, and the degree of temperature uniformity and control necessary. As thickness of insulation is increased the cost of heat lost per year is decreased, but the cost per year of insulation (first cost multiplied by per cent fixed charges) is increased. The thickness at which the sum of these two costs is a minimum, is obviously the most economical.

The annealing of glass is a delicate operation requiring close control of the temperature gradient through the lehr, which is difficult to obtain with a cycle of decreasing temperatures. Thorough insulation is not only necessary from the standpoint of economical operation but also is a great factor in insuring accurate temperature control, uniform heat distribution and a perfectly annealed product.

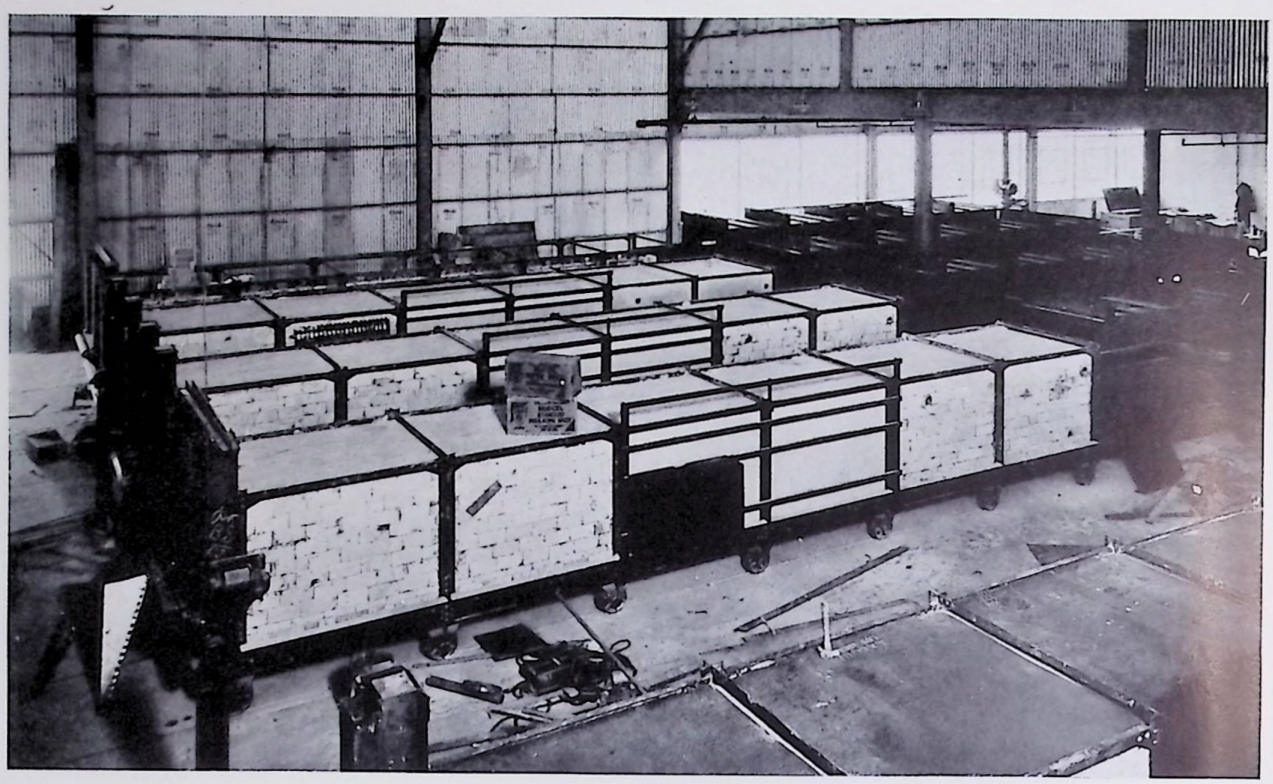
For a cheap fuel, lehr exteriors may be economically insulated with 4" of Superex or 4½" of Sil-O-Cel Natural Brick. In an electrically heated lehr,



Upper portion of regenerators above floor level, insulated with Superex Blocks. W. T. Rawleigh Co., Freeport, Ill.

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Electrically heated lehrs under construction at the Illinois-Pacific Glass Co., Los Angeles, Calif. Sil-O-Cel Super Brick used as combination refractory and insulation inside of Sil-O-Cel Natural Brick

the economical thickness of insulation may amount to 18″ or 20″ or more. Frequently the necessity of close temperature control will occasion the use of much thicker insulation than considerations of heat saving would justify.

The development of Sil-O-Cel C-22 Brick and Sil-O-Cel Super Brick during the past few years has made possible, in many cases, the elimination of fire brick linings. These brick are now being successfully used as combination insulating and refractory linings in many large electrically heated lehrs. Such application not only saves construction costs but also cuts down heat storage capacity, which conserves heat during shut-downs and permits the equipment to be brought up to temperature again in a very short time with minimum expense.

One installation of the type mentioned was made at the Los Angeles plant of the Illinois-Pacific Glass Company where six electrically heated lehrs were constructed with 4½″ of Sil-O-Cel Super Brick as an inside lining on sides and top, backed up with 5″ of Sil-O-Cel Natural Brick. The bases were insulated with 7½″ of Sil-O-Cel Natural Brick, above which was placed 2½″ of Sil-O-Cel Super Brick.

Pot Arches

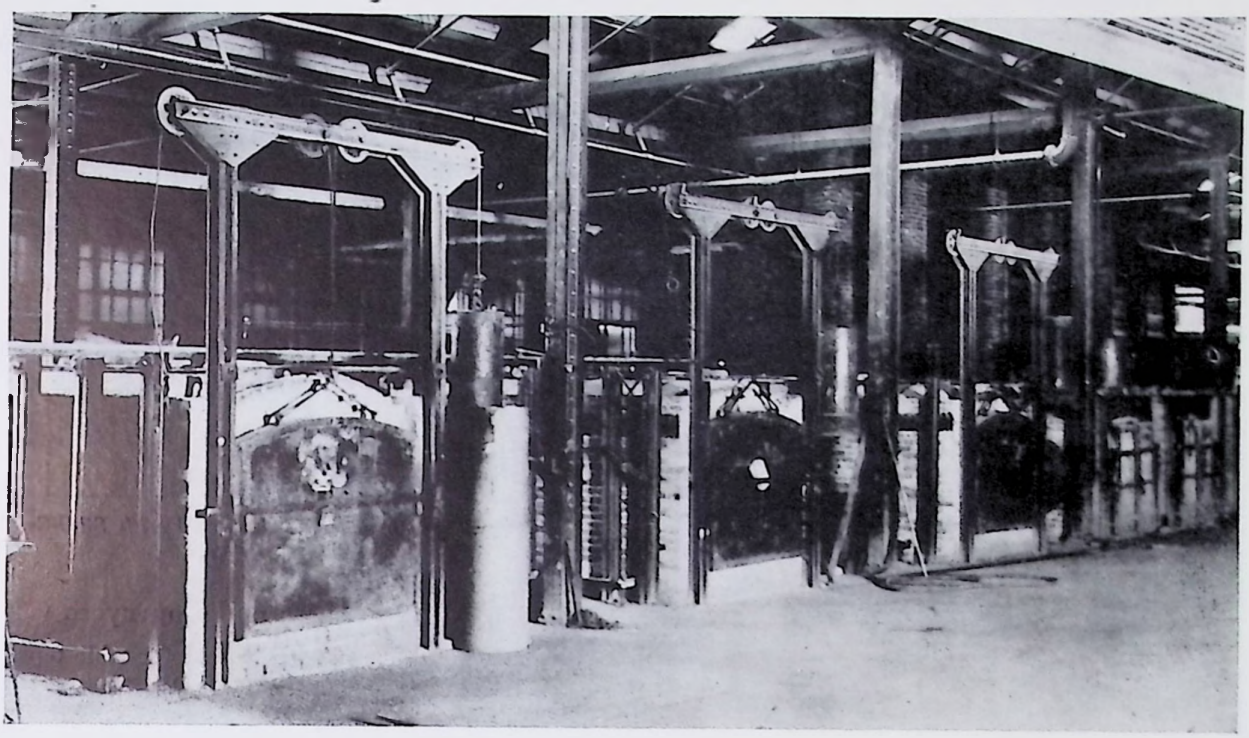
Insulation of pot arches is an excellent investment not only from the standpoint of fuel saving, but also because of the more uniform heating of the pots with elimination of trouble due to cracking or breaking.

Bases are insulated with 4″ to 6″ of Sil-O-Cel C-3 Concrete protected by two 2½″ layers of fire brick. Side and end walls are usually insulated with 4½″ of Sil-O-Cel Natural Brick between the fire brick and a red brick outer wall. Superex Blocks, 4″ thick, may also be used behind the fire brick, with a Transite casing, or a cement finish. Tops are insulated either with two 2½″ layers of Sil-O-Cel Natural Brick or with two 2″ layers of Superex Blocks.

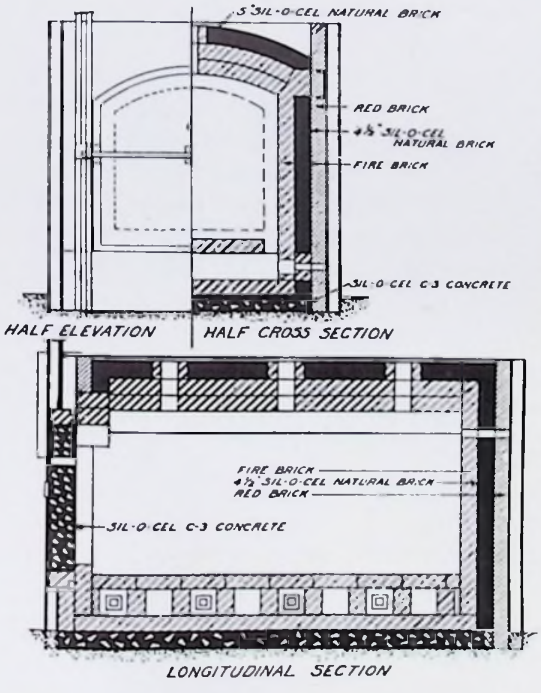
Insulated doors, which further assist in improving heat distribution, can be made by lining the door frame with Sil-O-Cel C-3 Concrete from 6″ to 9″ thick. Such doors weigh only half as much as fire brick and conduct only one-third as much heat.

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Pot arches insulated with Sil-O-Cel Natural Brick and Sil-O-Cel C-3 Concrete.
Bausch & Lomb Optical Co., Rochester, N. Y.



J-M insulation recommendation for pot arches

Flattening Ovens

Flattening ovens operate much more efficiently when properly insulated. The usual construction consists of 4½" of Sil-O-Cel Natural Brick between the fire brick and red brick on the sides. Superex Blocks, 4" thick, with a Transite casing, or a cement finish, may also be used to advantage for this purpose. Tops should be insulated either with two 2½" layers of Sil-O-Cel Natural Brick finished with a slurry of Sil-O-Cel Mortar, or with two 2" layers of Superex Blocks finished with cement.

Fourcault Squeeze Rolls

Development over several years is responsible for the present Fourcault rolls made of special J-M Asbestos Sheet Millboard. In the Fourcault process the rolls actually pull the glass from the drawing canals and the speed and setting of the rolls determines the thickness of the glass. These millboard rolls will not polish or slip, and have a certain resiliency which permits a small pebble or other foreign substance picked up with the glass to press into

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the surface of the roll rather than shadow the glass.

In making one type of roll, 5½″ dia. discs of 3/16″ millboard with a 1¾″ square hole in the center are densely pressed together about 20 at a time over a square shaft. After the length of the shaft has been covered, the discs are secured in place, the rolls turned down to 5¼″ dia. and finished with sand paper and fine files. A 54″ roll requires from 340 to 360 such discs. It is possible after using the rolls for a time to turn them down further and use them for a second run.

The casings which enclose the rolls are variously insulated with Asbesto-Sponge Felted, Super Fire-Felt, or Asbestos Sheet Millboard.

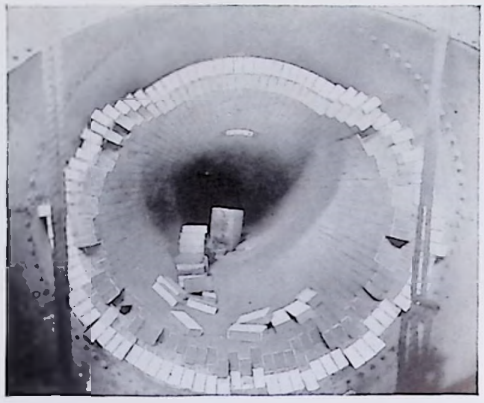
Fourcault Canals

It is important to insulate drawing canals in order to obtain uniform temperature conditions in the glass bath. Temperature control within a narrow range is absolutely essential to assure the delivery of glass in proper condition for drawing. This is accomplished by the use of adequate insulation outside the refractory.

The canals are heavily insulated in accord with individual requirements in the bottom, side walls, and over the crown. Extensive studies of operating requirements have resulted in the accumulation of a great amount of data on this subject. Recommendations are made separately for each particular installation.

Producer Gas Mains

Producer gas mains are insulated between refractory lining and steel shell with 2½″ to 4″ of Superex Blocks. Sil-O-Cel Brick are similarly used in 2½″ or 4½″ thicknesses. Such insulation reduces tar deposition, keeps the gas of higher heat value and extends the periods between necessary burnouts. As an example of sensible heat saving: Superex Blocks, 2½″ thick, save in heat over four times their cost in a year of operation, assuming 1400 deg. F. gas, and sensible heat worth $0.25 per million B.t.u.



Producer gas main being insulated with Sil-O-Cel Natural Brick

Transfer Tables and Conveyors

The surfaces of roll table or transfer table tops are often made of flat Transite, 1½″, 1¾″ or 2″ thick. Oftentimes small holes about 1/16″ dia. are drilled over the entire surface on approximate 4″ centers both ways. Without such holes, bubbles may form under the glass due to expansion of air confined as a result of small elevations on the surface of the glass. Conveyor plates of Transite are drilled in much the same manner.

Unit-type lehr walls and tops are often lined inside with ½″ flat Transite, except at muffle heating zones. Insulation is placed between inner and outer casings. At the top of the cool end, it is not unusual to omit the insulation and use loose Transite sheets which can be moved as dampers to control the cooling rate of the glass.

For conveying moulded glass containers, J-M No. 121 Woven Asbestos Gasketing Tape of commercial or 95% grade finds excellent application.

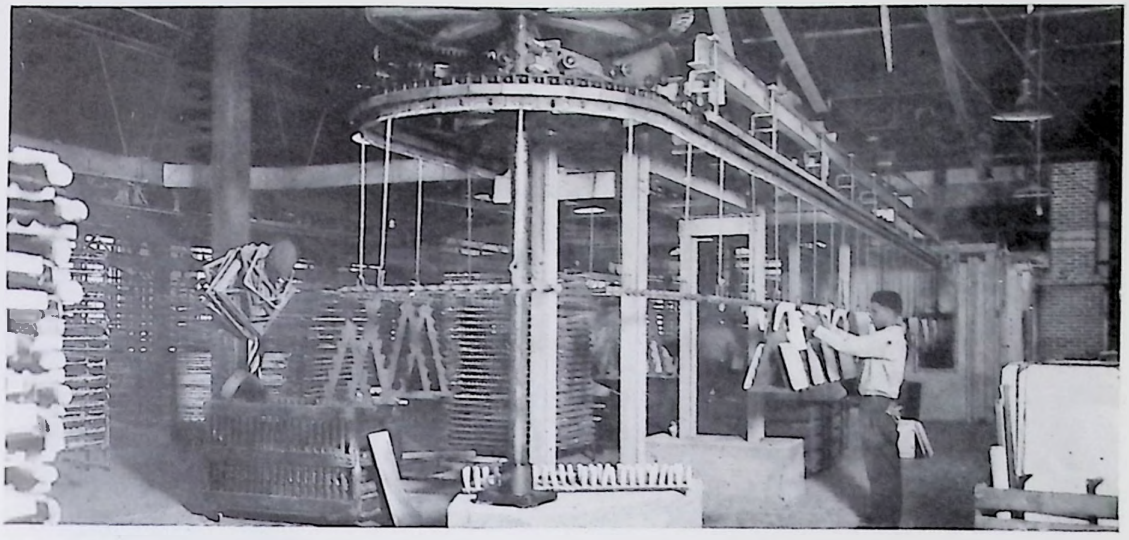
J-M Asbestos Fibres 201-A and 209 are used to protect glassware and prevent contact with hard, cold surfaces.

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Insulation of Vitreous Enameling Furnaces



Beemack enameling furnace, designed and built by the Surface Combustion Corporation. Insulated with Sil-O-Cel Natural Brick and C-3 Concrete

All modern furnaces for vitreous enameling are insulated to reduce fuel costs, facilitate temperature control and improve working conditions.

Methods of insulating continuous furnaces are the same as those employed in the case of tunnel kilns for firing other ceramic products.

The in-and-out type of furnace is insulated in the same general way as heat-treating furnaces of similar design. The thickness of insulation varies with the method of heating. A minimum of 4″ of insulating material should be used in any case, while in electrically heated furnaces, a thickness of 12″ or more is economical. In the bases, under one or two layers of fire brick, Sil-O-Cel C-3 Concrete, 4″ or more in thickness, is used. Walls are insulated with Sil-O-Cel Natural Brick, JM-20 Brick or Superex Blocks behind the refractory, and enclosed in a steel or Transite casing or covered with a cement finish. Tops are usually insulated with the same materials used on the sides.

By lining the doors of in-and-out furnaces with Sil-O-Cel C-3 Insulating Concrete faced with Firecrete*, working conditions are improved in front of the furnaces and more uniform temperatures can be maintained. Sil-O-Cel C-3 Concrete is made by mixing four parts of Sil-O-Cel C-3 and one part of portland cement by volume with only sufficient water to form a plastic mass. The C-3 Concrete is tamped into the door frame to a level approximately 1½″ below that desired for the finished lining. While the concrete is still fresh, ½″ of Firecrete is applied and rodded sufficiently to obtain a mixing of the Firecrete and C-3 for a depth of an inch or more below the surface of the mixture. Immediately thereafter, before the concrete has set, an additional 1″ of Firecrete is applied without rodding, and troweled to a smooth finish. Such a door lining is inexpensive, relatively light in weight and about three times as effective as fire brick in retarding heat flow.

Frit Furnaces

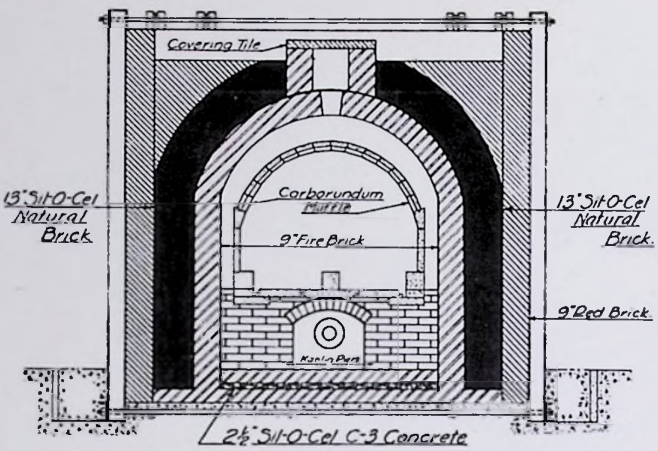
Most of the recent installations of furnaces for enamel smelting have been insulated. One large oil-fired furnace was insulated with 10″ of Sil-O-Cel Natural Brick in the bottom, covered with 7½″ of fire brick and 6″ of hearth tile. Sil-O-Cel Natural Brick, 9″ thick, were used on the sides behind 9″ of fire brick and 6″ of hearth tile. The 9″ crown was grouted with a relatively thin layer of Sil-O-Cel C-3 Concrete because of the high operating temperature involved (2600 deg. F.). The charging door was lined with 6″ of Sil-O-Cel C-3 Concrete and faced with a 3″ clay slab. This furnace operated at 35% efficiency compared to 10% for the old uninsulated furnaces.

* U. S. Patent No. 2,042,870.

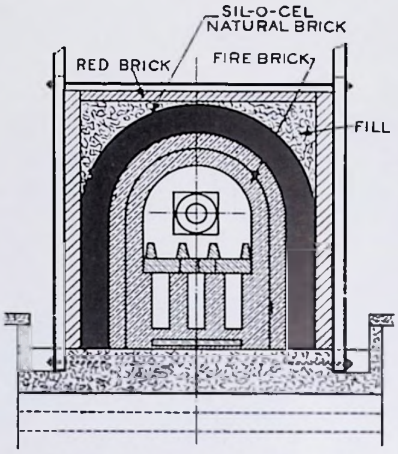
VITREOUS ENAMELING FURNACE INSULATION
March, 1937 (Cancelling sheet dated October, 1931)
IN-1250

Printed in U.S.A.

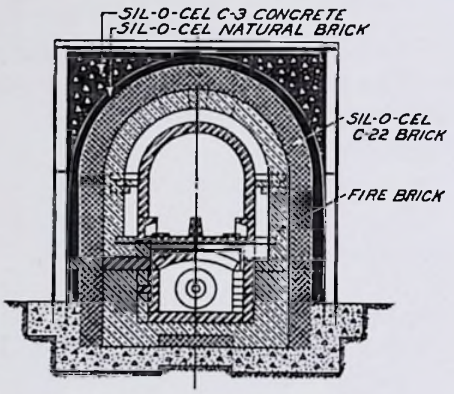
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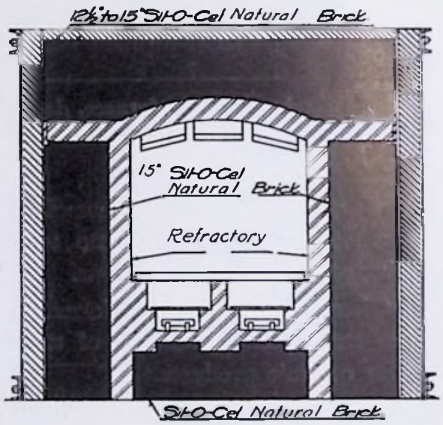
Method of insulating oil-fired enameling furnace recommended by Porcelain Enamel & Manufacturing Co., Baltimore, Md.



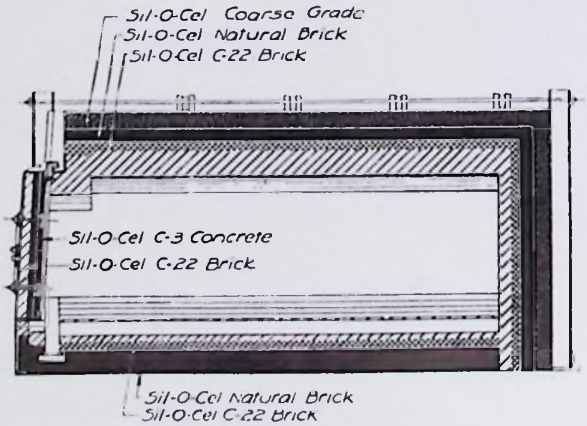
"H & H" enameling furnace, designed and built by C. A. Hoppin & Co., Peoria, Ill.



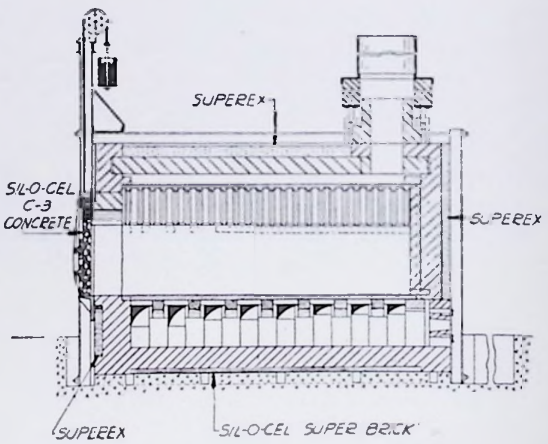
Vitreous enameling furnace, showing method of insulating recommended by designer and builder. Surface Combustion Corp., Toledo, Ohio.



Box-type electric vitreous enameling furnace, showing method of insulating recommended by General Electric Company.



Electric enameling furnace, designed and built by Gas Equipment Engineering Corporation, Philadelphia, Pa.



Muffle furnace for vitreous enameling, designed and built by the Carborundum Co.

Vitreous enameling furnaces insulated with J-M Materials

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Insulation of Ceramic Kilns



Applying Superex Blocks to top of rectangular down-draft kiln at Hazelton Brick Co., Hazelton, Pa.

High temperatures are so intimately associated with the manufacture of ceramic products that adequate insulation is recognized as an essential in the design and construction of efficient equipment. On all kilns of the permanent type, whether continuous or periodic, insulation effects marked savings in production cost. In the continuous tunnel kiln, heavy insulation has always been used. On periodic kilns, crown insulation alone effects savings of 10% to 13% in fuel costs, while kilns insulated throughout, in bases, walls and crowns, operate with 17% to 20% less fuel than similar uninsulated kilns. Proper insulation also improves the quality of the ware, a logical result of the more uniform temperatures maintained through the blanketing effect of the insulation.

Insulated kilns can be brought up to heat and held at the desired temperature much more easily. The result is more rapid kiln turn-over with consequent lower labor costs. Furthermore, temperatures can be more accurately controlled in bad weather, an advantage particularly important in climates where wide ranges or sudden fluctuations in temperature are encountered.

Periodic Kilns

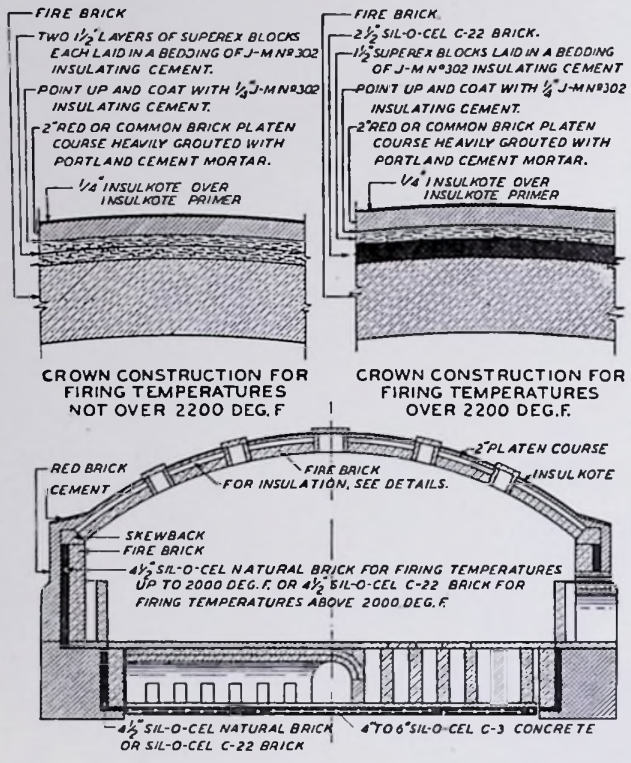
Usual methods of insulating round down-draft kilns and bottle-neck up-draft kilns are shown in the drawings. Rectangular down-draft kilns are insulated in the same general manner as round down-draft kilns.

Crowns:

Insulation of the crown is particularly important because of its relatively thin construction. In addition to reducing radiation losses approximately 75%, insulation more nearly equalizes the temperature

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J-M insulation recommendation for round down-draft kiln

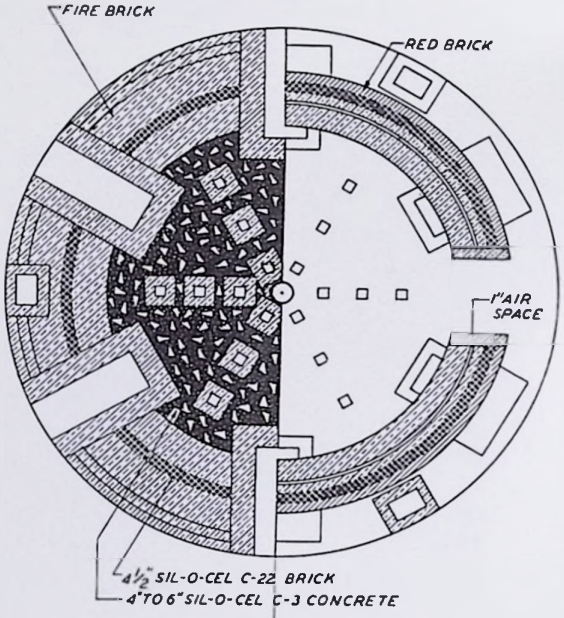
through the fire brick, preventing stresses which are the usual cause of cracking. Insulation also reduces the exterior temperature sufficiently to permit the use of asphaltic waterproofing treatment.

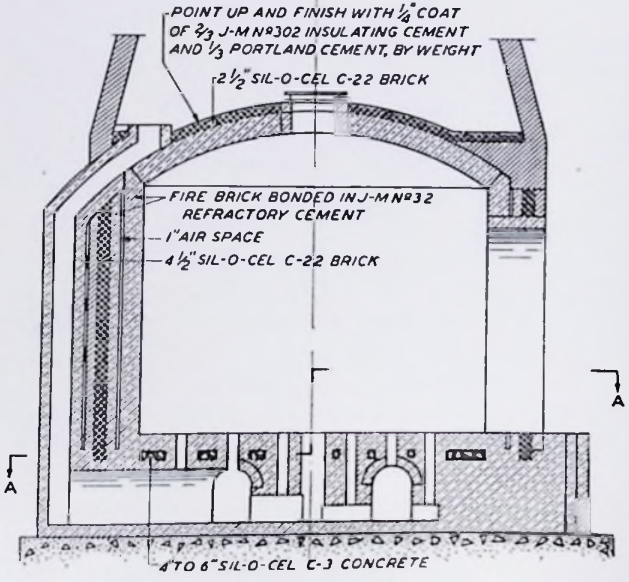
For best results, the insulation, platen course and Insulkote waterproofing on the crown should be applied while the kiln is hot, to prevent subsequent cracking due to expansion under heat. The crowns of new kilns should be left uninsulated for one or two burns to allow settling to take place.

Superex Blocks, whether used directly over the fire brick (operating temperatures not more than 2200 deg. F.), or over an intermediate layer of Sil-O-Cel C-22 Brick (operating temperatures exceeding 2200 deg. F.), should be laid in a bedding of J-M No. 302 Insulating Cement and should be pointed up and coated with ¼" of the same material. The platen course of red brick or common brick is heavily grouted with a slurry of portland cement and sand, after which the surface is primed and Insulkote applied.

The crowns of bottle-neck kilns, because of being enclosed in the stack with consequent lower radiation loss than if exposed, ordinarily require insulation with 2½" Sil-O-Cel C-22 Brick only.

Existing Crowns: Old kilns can be made to operate more economically and, in many instances, quality can be improved and output increased, by insulating the crown alone. Such crowns should be of good quality fire brick and in good condition. The





J-M insulation recommendation for bottle-neck kiln

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existing platen course, if any, may be removed if weight must be considered, and replaced after the insulation is applied. Insulation, because of its light weight, does not add appreciably to the load on the crown. Application is made in the same manner as shown for new kilns.

Walls:

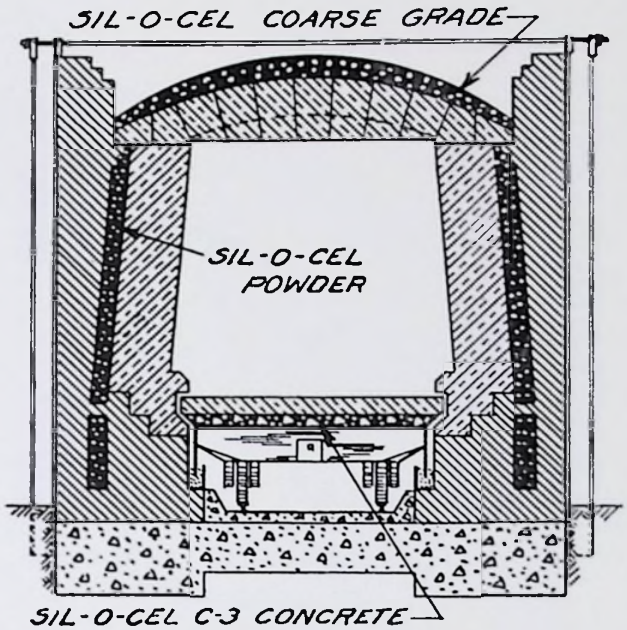
Kiln walls are insulated with 4½" of Sil-O-Cel Natural Brick for operating temperatures up to 2000 deg. F., or with 4½" of Sil-O-Cel C-22 Brick for temperatures above 2000 deg. F. Insulation permits the use of relatively thin walls without sacrificing efficiency because of undue radiation losses. A 4½" course of Sil-O-Cel Brick will reduce heat losses at least 60% compared with those through uninsulated walls of the same total thickness.

Bases:

The earth on which a kiln stands will absorb a large amount of heat. This constant source of loss not only often interferes with the draft but also makes it difficult to maintain temperatures in the bottom of the kiln. In many instances this results either in under-firing the ware in the bottom, or over-burning the top ware in an effort to bring bottom temperatures to the desired point. Insulating the base with from 4" to 6" of Sil-O-Cel C-3 Concrete is a most effective means of insuring uniform temperatures throughout all parts of the kiln.

Continuous Kilns

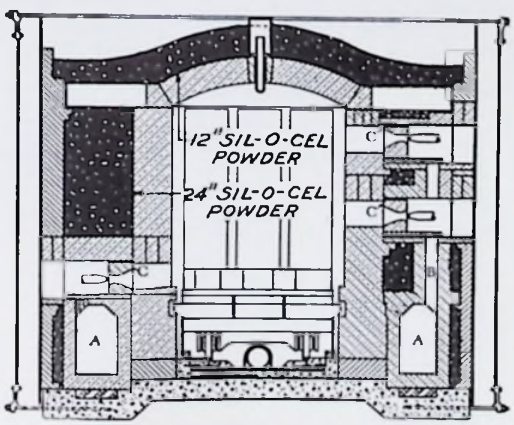
Continuous tunnel kilns, because of the great areas exposed to radiation, would be very wasteful of heat unless thoroughly insulated. Sil-O-Cel materials have been used in practically every tunnel kiln built during the past fifteen years.



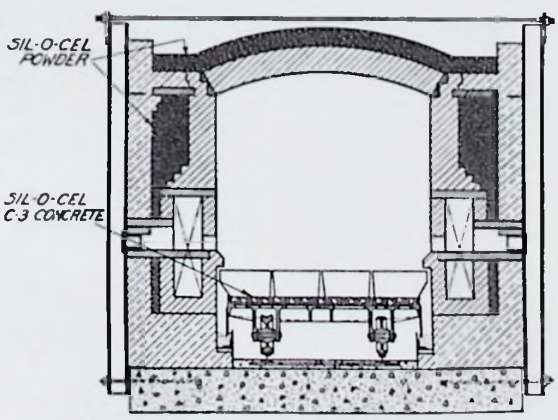
Method of insulating Harrop tunnel kiln

Cross sections of tunnel kilns show typical methods of insulation in general use. Sil-O-Cel Powder, or Sil-O-Cel Coarse Grade, is usually employed for this purpose and is highly effective in minimizing heat loss.

One illustration shows a tunnel kiln used for decorated china-ware, in which walls and top, as well as the decks of the tunnel kiln cars, are composed entirely of Sil-O-Cel insulating materials. At this tem-



Swindell-Dressler tunnel kiln. Car decks are insulated with Sil-O-Cel C-3 Concrete



Russell direct-fired tunnel kiln, showing insulation of walls, top and car deck

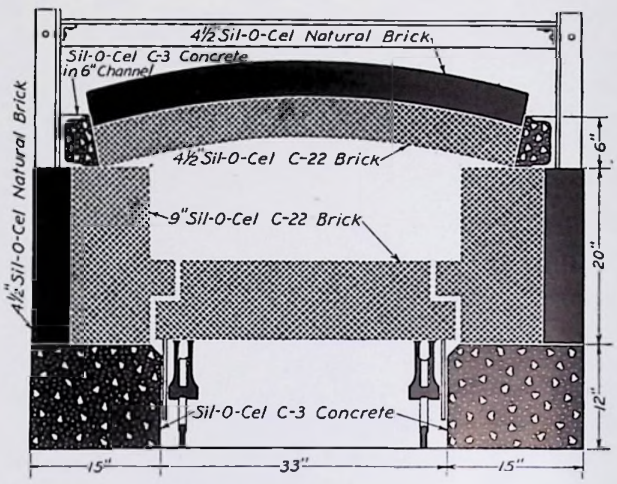
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perature, 1400 deg. F., with electric heat (where there are no combustion gases) Sil-O-Cel C-22 Brick can be used with great success as a combination insulation and refractory. Due to reduction in the heat storage capacity of the masonry, the equipment can be brought up to temperature rapidly with considerable saving in power costs.

In continuous kilns, where the hot gases and heat from cooling ware is transmitted to other compartments containing green ware or ware at a lower temperature, insulation greatly increases efficiency by retaining the heat within the system. General methods of insulating are the same as for periodic kilns.

Where periodic kilns are connected by underground flues for operation as a continuous system, the waste heat flues, as well as the kilns, should be insulated. Sil-O-Cel C-3 Concrete, from 4″ to 6″ thick, is ideally suited for underground flue insulation.



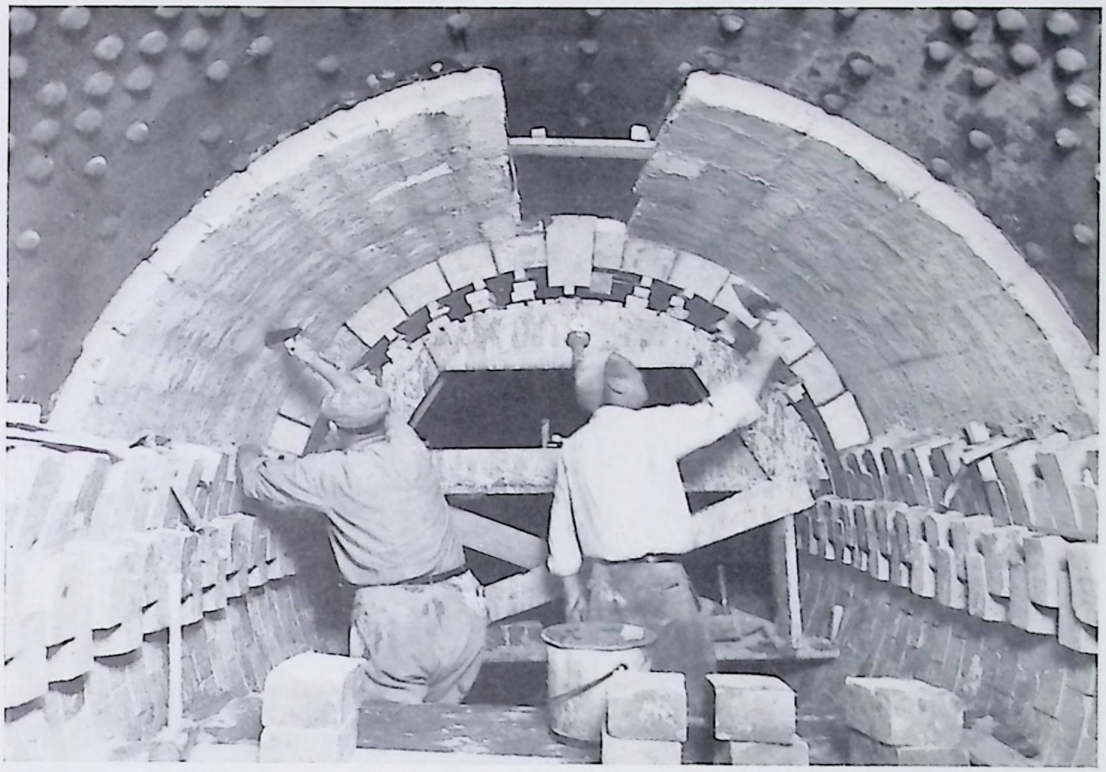
Section through hot zone of electrically heated china decorating kiln. Sil-O-Cel C-22 Brick used as combination refractory and insulation



Swindell-Dressler tunnel kiln nearing completion. Insulated with 4″ to 12″ of Sil-O-Cel Coarse Grade

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Insulation of Lime and Cement Kilns



Superex Insulation in rotary kiln, showing completion of the lining by the arch-form method

Rotary Kilns

High temperature rotary kilns, such as are used for burning cement and lime, offer an interesting example of economy resulting from the use of Superex Insulation. There is no apparatus operating under temperature conditions similar to those encountered in the rotary cement kiln in which the materials used in the lining are subjected to such severe service. In addition to high temperature, there is rotation, vibration, abrasion, expansion and contraction of the fire brick lining and the continued impact of the heavy mass of clinker throughout the kiln. In wet process kilns there is also the effect of water in the slurry.

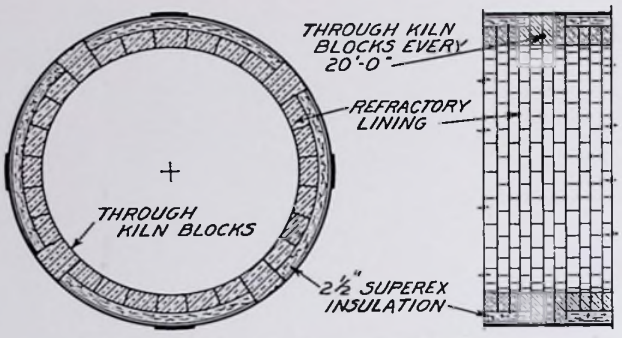
Taking into account these factors, and the fact that shut-down due to a hot spot means a loss of several thousand dollars per kiln every 24 hours, it was only natural that for many years authorities were doubtful of the advisability of insulating to reduce excessive heat waste. In the Spring of 1924, J-M Superex Block Insulation was subjected to its first severe trial in a cement kiln. Since then this kiln has operated almost continuously with only the necessary periodical shut-downs for renewing fire brick at the hot zone where insulation is not installed. On such occasions, an inspection of the Superex revealed it to be in perfect condition.

Since 1924, as the excellent record of the first kiln became generally known, a great many kilns have been insulated in accordance with specifications similar to those followed in the first installation, and without a single failure. These kilns are insulated between the steel shell and the refractory lining with 2½" thick Superex Blocks, set up in J-M No. 319 Semi-Refractory Cement.

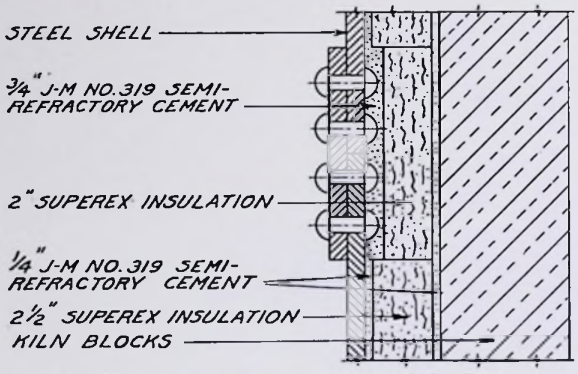
In both dry and wet process kilns, insulation is omitted at the hot end for a distance equal to 25% of the kiln length, or a minimum of 45 ft. The insulation is terminated flush with the upper end, except in wet process kilns where filters are not used, in which case the insulation is omitted for a distance of 20 ft.

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SECTIONS THROUGH INSULATED PORTION OF KILN



SECTION OF INSULATION AT RIVETS

J-M insulation recommendation for rotary kilns

at the wet end. The refractory lining over the insulated section consists of 6″ kiln blocks, bonded to the steel shell with 9″ kiln blocks on each quadrant longitudinally and at approximate 20-ft. intervals circumferentially, to insure that the lining shall be wedged tightly in place.

The successful insulation of a rotary kiln depends not only on the use of the right material but also on proper installation of the lining to prevent circumferential slippage and to localize longitudinal movement. J-M installations made since 1924 have accomplished this result.

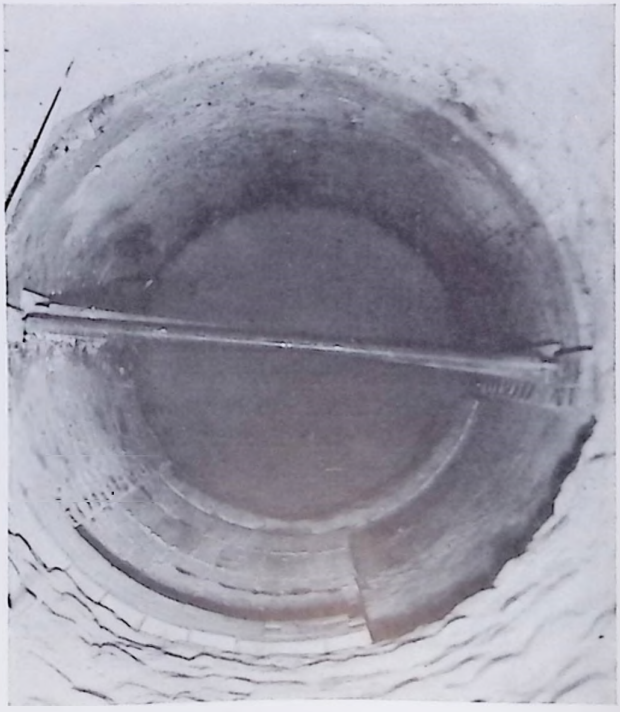
The advantages of insulating rotary kilns may be summarized under the headings of fuel conservation, increased flue gas temperature, more uniform heat distribution and protection of the kiln shell.

Fuel Conservation: The heat lost by radiation from a 10-ft. x 200-ft. uninsulated kiln, is equivalent to approximately 9,500,000 B.t.u. per hr. Using pulverized coal with available heat of 10,000 B.t.u. per pound and coal costing $5.00 per ton, the annual loss equals $17,000. By insulating the upper portion of the kiln for a distance of 150 feet, it is possible to save about 50% of this loss or $8,500 per year.

Increased Flue Gas Temperature: In plants where waste heat boilers are used, insulation in the kilns and waste heat flues will increase the temperature of the gases 150 to 250 deg. F. Where waste heat boilers are not installed, it is possible through insulation to reduce coal consumption from 30 to 60 lb. per ton of clinker.

Uniform Heat Distribution: There is considerably less variation in temperatures throughout the length of the insulated kiln and the kiln is less susceptible to outside temperature changes. Air currents also have less effect in increasing heat loss on insulated kilns.

Protection of the Kiln Shell: Insulation materially reduces the temperature on the kiln shell, overcoming to a large degree the expansion stress on the steel plates, the loosening of rivets and the bulges that sometimes occur in an unprotected shell. In a test on rotary kilns having an average inside temperature in the intermediate zone of 1550 deg. F. in an uninsulated kiln, and 1750 deg. F. in an insulated kiln, the average external surface temperatures were 640 and 280 deg. F., respectively.



Superex insulation in rotary kiln, showing longitudinal timber and cross-jack method of installation

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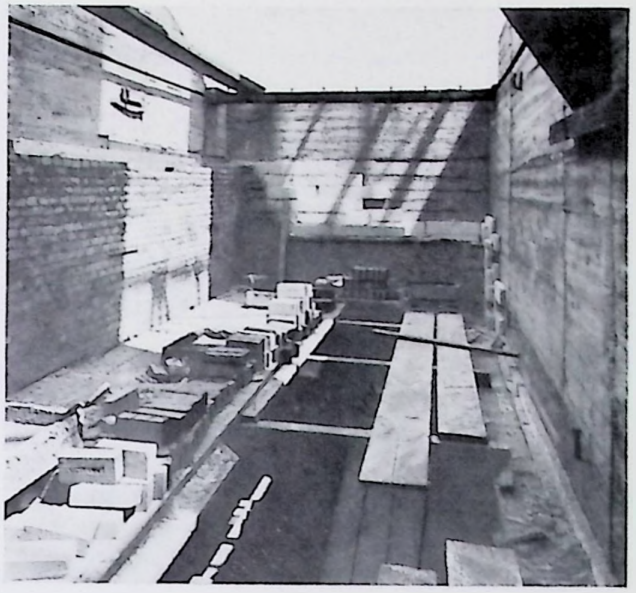
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Settling Chambers, Waste Heat Flues and Boilers

When exit gases from the kilns are utilized in waste heat boilers, insulation of the entire system, including settling chambers, waste heat flues and boilers, is particularly important.

Settling chambers are usually insulated with 4½" of Sil-O-Cel Natural Brick, or with two 2" layers of Superex Blocks, between a 9" fire brick lining and an outer wall of concrete. The top is insulated over the fire brick with two 2½" layers of Sil-O-Cel Natural Brick or with two 2" layers of Superex Blocks. In the base, Sil-O-Cel C-3 Concrete, 4" thick, is applied over the regular portland cement concrete and covered with one or two layers of fire brick. Sil-O-Cel C-3 Concrete is made by mixing four parts of Sil-O-Cel C-3 with one part of portland cement by volume, with only sufficient water to make a plastic mass. This concrete is strong, durable and more than three times as effective as fire brick in resistance to heat flow.

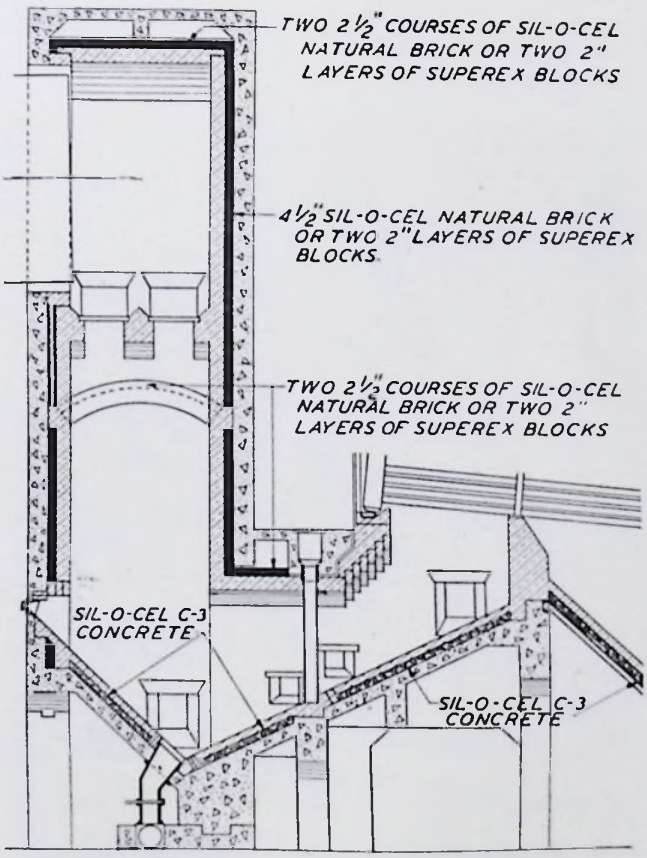
Sil-O-Cel Natural Brick and Superex Blocks have been used for insulating flues and boilers in practically every waste heat installation in the Cement Industry. A number of methods of insulating have been employed, the thickness of insulation varying from 3" to 5". The usual construction has been 4½" (or 5") of Sil-O-Cel Natural Brick, or two 2" layers of Superex Blocks, on sides and top. Sil-O-Cel C-3 Concrete, 4" thick, is recommended for insulating the bases. Waste heat boilers are insulated by the same methods used for direct-fired boilers, described in other data sheets.



Cement mill waste heat flue being insulated with two 2" layers of Superex Blocks



Waste heat flue in cement mill. Sil-O-Cel Natural Brick in bottom and over arch; Sil-O-Cel Coarse Grade on sides



Waste heat flue insulation recommendation

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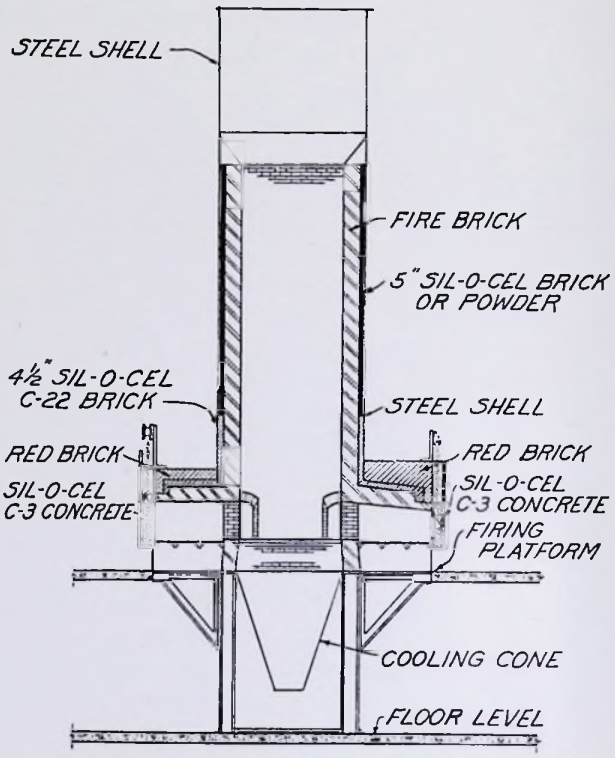
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Vertical Lime Kilns

Insulation of vertical lime kilns not only quickly pays for itself in fuel saving but also assists in the production of clean, white lime with no "core" or unslakable lumps. Lime, especially if the stone contains impurities, is exceedingly sensitive to over-burning and temperatures must be controlled within a relatively small range. Insulated kilns are blanketed against fluctuations in atmospheric conditions which interfere with temperature control.

In the fire-box of vertical lime kilns, 4½" of Sil-O-Cel C-22 Brick are used behind 18" of fire brick. The balance of the lined portion of the kiln is insulated, behind 13½" of fire brick, with two 2½" layers of Sil-O-Cel Natural Brick or with from 4" to 5" of Sil-O-Cel Coarse Grade. Superex Blocks, in two 2" layers, may also be used. Brick or block insulation is preferred in most instances. When Sil-O-Cel Coarse Grade is used care should be taken to pack it carefully so the space between the lining and shell will be completely filled.

The above constructions have the advantages of high insulating value, a "cushioned" shell protected from excessive heat, and a thin wall which gives maximum volume within the kiln.



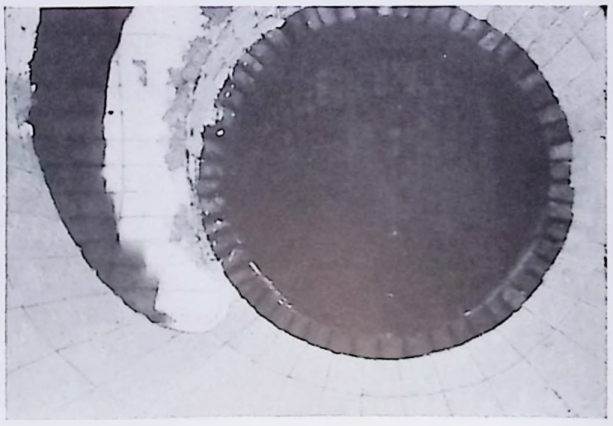
J-M insulation recommendation for vertical lime kiln



Installing Sil-O-Cel Coarse Grade in wall of vertical lime kiln

Producer Gas Mains

Producer gas mains are insulated between the refractory lining and steel shell with Superex Blocks 2½" to 4" thick, or with Sil-O-Cel Natural Brick 2½" or 4½" thick. Insulation pays for itself in a few months of operation by minimizing heat loss. Tar deposition is also reduced, necessitating fewer burnouts.

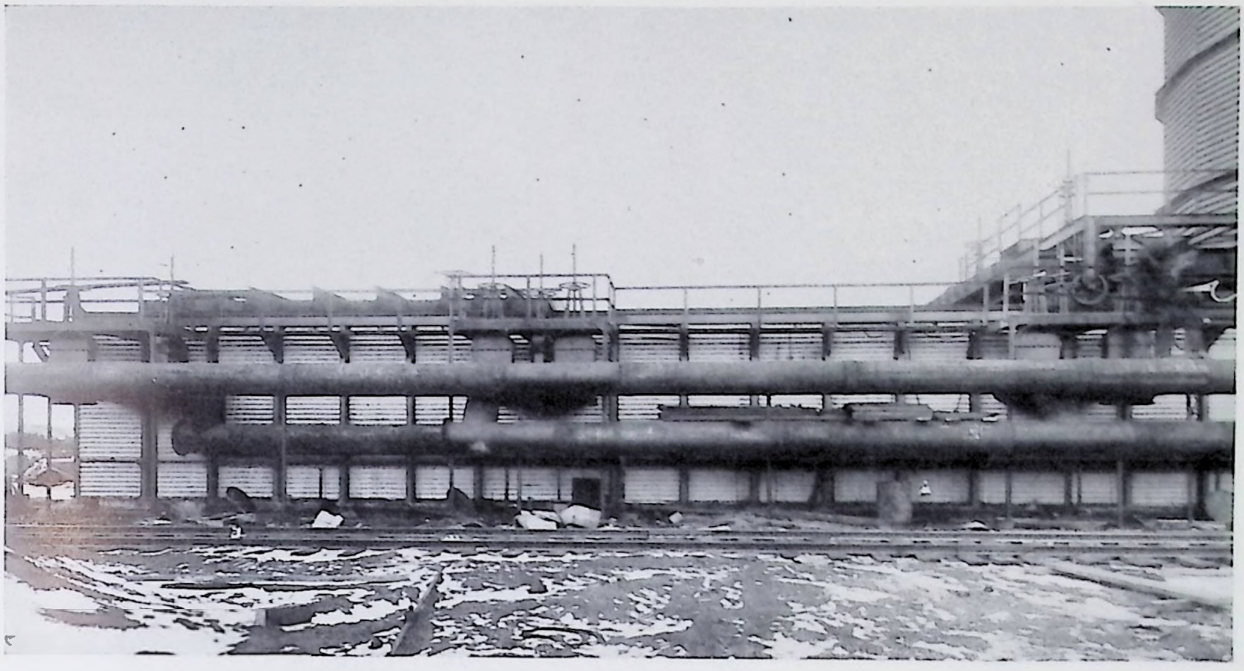


Main being insulated with Superex Blocks between steel shell and refractory lining

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Insulation of Gas Making Equipment



Gas purifier box at the Utica Gas & Electric Company, Utica, N. Y., insulated with 3" Rock Cork sheets on the sides and 2" of Rock Cork sheets on the top covers. The total area insulated amounts to approximately 4900 sq. ft. Corrugated Transite provides a protective casing on all four sides

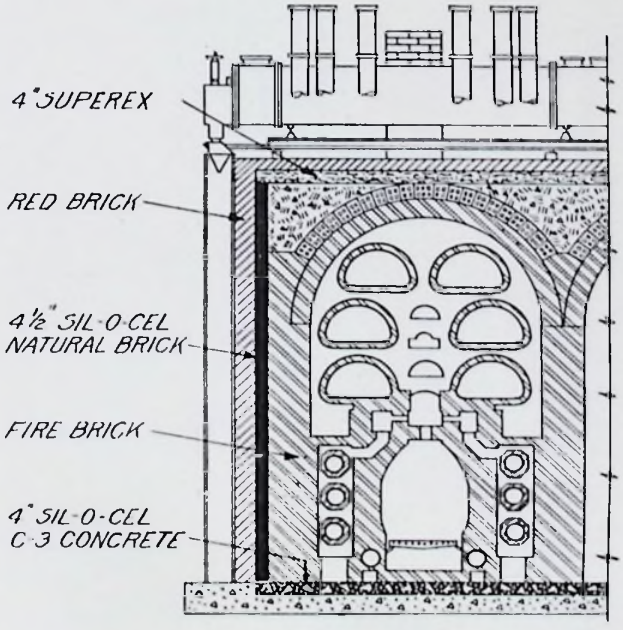
Coal Gas Apparatus

Maintaining a uniform effective temperature in the carbonization chambers of a coal gas bench as well as efficient operation of the producer are important factors in successful bench operation. Insulation of benches and of producer take-offs and mains assists greatly in securing proper control of these factors and in reducing operating costs.

Coal Gas Retorts:

Horizontal and inclined retort benches are insulated in the exterior walls with 4½" of Sil-O-Cel Natural Brick, usually outside 9" of fire brick. The tops are insulated most satisfactorily with 4" of Superex applied in two 2" layers with staggered joints, closely butted and pointed up with J-M No. 302 Cement. Bases are insulated with a minimum of 4" of Sil-O-Cel C-3 Concrete, protected by 5" of fire brick over the insulation.

The wall insulation of vertical retort benches is the same as in the horizontal retorts, consisting of 4½" of Sil-O-Cel Natural Brick.



J-M insulation recommendation for horizontal coal gas retort bench

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Water Gas Apparatus

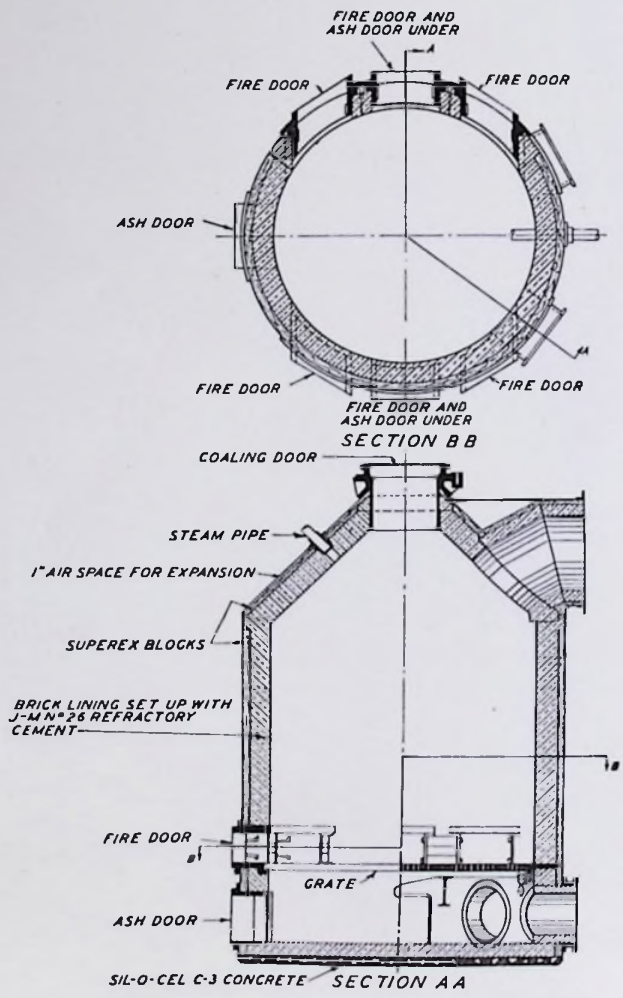
Modern manufacture of carburetted water gas has been developed to a highly efficient process in which insulation naturally plays an important part. In every piece of apparatus in the modern water gas plant where heat is to be controlled or conserved, from generator base to the steam lines of the storage holder cups, J-M insulation contributes to satisfactory and economical operation.

Water Gas Sets:

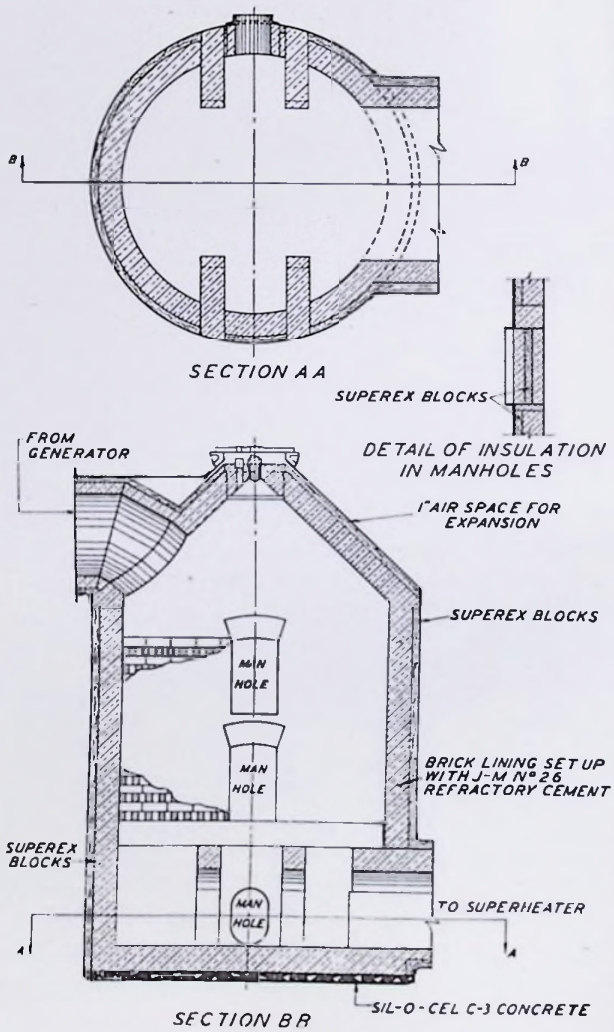
In the modern cone-top steel-cased set, consisting of generator, carburetter and superheater, the side walls, cone tops and connections are insulated with 3″ of Superex Blocks behind at least 9″ of refractory. In the cone tops, 1″ air space is allowed between the insulation and the steel casing for expansion of the brickwork.

Before the application of any insulation, the entire inside surface of the steel shell is coated with J-M Resisto Primer and then painted with J-M Resisto Paint for protection against acid and moisture conditions. The Superex is then applied in two 1½″ layers between the fire brick and the shell, as the brickwork progresses. All joints in the insulation should be staggered, closely butted and pointed up with J-M No. 302 Cement.

Bases of generator, carburetter and superheater are insulated with 4″ of Sil-O-Cel C-3 Concrete with 5″ or more of fire brick over the insulation.

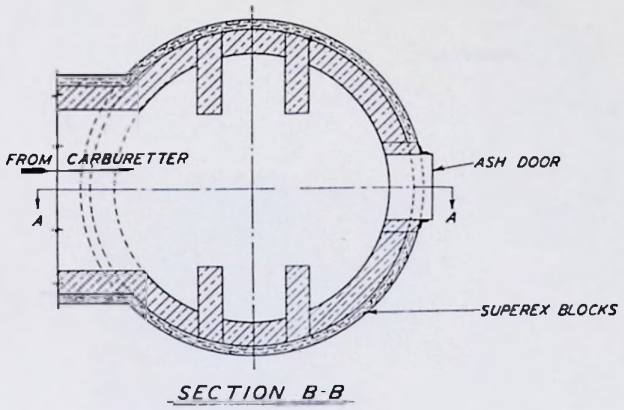


Method of insulating water gas generator

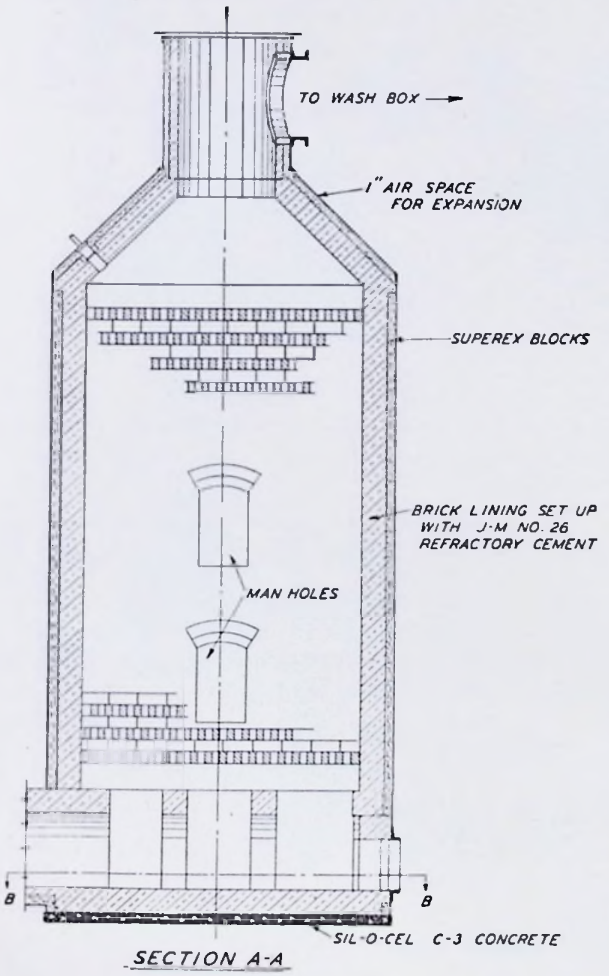


Typical water gas carburetter insulation

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SECTION B-B



SECTION A-A

Water gas superheater insulated in sides and over cone top with Superex Blocks, Sil-O-Cel C-3 Concrete used in base

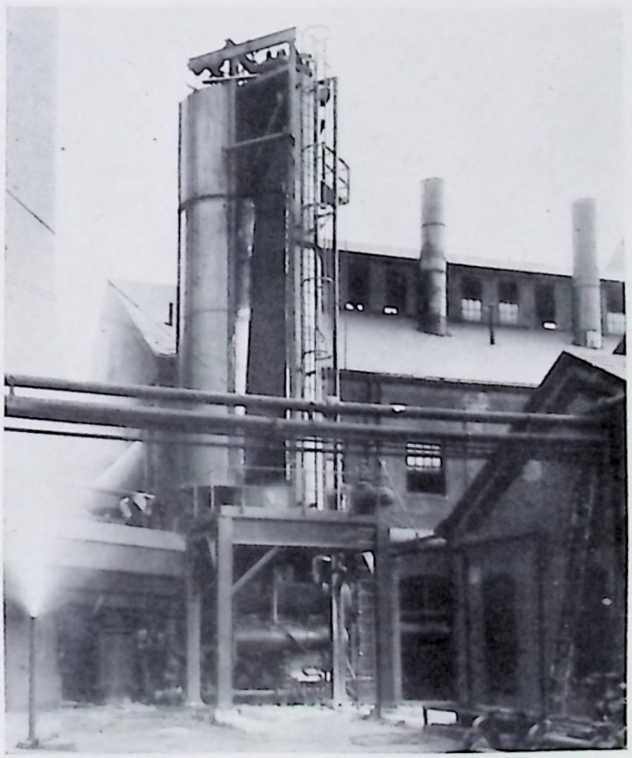
Power Plant Equipment

The insulation of steam pipes, direct-fired boilers, breechings and other power plant equipment is fully treated in other data sheets.

Waste-heat Boilers:

Horizontal or inclined waste-heat boilers of the fire-tube type are insulated with 2″ thick J-M 85% Magnesia Blocks, applied longitudinally, with all joints closely butted. Insulation blocks are securely wired to the boiler with two turns to each course of blocks, followed by 1½″ hexagonal mesh galvanized wire netting, tightly stretched over the insulation and fastened. Over the wire netting two ¼″ coats of J-M No. 302 Cement are applied, the first coat being left to dry with a rough surface before the application of the smooth finishing coat.

In vertical waste-heat boilers of the LaMont type, the steam pot and water pump body are insulated with 2″ thick J-M 85% Magnesia Blocks, wired on and finished with J-M No. 302 Cement, similarly to the horizontal type previously described. Vertical waste-heat boilers of the Wickes type are insulated with 2½″ of Sil-O-Cel C-22 Brick over the arch; 2″



LaMont waste-heat boiler insulated with J-M Materials

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to 3″ of Sil-O-Cel Coarse Grade tamped in place between the fire brick side wall and the steel casing; and 2½″ of Sil-O-Cel Natural Brick over the top.

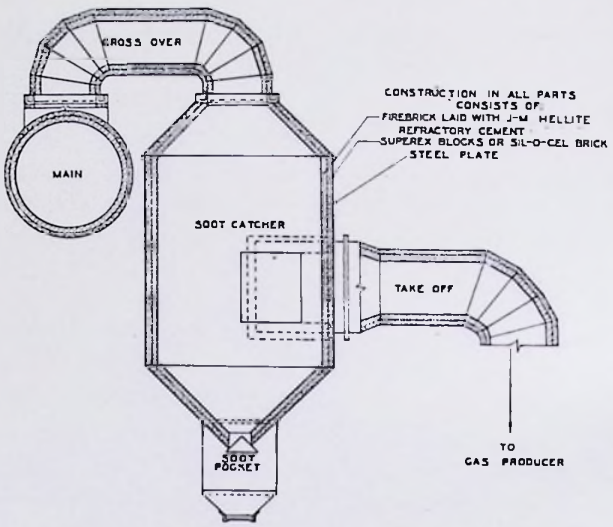
Other waste-heat boilers of the various water-tube types are insulated in the same manner as employed in direct-fired boilers, discussed on other data sheets.

Producer Gas Mains

Since producer efficiency is greater, by 20% or more, where the gas is used hot, the take-off, soot-catcher and main should always be insulated. Insulated linings in producer gas mains also effect operating economies entirely apart from savings in sensible heat. By maintaining a high temperature in the gas, insulation inhibits the condensation of the tarry vapors resulting from the breaking down of unstable hydrocarbons, which subsequently deposit on the fire brick lining and, as a corollary effect, the length of time between shut-downs for burnout is materially increased. In addition, these vapors, by remaining in suspension, increase the calorific value of the gas at the furnaces.

The economy attained through the proper use of insulation appears in producer mains as elsewhere. Heat loss through an uninsulated main lined with 4½″ of fire brick with a gas temperature of 1400 deg. F., approximates 1569 B.t.u. per sq. ft. per hour. Insulated with 2½″ of Superex Blocks, this loss is reduced to 287 B.t.u. On the basis of heat worth 25 cents per million B.t.u. and continuous operation, the saving corresponds to $2.82 per sq. ft. per year on an outlay of less than 45 cents per sq. ft. for insulating materials.

Producer gas mains are insulated, either when old mains are being re-lined or when new mains are being installed, with 2½″ to 4″ of Superex Blocks or



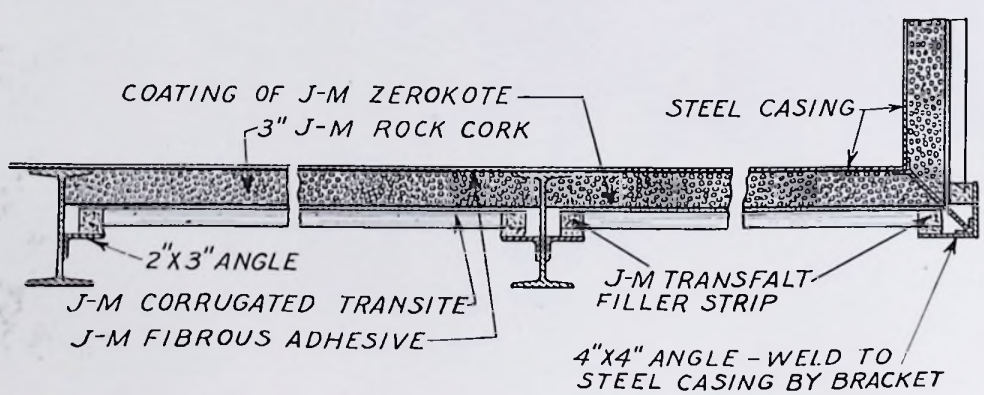
Producer gas take-off, soot-catcher and main insulation

2½″ or 4½″ of Sil-O-Cel Natural Brick between the fire brick lining and the steel shell.

Purifier Boxes and Covers

When purifier boxes are located in the yard, they are protected from variations of temperature by insulating the sides and complete top with 2″ or 3″ of Rock Cork sheets, the thickness depending upon the climate. The sheets are applied with J-M Fibrous Adhesive directly against the sides, the Rock Cork protected with a coating of Zerokote, and all in turn provided with an outer casing of Corrugated Transite. The top covers are insulated with Rock Cork which is supported by small channels welded to the top plate, and protected on the bottom by sheet metal bolted to the channels.

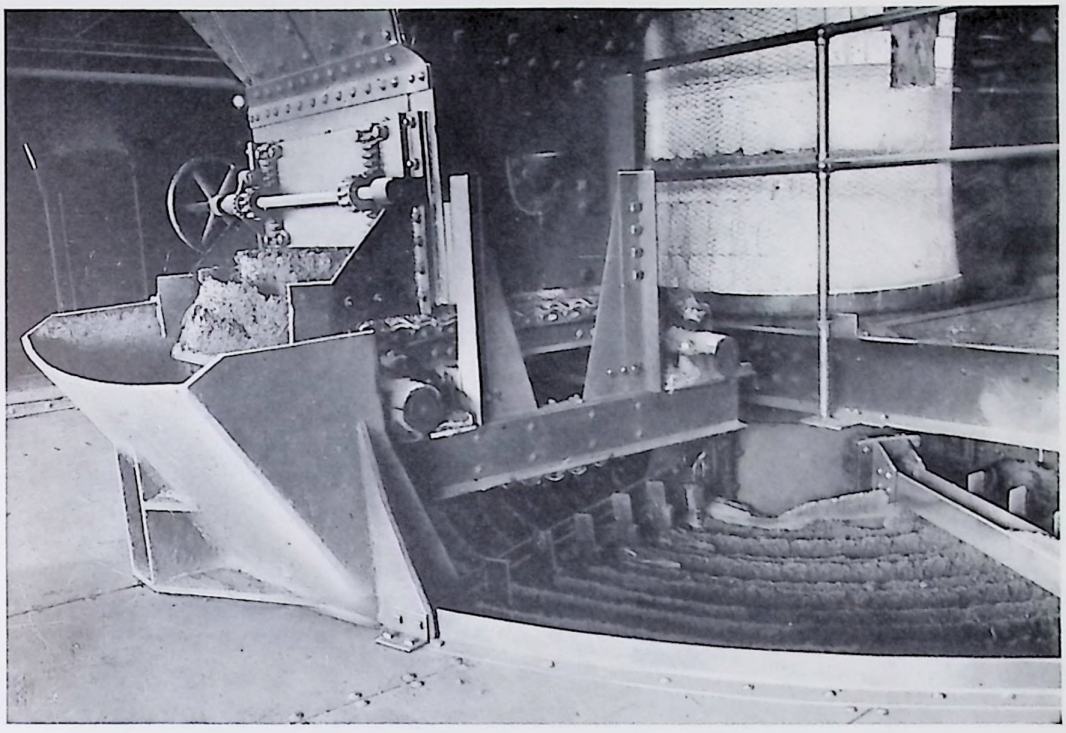
As an alternate specification the sides are insulated with 2½″ of Sil-O-Cel Powder, tamped to a density of 15 to 17 lb. per cu. ft. and the tops and covers with 2½″ of Sil-O-Cel C-3 Concrete.



Plan section showing application of J-M Materials on the steel sides of gas purifier box

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Insulation of Non-Ferrous Metallurgical Equipment



Upper hearth of J-M insulated roaster. Up-take insulated with 2½" Sil-O-Cel Natural Brick to be finished with cement

Heat is such an essential in metallurgy that its control or conservation is naturally one of the major factors in the design of any reduction or refining equipment. With non-ferrous metals, the intricacies of the reduction processes, the refractoriness of many of the ores and the close margin between profit and loss in operating, all demand exhaustive consideration of proper heat insulation. Typical examples of how J-M products serve are briefly discussed here.

Roasting Equipment

In the reduction of non-ferrous ores, as a general rule the products of milling and concentrating require treatment preliminary to smelting and refining. This may be either drying, calcining, nodulizing, roasting or sintering, or, more usually, a combination of two or more of these, depending on the characteristics of the particular ore. In much of this preliminary treatment temperature control is of paramount importance rather than fuel saving, although in some instances conserving the heat of the reaction is a distinct economy, reflected in lower operating costs.

Kilns:

Drying, and calcining which differs only in the higher temperatures used, are usually accomplished in rotary kilns, which are partly or wholly lined and. when used for calcining (or for the nodulizing of flotation concentrates), insulated between the kiln blocks and the steel shell. Both wet and dry process kilns are uninsulated at the hot end for a distance equal to 25% of the kiln length. Wet process kilns are usually uninsulated for a distance of approximately 20 ft. at the wet end.

The insulation consists of 2½" thick Superex Blocks, 6" x 36", next to the steel shell, laid in and coated with J-M No. 319 Semi-Refractory Cement. The refractory lining over the insulated portion is

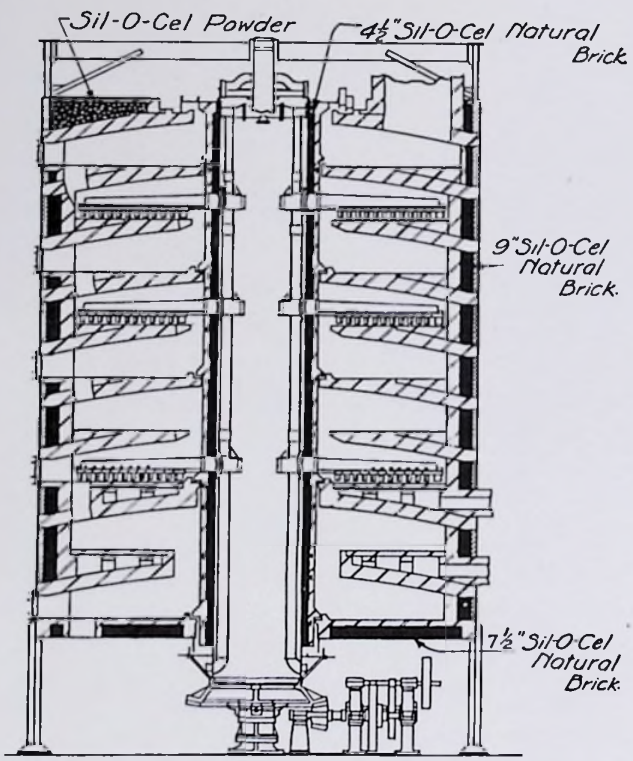
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bonded to the shell with through kiln blocks on each quadrant longitudinally and at 20-ft. intervals circumferentially, to prevent slipping.

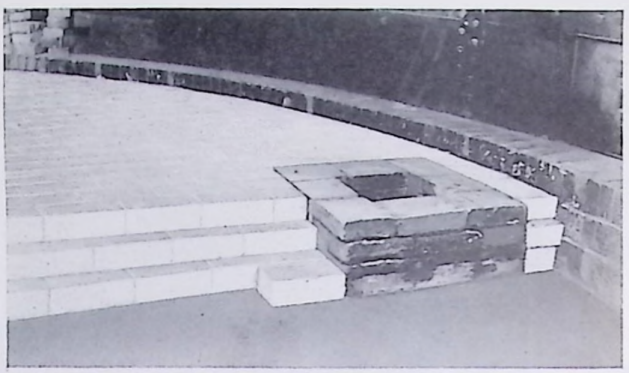
Roasters:

Single hearth reverberatory furnaces, when used for rough roasting at temperatures from 500 to 1300 deg. F., are economically insulated in side wall, base and roof. Sil-O-Cel Natural or C-22 Brick, 4½" thick, are used behind 13½" of fire brick in the side walls, and 2½" or 5" thick on the roof. The base is insulated with 4" to 6" of Sil-O-Cel C-3 Concrete overlaid with one or two layers of fire brick.



J-M insulation recommendation for Wedge roaster

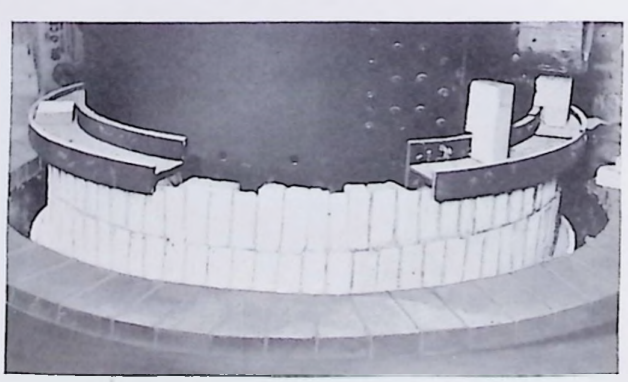
The Wedge multiple hearth roaster is insulated on the sides with 9" and on the bottom hearth with 7½" of Sil-O-Cel Natural Brick between the fire brick and the steel shell. The central rotating shaft is insulated with 4½" of Sil-O-Cel Natural Brick protected by a course of fire brick. The top of the roaster, above the first or drying hearth, is insulated with 8" to 12" of Sil-O-Cel Powder, tamped to a density of 15 to 17 lb. per cu. ft.



Three courses of Sil-O-Cel Natural Brick in bottom of Wedge roaster

The Nichols-Herreshoff type of roaster is similar to the Wedge with the exception of the central shaft which, serving as a passage for cooling air to the rabble arms, is smaller and not insulated. Insulating brick are applied on the walls and bottom hearth as in the Wedge type. When the heated cooling air is used for combustion purposes on the hearths, the housing and steel distributing pipes are insulated with J-M 85% Magnesia or Superex Combination Insulation.

In the Queen-type roaster, designed for one of the most modern copper smelters, the upper three hearths are used to dry the concentrates, with no combustion occurring on them. These drying hearths are insulated with 4½" of Sil-O-Cel Natural Brick overlaid with 3" of re-pressed red brick. The lower eight hearths, where the roasting takes place, are insulated with 7½" of Sil-O-Cel Natural Brick, laid in three 2½" courses and protected by a 3" re-pressed red brick lining. In the base of the roaster, three courses



Installing Sil-O-Cel Natural Brick 4½" thick around central rotating shaft of Wedge roaster

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of 2½" Sil-O-Cel Natural Brick are used beneath a 4" course of re-pressed red brick.

Burner Boxes: Where exterior burner boxes are used, they are insulated between the refractory and the steel shell in the same manner as the roaster wall.

Roaster Up-takes: Roaster up-takes are insulated with 2½" of Superex Blocks or Sil-O-Cel Natural Brick, wired on and followed by 1½" hexagonal galvanized wire netting over which is applied ½" of J-M No. 302 Insulating Cement in two ¼" coats, the first coat allowed to dry with a rough surface and the second troweled to a smooth finish.

Calcine Pipes and Hoppers:

The hot calcine pipes between the roaster bottom hearth and the calcine hoppers are insulated with 2½" of Superex Blocks or Sil-O-Cel Natural Brick, finished over hexagonal wire mesh with ½" of cement in the same manner as the roaster up-take. As a further protection, the calcine pipes are usually encased with a steel sleeve.



Hot calcine pipes between roasters and calcine hoppers, insulated with J-M Materials

The calcine hoppers, generally mounted above the reverberatories, are insulated in the sides and bottom with two 2½" courses of Sil-O-Cel Natural Brick behind one 2½" course of fire brick. The crowns of the hoppers are insulated with one 2½" course of the insulating brick above the 9" fire brick crown.

Ignition Stove for Straight-line Machine:

On the Dwight-Lloyd straight-line machine, which is used for giving a finishing roast, as well as for sintering, the ignition stove is insulated.

One efficient installation is the insulated coke-burning stove designed and used on the Dwight-Lloyd machines at the Midvale plant of the U. S. Smelting, Refining and Mining Co., Midvale, Utah. The shell is of sheet steel, open at the top, within which a fire brick lining is built up with 3" of Sil-O-Cel Powder tamped between the lining and the shell. The roof is a fire brick arch covered with 1" of rock wool (Banroc) over which is applied a ½" layer of insulating cement reinforced with wire mesh.

Dust Collecting Equipment



J-M insulation being applied to large flue at zinc smelter

Flues:

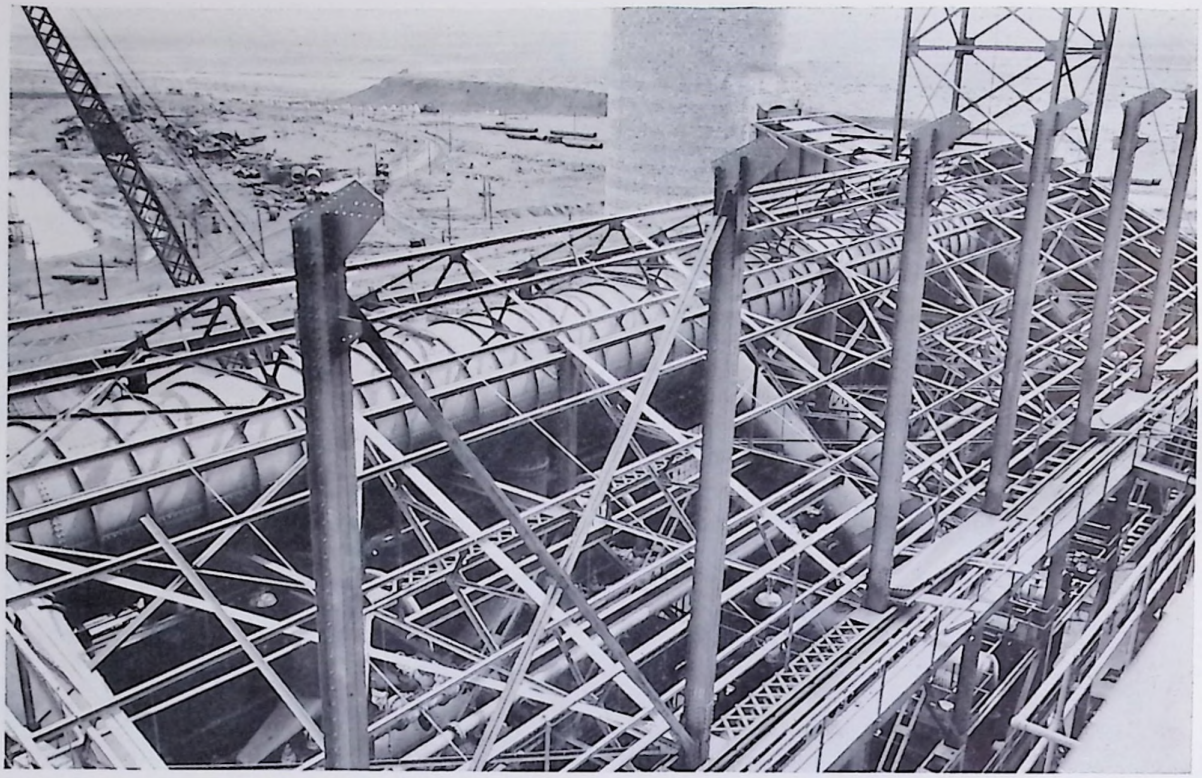
Flues are insulated to protect the material of which the flue is made, as well as to maintain the temperature of the gases, necessary to the process in many instances. Temperatures must be held above the condensation point of sulphur gases or a steel flue quickly deteriorates from corrosion, occasioning replacement costs far in excess of the price of original insulation.

Because of the varying temperatures due to the widely differing process demands, each installation of flue insulation becomes a problem of the particular plant and depends largely on local conditions.

Comparatively short internal flues and gas passages are usually insulated either externally with Sil-O-Cel Brick or Superex Combination Insulation, similarly to the apparatus which they connect, or internally with the insulating brick or blocks bonded to the steel with J-M Fibrous Adhesive and wired in place

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Boiler up-takes and flue to stack at large copper smelter, insulated with Sil-O-Cel Natural Brick and Sil-O-Cel Coarse Grade

to spot-welded lugs. The insulation is protected from erosion by the hot moving gases with ½″ or more of J-M No. 319 Semi-Refractory Cement, applied in ¼″ coats and reinforced with suitable wire mesh.

Long out-door flues call even more for adequate insulation because of the additional exposure to temperature changes. Sometimes the insulation is applied internally, as at the Consolidated Mining and Smelting Co., at Trail, B. C. Here the steel flue is insulated with 5″ thick Superex Combination Insulation (2″ of J-M 85% Magnesia overlaid with 3″ Superex) secured to the interior steel surface by 1½″ x 1/16″ band iron attached to lugs welded at 18″ intervals and protected by 1″ of J-M No. 319 Semi-Refractory Cement reinforced with 16-gauge galvanized wire netting. The results have been entirely satisfactory.

Equally successful is the externally insulated flue at the International Nickel Co. plant at Copper Cliff, Ontario. This flue was insulated on the outside with 1½″ thick Superex Blocks wired on with circumferential tie wires and covered with ½″ of J-M No. 302 Insulating Cement reinforced with wire mesh and applied in two coats in the usual manner. The insulation was then waterproofed with a roofing jacket, the laps sealed with J-M Laptite and the sheets additionally secured by circumferential tie wires. The roofing jacket was finally painted with J-M Regal Roof Coating.

Balloon flues have been jacketed for a 3″ fill of Sil-O-Cel Coarse Grade.

Cottrell Precipitators:

In the larger, modern plants, Cottrell apparatus is widely used for the electrical precipitation of dust in the flue gas stream. Such precipitators handle flue gas at temperatures to 1200 deg. F. with a drop through them of only 100 deg., thus solving at one time the double problem of gas-cleaning and heat conservation.

The steel housings of Cottrell precipitators are usually jacketed and filled with 3″ to 4″ of Sil-O-Cel Coarse Grade, with 2½″ or 5″ of Sil-O-Cel Natural Brick or with 2½″ to 4″ of Superex Blocks, over

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the tops. Inspection doors are also insulated, using Sil-O-Cel C-3 Concrete to fill the entire frame of the door, and not less than 4″ thick, the total thickness depending on the temperatures encountered. Sil-O-Cel C-3 Concrete is made by mixing Sil-O-Cel C-3 and portland or lumnite cement in the proportion of four parts of C-3 to one part of portland or lumnite cement by volume, with only sufficient water to make a plastic mixture.

Cottrell Dust Hoppers: The dust hoppers into which the hot dust from the gas stream is precipitated by the Cottrell apparatus are insulated on the inside with a 2½″ course of Sil-O-Cel Natural Brick protected by a course of fire brick.

Cottrell Discharge Pipes: With the comparatively slight temperature drop through the Cottrell apparatus, the discharge pipes require practically the same insulation as the flue system. They are usually insulated on the outside with Superex Blocks, 2½″ thick, wired in place and covered with ½″ of insulating cement, reinforced with mesh wire and applied in two ¼″ coats.

Smelting Equipment

When blast furnaces are used in non-ferrous ore reduction, as a general rule they are water-jacketed, not insulated. Reverberatories, also, are often run at temperatures too high to permit insulation. In specific instances, however, reverberatories have been successfully insulated on the side walls with a 4½″ course of Sil-O-Cel C-22 Brick behind 13½″ of refractory.

Approximately 80 percent of the heat loss in reverberatories is transmitted through the roof. During the past few years several of these roofs have been successfully insulated. For this purpose the following materials are recommended: J-M No. 500 Insulating Cement; vermiculite granules covered with a binding of No. 500 Insulating Cement; Sil-O-Cel Coarse grade powder with a binding ingredient to give a monolithic slab insulation; Superex Blocks; Sil-O-Cel C-22 Brick; or Sil-O-Cel Super Brick. Where insulation can be used considerable savings in fuel are obtained.

Waste Heat Boilers:

Waste heat boilers are insulated similarly to other types of boilers of the same class, discussed in detail in other data sheets. The dust hoppers beneath the



Cottrells insulated on sides with 3″ Sil-O-Cel Coarse Grade. Tops are insulated with 2½″ of Sil-O-Cel Natural Brick

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boilers are insulated with a 2½" course of Sil-O-Cel Natural Brick beneath a layer of fire brick. The breechings are insulated outside with 2½" of Superex Blocks or Sil-O-Cel Natural Brick, wired in place and covered with ½" of J-M No. 302 Cement, reinforced with wire mesh.

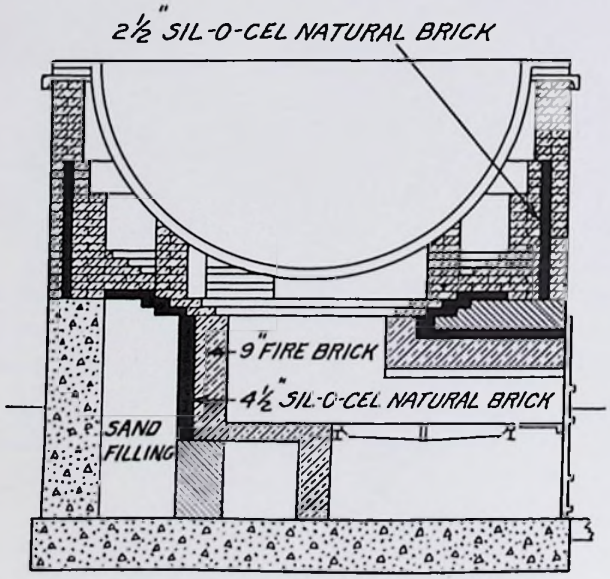
Refining Equipment

Certain of the non-ferrous metals are reduced in equipment peculiar to the individual process. Some of such appliances, to the economical or efficient operation of which adequate insulation is essential, are discussed in the following paragraphs.

Lead Drossing Kettle:

A noteworthy example of the effectiveness of insulation to achieve economical operation is the 90-ton remelting furnace for lead bullion designed and constructed at the Midvale smelter of the U. S. Smelting, Refining and Mining Co. Daily use over a long period necessitated no repairs and, owing to the efficiency of the insulation, this furnace consumes no more coal in melting 90 tons of lead than do the uninsulated furnaces in melting 30 tons.

Above the concrete foundation to the cast steel ring which supports the kettle, the circular wall is insulated with 2½" of Sil-O-Cel Natural Brick laid in "core wall" construction between fire brick and red brick. The fire box is also insulated with Sil-O-Cel Natural Brick, with the space between the insulating brick and the concrete wall filled with granulated slag. In spite of the greatly increased melting capacity, the grate area of this furnace is identically the same as that of the 30-ton uninsulated furnaces.



90-ton remelting furnace for lead bullion, U. S. Smelting, Refining and Mining Co.

Aluminum Reducing Furnace:

The electrolytic cell in which molten aluminum is precipitated from a fused bath at a temperature of about 1650 deg. F., is insulated between the refractory lining and the steel shell with one or more courses of Sil-O-Cel Natural Brick or Superex Blocks.

The furnaces used in remelting the metal from the reduction cell are insulated in the side walls and over the top with two 2½" courses of Sil-O-Cel Natural Brick or with two 2" layers of Superex Blocks. The base is insulated with 4" to 6" of Sil-O-Cel C-3 Concrete, protected by one or two layers of fire brick.

Zinc Distillation Furnace Regenerators:

It is estimated that the use of a regenerative system saves 50% of the coal required when producer gas is used in the distillation furnace. Regenerator insulation consists of Sil-O-Cel Natural Brick or Superex Blocks behind the refractory on sides and top. Bases are insulated with Sil-O-Cel C-3 Concrete overlaid with fire brick.

Remelting and Heat Treating Furnaces

The insulation of industrial furnaces similar to those used in the fabrication of non-ferrous metals is discussed in other data sheets.

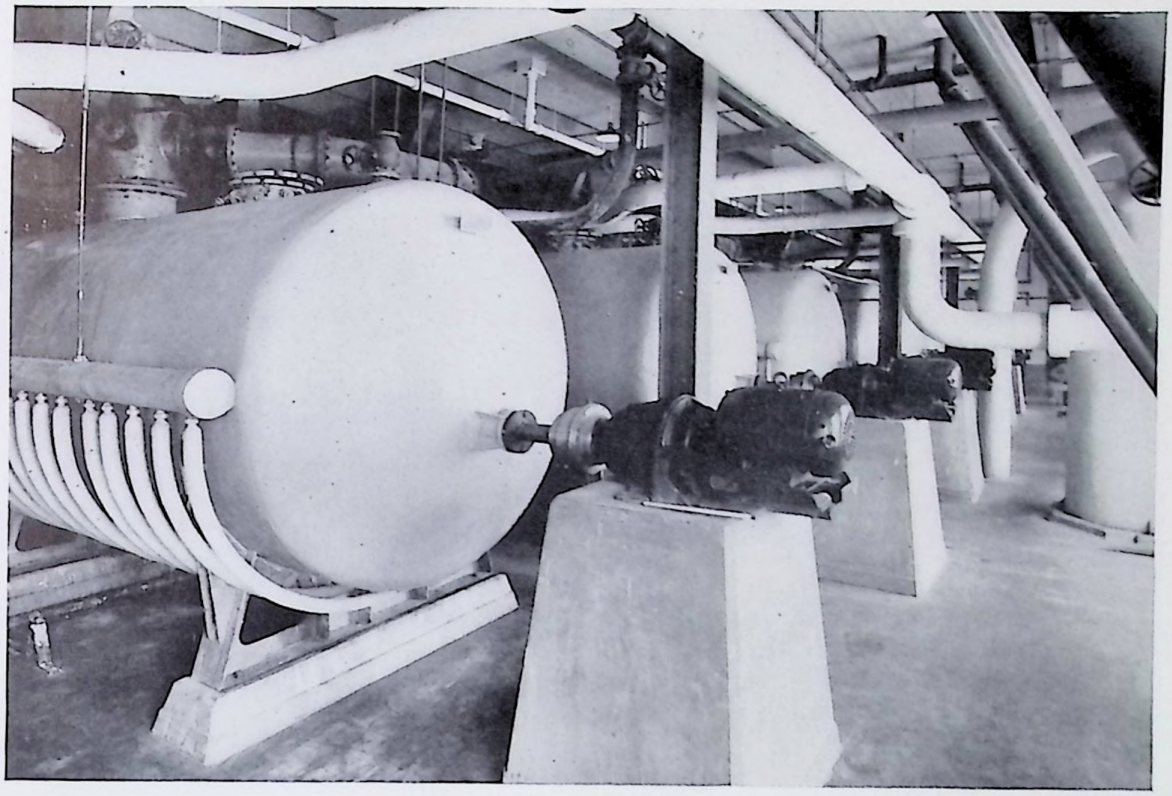
Either block or brick insulation of suitable temperature resistance may be used behind the refractory lining, but in cases where slag erosion, flame impingement and mechanical impact do not occur, it is economical to use insulating refractory brick as the lining and, if necessary, back it up with additional insulation. The recommended insulating refractories include Sil-O-Cel C-22 and Super Brick and JM-20 Insulating Brick.

For furnaces operating between 1500 and 2300 deg. F., 4" is the minimum advisable thickness of insulation. For electrically heated equipment, much heavier insulation is necessary. As back-up insulation, the block and brick insulations mentioned in the foregoing paragraphs offer a range of temperature resistance to accommodate any required furnace temperature.

Specific recommendations for individual installations will be furnished by Johns-Manville upon receipt of necessary information relating to heats, cycles, fuel costs and other conditions. Best practice demands that each furnace be analyzed separately and the proper insulation provided to meet the requirements of the particular job.

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Insulation in the Distillery



Cookers insulated with J-M 85% Magnesia, at the Hiram Walker & Sons Distillery, Peoria, Ill.

In the keen competition which has developed from the renewed activity in distillery operations, no small advantage accrues through the efficiency and economy made possible by heat conservation. With all the process equipment operating between closely controlled and, of necessity, narrow limits, it is vital to insulate properly the boilers and power auxiliaries, heat exchangers, steam and hot and cold water piping, as well as the distilling vessels, cookers and dryers. This attention to insulation marks the line between black or red on the balance sheet, and achieves new standards of quality and quantity production attainable only by an efficiently insulated plant.

Whether the distillery is large or small, fuel cost is one of the principal items of expense. Boiler furnace wall insulation reduces radiation losses, minimizes air infiltration and betters working conditions. Insulation of boiler drums and drum heads pays for itself in a short time, with a continual saving of fuel thereafter. Insulation of steam and hot water lines, particularly since much of the water is heated by various process activities, makes for efficiency as well as economy. Insulation of the heat exchangers is equally important. Cold water lines are profitably insulated, not only because of process requirements but also because of the otherwise high cost of refrigeration of the large quantity of cooling water necessary. Ample insulation of the cookers is a large heat conservation item, as is the insulation of the spent-grain dryers.

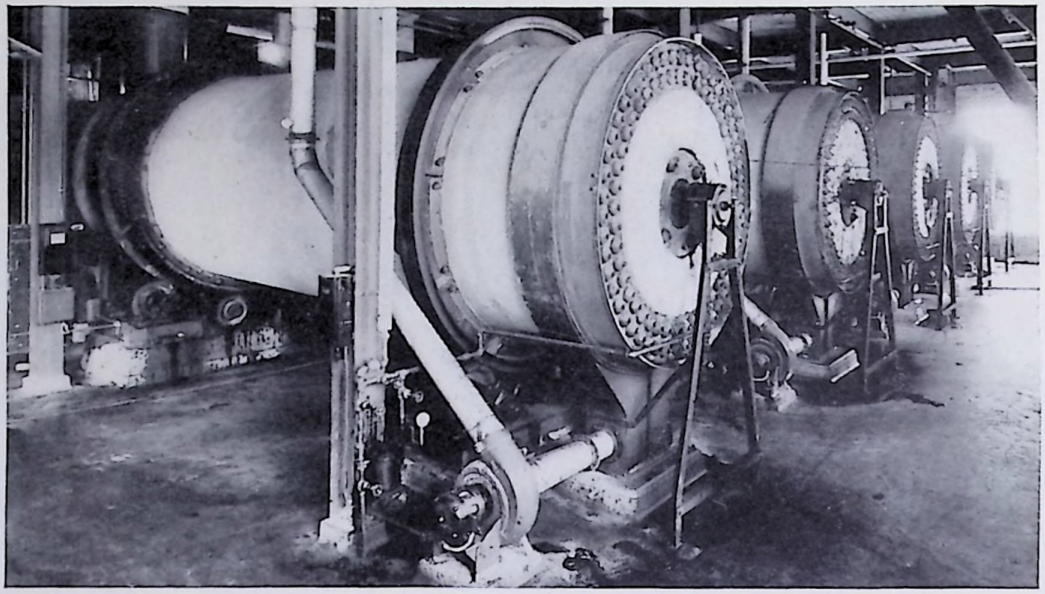
Temperature control, such an important factor in the distilling processes, even quite apart from fuel saving, demands proper insulation as a necessary adjunct to its successful maintenance. For all temperatures and any service conditions, Johns-Manville can furnish, from its complete line, the suitable insulation which will pay a handsome return on the investment.

The economical thickness of insulation is ordinarily computed on the basis of fuel or refrigeration costs and operating conditions so that the heat transmitted through the insulation is only that portion which may not be prevented economically.

INSULATION IN THE DISTILLERY
March, 1935
9-W-80 [IN-2680]

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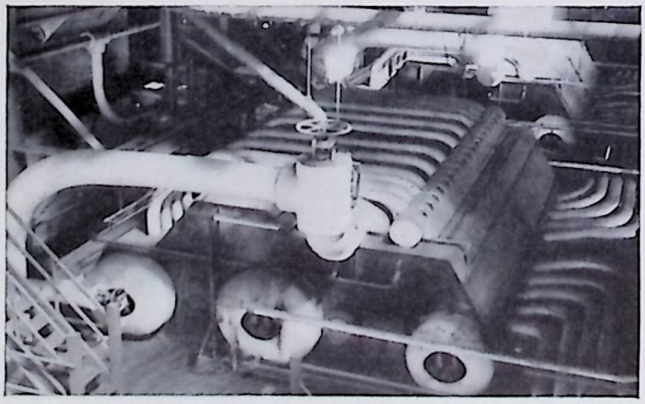
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Spent-grain dryers insulated with J-M 85% Magnesia blocks. These dryers are used in the treatment of spent grain to manufacture live-stock feeds

In the next column, Johns-Manville general recommendations for insulation in the distillery are briefly summarized. Descriptions of J-M Insulating Materials and details of their application to various types of equipment will be found on other data sheets.

Boiler bases, tube doors, breechings, stacks and other boiler room equipment should be insulated as specified on Data Sheets IN-500 to 503.



Boiler tops in the Hiram Walker & Sons, Peoria power plant. All piping is insulated with J-M Materials

Special recommendations for particular conditions will be furnished by Johns-Manville upon request.

J-M Recommendations for Insulation in the Distillery

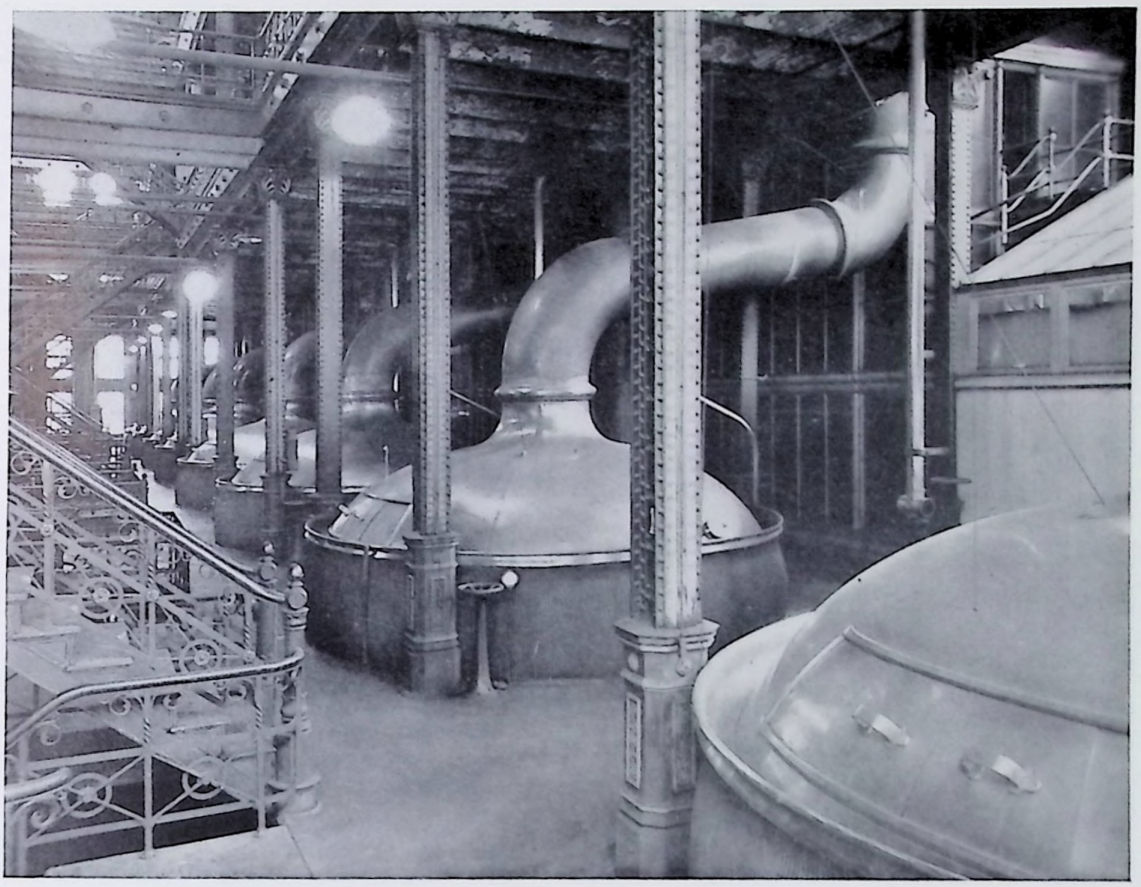
Equipment or location	*Recommendations*
Cookers and Tanks	
Cereal cookers Spent-grain dryers	1½" 85% Magnesia blocks finished with ½" No. 302 Insulating Cement and canvas, painted with two coats of lead and oil paint
Hot water tanks	1" 85% Magnesia blocks finished as above
Hot water tanks Process steam piping	Std. Thick 85% Magnesia or 1" Asbesto-Sponge Felted
Boiler Room	
Steam piping, 150-250 lb. ga.	
Pipes larger than 4"	Double Standard 85% Magnesia or 2½" Asbesto-Sponge Felted
Pipes 2" to 4"	2" 85% Magnesia or Asbesto-Sponge Felted
Pipes smaller than 2"	1½" 85% Magnesia or Asbesto-Sponge Felted
Steam piping, 100-150 lb. ga.	
Pipes larger than 4"	2" 85% Magnesia or Asbesto-Sponge Felted
Pipes 2" to 4"	1½" 85% Magnesia or Asbesto-Sponge Felted
Pipes smaller than 2"	Std. Thick 85% Magnesia or 1" Asbesto-Sponge Felted
Feed water piping	Std. Thick 85% Magnesia or 1" Asbesto-Sponge Felted
Boiler drums	2" 85% Magnesia blocks and ½" No. 302 Cement
Brick-set boiler walls	3" Superex-Magnesia Combination block insulation or 4½" Sil-O-Cel Brick

Among other J-M Materials for the distillery are Packings, Refractory Cements, Floorings, Friction Materials, Filter-Aids, Transite Pipe, Flat and Corrugated Transite Sheets, and a full line of Roofing Materials. Complete information on any of these J-M Products will be furnished upon request.

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Insulation in the Brewery



Insulation on brew kettles pays a return of over 100% per year on the investment

To operate economically and on a competitive basis, the present-day brewery must be equipped to take advantage of proved modern methods of decreasing production costs. In every industry where heat or refrigeration is utilized, adequate insulation has, during the past fifteen years, come to be recognized as a vital economy measure and one of the major essentials to efficient operation.

Insulation of low temperature equipment and storage rooms is especially important because of the high cost of refrigeration. Furthermore, temperatures must be controlled within a relatively narrow range, a condition which cannot be maintained without adequate insulation.

In the case of heated equipment, fuel cost is one of the principal items of expense and the problem of heat conservation is a matter of major consequence. In the boiler room, insulation of the boiler furnaces reduces radiation losses, minimizes air infiltration and assures better working conditions. Insulation on boiler drums and steam lines pays for itself many times over in fuel savings.

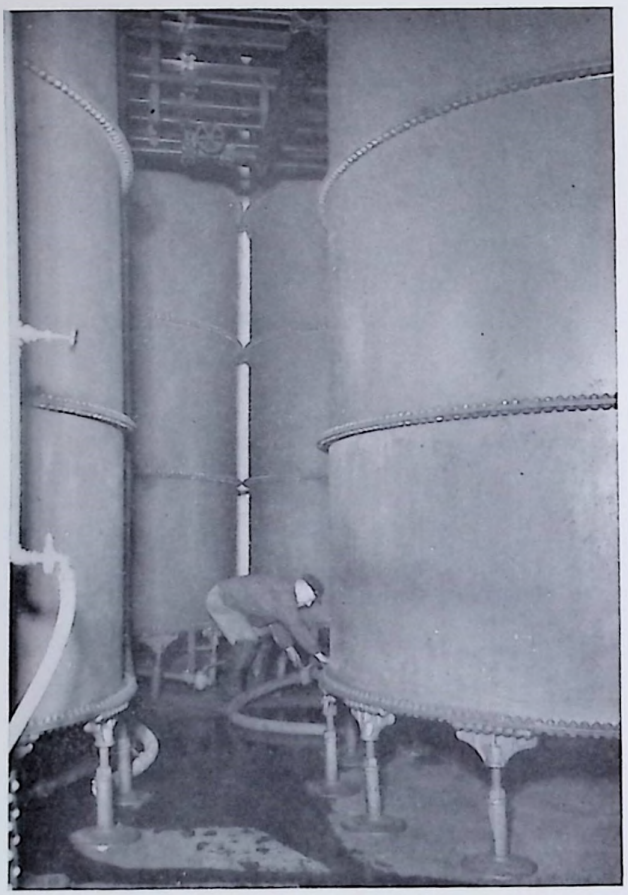
Brew kettles, cereal cookers, mash tuns, hot water tanks and similar equipment, all can be made to operate more economically by the careful selection and application of insulating material of the proper type and thickness.

Whether heating or refrigeration is involved, whether the surface requiring insulation is a pipe, kettle or the wall of a storage room, there is a J-M product which will serve the purpose effectively and economically.

INSULATION IN THE BREWERY
June, 1936 (Cancelling sheet dated February, 1933) 9-W-1 [IN-2700]

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Without adequate insulation in beer cellars, low temperatures cannot be maintained economically

The economical thickness of insulation is ordinarily computed on the basis of fuel or refrigeration costs and operating conditions so that the heat transmitted through the insulation is only that portion which may not be prevented economically. Sometimes special conditions, such as the need for accurate temperature control, necessitate thicker insulation than would otherwise be warranted.

In the accompanying table J-M recommendations for insulation in the brewery are briefly summarized. Descriptions of J-M insulating materials and details on their application to various types of equipment will be found on other data sheets.

Note: A nation-wide group of Approved Insulation Contractors assures expert workmanship in the application of J-M materials.

J-M Recommendations for Insulation in the Brewery

Equipment or location	*Recommendations*
Stock House	
Fermenting and storage cellars	Two 2″ layers Rock Cork
Hops and yeast storage	Two 2″ layers Rock Cork
Brine piping, etc.	Rock Cork Pipe Insulation, brine thickness or 2 layers Built-up Brine and Ammonia Insulation
Compressor Room	
Brine coolers	4″ Rock Cork Lagging
Brine pipes	Rock Cork Pipe Insulation, brine thickness or 2 layers Built-up Brine and Ammonia Insulation
Low side ammonia lines	Rock Cork Pipe Insulation, heavy brine thickness or 3 layers Built-up Brine and Ammonia Insulation
Steam piping, 100-150 lb. ga. Pipes larger than 4″	2″ 85% Magnesia or Asbesto-Sponge Felted
Pipes 2″ to 4″	1½″ 85% Magnesia or Asbesto-Sponge Felted
Pipes smaller than 2″	Std. Thick 85% Magnesia or 1″ Asbesto-Sponge Felted
Brew House	
Brew kettle	1½″ 85% Magnesia blocks finished with ½″ No. 302 Insulating Cement and canvas, painted with two coats of lead and oil paint
Cereal cooker, Mash tun, Lauder tub, Hot water tank	1″ 85% Magnesia blocks finished as above
Wort piping, Hot water piping, Process steam piping	Std. Thick 85% Magnesia or 1″ Asbesto-Sponge Felted
Boiler Room	
Steam piping, 100-150 lb. ga. Pipes larger than 4″	2″ 85% Magnesia or Asbesto-Sponge Felted
Pipes 2″ to 4″	1½″ 85% Magnesia or Asbesto-Sponge Felted
Pipes smaller than 2″	Std. Thick 85% Magnesia or 1″ Asbesto-Sponge Felted
Feed water piping	Std. Thick 85% Magnesia or 1″ Asbesto-Sponge Felted
Boiler drums	2″ 85% Magnesia blocks and ½″ No. 302 Cement.
Brick-set boiler walls	3″ Superex-Magnesia Combination block insulation or 4½″ Sil-O-Cel Brick.

Boiler bases, tube doors, breechings, stacks and other boiler room equipment should be insulated according to detailed recommendations on Data Sheets IN-500 to 503.

Among the other J-M materials for the brewery are Packings, Refractory Cements, Floorings, Waterproofing Materials, Filter-Aids, Transite Pipe, Flat and Corrugated Transite Sheets, Friction Materials and a full line of Roofing Materials. Complete information on any of these J-M products may be had on request.

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Efficiency of Insulation

The efficiency of an insulation is obtained by subtracting the heat loss through the insulation from the heat loss of the uninsulated surface and dividing the difference by the heat loss of the uninsulated surface.

The common unit of heat is the B.t.u. (British thermal unit), which is the quantity of heat required to raise the temperature of one pound of water 1 deg. F., or, to be more exact, a B.t.u. is 1/180 of the heat required to raise the temperature of a pound of pure water from 32 deg. F. to 212 deg. F.

Heat Transmission:

Heat transmission is usually expressed in B.t.u. per square foot, or per linear foot, per degree temperature difference, per hour. The term "conductivity" is often used erroneously where "heat transmission" or "heat loss" is meant.

Conductivity:

Conductivity, like density, is a specific property of a material. Conductivity is expressed in B.t.u. per square foot per degree temperature difference between surfaces per hour, for a thickness of 1". It is not necessary, however, to have exactly 1"-thick material in order to express its conductivity per inch thick.

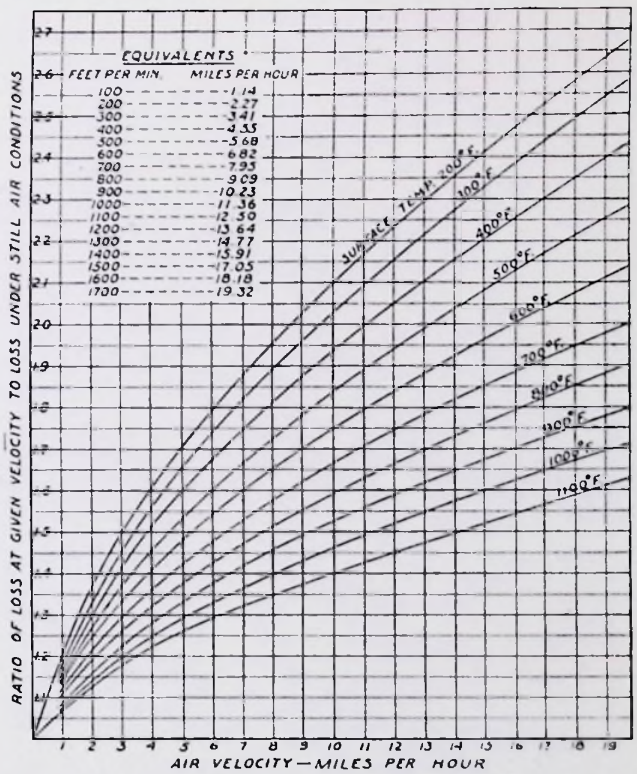
The *rate of heat transmission* is much *less* for a thick layer of a material than it is for a thin layer of the same material, but the *conductivity* is the *same*. This illustrates why the terms "conductivity" and "heat transmission" can not be used interchangeably.

Condensation in Steam Pipes

Loss of heat from a pipe containing saturated steam does not result in a change in temperature, but causes the condensation of a portion of the steam. In order to determine the amount of condensation it is necessary to divide the total heat loss by the latent heat of evaporation (found in the steam tables).

For example, it will be noted from the steam tables that at 100-lb. gauge pressure the latent heat of evaporation is 880.8 B.t.u. This means that at 100-lb. steam pressure there will be 1 lb. of condensation for each 880.8 B.t.u. lost.

In case of superheated steam, the loss of heat results in a lowering of the temperature or loss of superheat. Condensation, in the case of superheated steam lines, will not take place until all of the superheat has been dissipated.



Effect of air velocity on bare surface loss. Temperature of air—80 deg. F.

Effect of Wind Velocity:

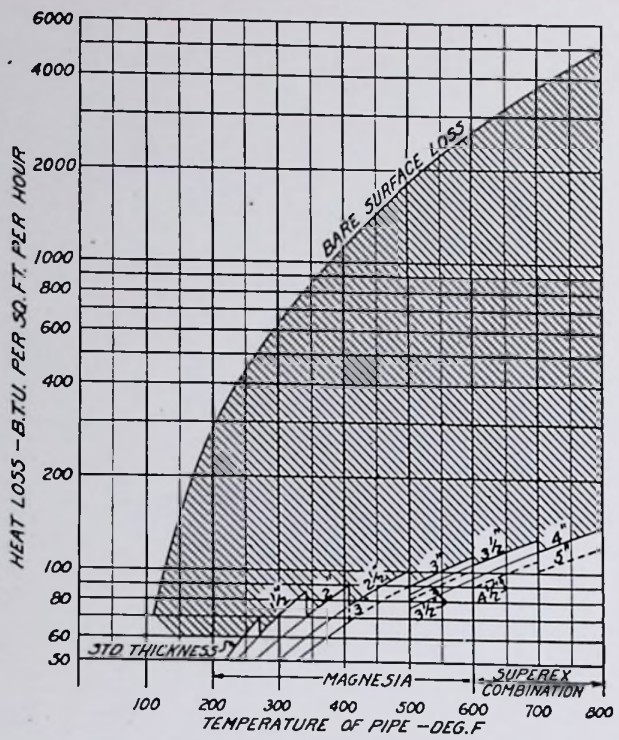
With a 10-mile per hour wind velocity the heat loss from bare pipe will be approximately 1.5 to 2 times as great as in still air. Higher wind velocities would further increase the heat loss.

On pipes covered with efficient insulation, the maximum increase in heat loss due to a wind velocity of 30 miles per hour is about 15% for 1" thick insulation, 10% for 2" thick insulation and 5% for 3" thick insulation. At lower velocities there would be a correspondingly lesser effect.

The heat losses and efficiencies shown in data sheet tables are based on still air conditions. From the figures in the two previous paragraphs it is apparent that the increase in heat loss as a result of wind velocity is very small for an insulated pipe as compared with the loss from a bare pipe—and the thicker the insulation, the less will be the effect of wind in increasing the loss. But, if the joints are open or the insulation is cracked, the increase in losses from air movement will be many times as great.

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Heat losses through Magnesia and Superex Combination Insulation, on 8" pipe, compared with bare pipe losses

Efficiency Tables

The efficiencies of pipe insulations vary with the size of the pipe insulated and with the temperature difference between the pipe and the surrounding air.

The efficiencies furnish a means of comparing the savings effected by insulation, with bare pipe losses.

Also the relative values of different insulations may be determined by comparing either their efficiencies or their heat losses. A small difference in efficiency may represent a really large difference in heat losses. The following example will explain further:

The efficiency of 2" thick Asbesto-Sponge Felted sheet insulation at 500 deg. temperature difference is 95.29% and of the same insulation 3" thick, 96.75%. The difference in efficiencies is only 1.46%, which seems small and might lead one to believe that it would not pay to use the extra inch of thickness.

However, the loss through the 95.29% efficient insulation is 4.71% of the bare surface loss and the loss through the 96.75% efficient insulation is only 3.25% of the bare surface loss. The difference is 4.71%—3.25%= 1.46%. Therefore, the loss through the 2" thickness is 1.46 ÷ 3.25=44.9% greater than the loss through the 3" thick insulation.

Tables of efficiencies of the different insulations on various sized pipes and on flat surfaces at various temperature differences are given in the data sheets on the respective insulations. Such efficiency tables are used as follows:

Example 1:

What is the *efficiency* of J-M Asbesto-Sponge Felted pipe insulation, 2" thick, on a 6" pipe conveying steam at 200 lb. gauge pressure through a room where temperature is 70 deg. F.?

To determine the difference between the temperature of steam in the pipe and the temperature of air surrounding the pipe, refer to the steam tables, where the temperature of steam at 200-lb. pressure is found to be 388 deg. F. The temperature of air around the pipe is the room temperature given, 70 deg. F. Therefore, the temperature difference is 318 deg. F.

Next refer to table of efficiencies for 2" thick Asbesto-Sponge Felted Pipe Insulation. Opposite 6" pipe size, the efficiency for 350 deg. F. difference is found to be 92.56% and for 300 deg. F. difference, 91.93%. The difference for 50 deg. F. is therefore, .63%.

If difference for 50 deg. F. = 0.63%, then for 1 deg., the difference is .63 ÷ 50 = .0126%. The temperature difference (318 deg.) is 18 deg. more than 300 deg.; so 18 x .0126 = .227%, which, added to 91.93% (efficiency for 300 deg.) = 92.16%, the required efficiency.

Example 2:

To find exactly *how much heat is saved* by applying this 2" insulation, proceed as follows:

By referring to table giving total heat loss in B.t.u. per linear foot of bare pipe, opposite 6" pipe size and under 300 deg. difference, the heat loss is found to be 1696 B.t.u. per hour. Under 350 deg. difference the loss is 2201 B.t.u. The difference in loss for the 50 deg. in temperature difference is 2201—1696 = 505 B.t.u. So, for 1 deg. difference, it is 505 ÷ 50 = 10.10 B.t.u.

The temperature difference (318 deg.) is 18 deg. more than 300 deg., so 18 x 10.10 = 181.8 B.t.u., which, added to 1696 (heat loss at 300 deg. difference) = 1877.8 B.t.u., the required total heat loss from 1 lin. ft. of 6" bare pipe, per hour.

Having obtained the loss for bare pipe, the saving effected by the 2" Asbesto-Sponge Felted Insulation is obtained by multiplying the total loss, 1877.8 B.t.u., by the efficiency of the insulation, previously found according to Example 1, as 92.16%, or 92.16% x 1877.8 = 1730.6 B.t.u. saved, per lin. ft. per hour, by the insulation.

This result may be compared with the quantities of heat saved by other types or thicknesses of pipe insulation, which quantities may be obtained in similar manner to the above.

Example 3:

If the *heat loss* through this 2" thick insulation is to be determined, proceed as follows:

Find the efficiency, as outlined in Example 1, which is 92.16%. If the insulation is 92.16% efficient, the per cent bare surface loss which is still lost through insulation is 100 — 92.16 = 7.84%.

Find the bare surface loss, as outlined in Example 2, which is 1877.8 B.t.u. per lin. ft., per hour.

Then the loss through the insulation is 7.84% of 1877.8 B.t.u. = 147.2 B.t.u., per lin. ft., per hour.

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Heat loss from bare surfaces

Losses given in B.t.u. per hour, per linear foot of bare pipe at various temperature differences.

(For finding losses at temperatures between those shown, the B.t.u. increments per degree are given in light-face type between the main columns.)

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F.											
		50°		100°		150°		200°		250°		300°	
½	0.220	21.5	.52	47.3	.64	79.2	.76	117.3	.90	162.3	1.06	215.2	1.28
¾	0.275	26.8	.65	59.2	.80	99.0	.95	146.6	1.13	202.9	1.32	269.0	1.60
1	0.344	33.5	.81	74.0	1.00	123.8	1.19	183.4	1.41	253.8	1.65	336.4	2.01
1¼	0.435	42.4	1.02	93.6	1.26	156.6	1.51	231.9	1.78	320.9	2.09	425.4	2.54
1½	0.498	48.6	1.17	107.2	1.44	179.3	1.72	265.4	2.04	367.4	2.39	487.0	2.90
2	0.622	60.7	1.46	133.9	1.80	223.9	2.15	331.5	*2.55	458.9	2.99	608.3	3.63
2½	0.753	73.4	1.77	162.1	2.18	271.1	2.61	401.4	3.08	555.6	3.62	736.4	4.39
3	0.917	89.4	2.16	197.3	2.66	330.1	3.17	488.8	3.76	676.6	4.40	896.8	5.34
3½	1.047	102.1	2.46	225.3	3.03	376.9	3.62	558.1	4.29	772.5	5.03	1024.0	6.10
4	1.178	114.9	2.77	253.5	3.41	424.1	4.08	627.9	4.82	869.1	5.66	1152.0	6.88
4½	1.309	127.6	3.08	281.7	3.79	471.2	4.53	697.7	5.35	965.1	6.30	1280.0	7.64
5	1.456	142.0	3.43	313.3	4.22	524.2	5.04	776.1	5.96	1074.0	7.00	1424.0	8.48
6	1.734	169.1	4.08	373.2	5.02	624.2	6.00	924.2	7.10	1279.0	8.34	1696.0	10.10
7	1.996	194.6	4.70	429.5	5.78	718.6	6.91	1064.0	8.18	1473.0	9.58	1952.0	11.64
8	2.257	220.1	5.31	485.7	6.54	812.5	7.81	1203.0	9.24	1665.0	10.84	2207.0	13.16
9	2.519	245.6	5.93	542.1	7.29	906.8	8.72	1343.0	10.32	1859.0	12.10	2464.0	14.68
10	2.817	274.7	6.63	606.2	8.16	1014.0	9.76	1502.0	11.52	2078.0	13.54	2755.0	16.42
11	3.073	299.6	7.23	661.3	8.89	1106.0	10.64	1638.0	12.58	2267.0	14.76	3005.0	17.92
12	3.338	325.5	7.86	718.3	9.67	1202.0	11.54	1779.0	13.68	2463.0	16.04	3265.0	19.46
14 o.d.	3.663	357.1	8.62	788.3	10.61	1319.0	12.66	1952.0	15.02	2703.0	17.58	3582.0	21.36
16 o.d.	4.188	408.3	9.86	901.3	12.13	1508.0	14.48	2232.0	17.16	3090.0	20.12	4096.0	24.42
18 o.d.	4.716	459.8	11.10	1015.0	13.66	1698.0	16.32	2514.0	19.32	3480.0	22.64	4612.0	27.50
20 o.d.	5.235	510.4	12.33	1127.0	15.16	1885.0	18.10	2790.0	21.44	3862.0	25.16	5120.0	30.52
24 o.d.	6.286	612.9	14.80	1353.0	18.20	2263.0	21.74	3350.0	25.76	4638.0	30.20	6148.0	36.64
30 o.d.	7.854	765.8	18.48	1690.0	22.74	2827.0	27.18	4186.0	32.18	5795.0	37.72	7681.0	45.80

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F.											
		350°		400°		450°		500°		550°		600°	
½	0.220	279.3	1.52	355.1	1.73	441.7	1.99	541.2	2.17	649.8	2.45	772.2	2.63
¾	0.275	349.1	1.90	443.9	2.16	552.1	2.49	676.5	2.71	812.2	3.06	965.3	3.29
1	0.344	436.7	2.37	555.2	2.71	690.6	3.11	846.2	3.40	1016.0	3.82	1207.0	4.12
1¼	0.435	552.2	3.00	702.1	3.42	873.3	3.93	1070.0	4.30	1285.0	4.84	1527.0	5.20
1½	0.498	632.2	3.43	803.8	3.92	999.7	4.51	1225.0	4.92	1471.0	5.54	1748.0	5.96
2	0.622	789.6	4.29	1004.0	4.90	1249.0	5.62	1530.0	6.14	1837.0	6.92	2183.0	7.44
2½	0.753	955.9	5.18	1215.0	5.94	1512.0	6.80	1852.0	7.44	2224.0	8.38	2643.0	9.00
3	0.917	1164.0	6.32	1480.0	7.22	1841.0	8.30	2256.0	9.04	2708.0	10.22	3219.0	10.96
3½	1.047	1329.0	7.22	1690.0	8.24	2102.0	9.48	2576.0	10.32	3092.0	11.66	3675.0	12.52
4	1.178	1496.0	8.10	1901.0	9.28	2365.0	10.66	2898.0	11.62	3479.0	13.12	4135.0	14.08
4½	1.309	1662.0	9.02	2113.0	10.30	2628.0	11.84	3220.0	12.92	3866.0	14.58	4595.0	15.64
5	1.456	1848.0	10.04	2350.0	11.46	2923.0	13.18	3582.0	14.36	4300.0	16.22	5111.0	17.40
6	1.734	2201.0	11.96	2799.0	13.64	3481.0	15.70	4266.0	17.10	5121.0	19.30	6086.0	20.74
7	1.996	2534.0	13.76	3222.0	15.70	4007.0	18.06	4910.0	19.68	5894.0	22.24	7006.0	23.88
8	2.257	2865.0	15.56	3643.0	17.76	4531.0	20.42	5552.0	22.28	6666.0	25.12	7922.0	27.00
9	2.519	3198.0	17.36	4066.0	19.82	5057.0	22.80	6197.0	24.86	7440.0	28.04	8842.0	30.20
10	2.817	3576.0	19.42	4547.0	22.16	5655.0	25.50	6930.0	27.80	8320.0	31.36	9888.0	33.60
11	3.073	3901.0	21.18	4960.0	24.18	6169.0	27.82	7560.0	30.32	9076.0	34.30	10790.0	36.60
12	3.338	4238.0	23.00	5388.0	26.26	6701.0	30.22	8212.0	32.94	9859.0	37.20	11720.0	39.80
14 o.d.	3.663	4650.0	25.24	5912.0	28.84	7354.0	33.14	9011.0	36.20	10820.0	40.80	12860.0	43.80
16 o.d.	4.188	5317.0	28.84	6759.0	32.96	8407.0	37.90	10300.0	41.40	12370.0	46.60	14700.0	50.00
18 o.d.	4.716	5987.0	32.50	7612.0	37.10	9467.0	40.70	11600.0	46.60	13930.0	52.40	16550.0	56.40
20 o.d.	5.235	6646.0	36.06	8449.0	41.20	10510.0	47.40	12880.0	51.60	15460.0	58.40	18380.0	62.60
24 o.d.	6.286	7980.0	43.40	10150.0	49.40	12620.0	56.80	15460.0	62.20	18570.0	69.80	22060.0	75.20
30 o.d.	7.854	9971.0	54.18	12680.0	61.80	15770.0	71.00	19320.0	77.60	23200.0	87.40	27570.0	93.80

*Example: 2″ pipe, 235° temp. diff.; 235° − 200° = 35°; 35° × 2.55 (B.t.u. per deg.) = 89.3 B.t.u.
331.5 + 89.3 = 420.8 B.t.u. loss at 235° temperature difference.

(Continued)

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HEAT LOSS FROM BARE SURFACES

Losses given in B.t.u. per hour, per linear foot of bare pipe at various temperature differences.

(For finding losses at temperatures between those shown, the B.t.u. increments per degree are given in light-face type between the main columns.)

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F. 650°		700°		750°		800°		850°		900°
½	0.220	903.8	2.86	1047	3.06	1200	3.28	1364	3.48	1538	3.70	1723
¾	0.275	1130.0	3.58	1309	3.84	1501	4.08	1705	4.36	1923	4.60	2153
1	0.344	1413.0	4.48	1637	4.80	1877	5.12	2133	5.44	2405	5.78	2694
1¼	0.435	1787.0	5.68	2071	6.06	2374	6.46	2697	6.88	3041	7.30	3406
1½	0.498	2046.0	6.50	2371	6.92	2717	7.42	3088	7.88	3482	8.34	3899
2	0.622	2555.0	8.12	2961	8.66	3394	9.24	3856	9.86	4349	10.42	4870
2½	0.753	3093.0	9.82	3584	10.50	4109	11.20	4669	11.90	5264	12.64	5896
3	0.917	3767.0	11.96	4365	12.76	5003	13.64	5685	14.52	6411	15.38	7180
3½	1.047	4301.0	13.66	4984	14.58	5713	15.56	6491	16.58	7320	17.56	8198
4	1.178	4839.0	15.36	5607	16.42	6428	17.52	7304	18.64	8236	19.76	9224
4½	1.309	5377.0	17.08	6231	18.22	7142	19.48	8116	20.72	9152	21.96	10250
5	1.456	5981.0	19.00	6931	20.26	7944	21.66	9027	23.10	10180	24.10	11400
6	1.734	7123.0	22.62	8254	24.14	9461	25.80	10750	27.40	12120	29.20	13580
7	1.996	8200.0	26.02	9501	27.80	10890	29.80	12380	31.60	13960	33.40	15630
8	2.257	9272.0	29.40	10740	31.60	12320	33.40	13990	35.80	15780	37.80	17670
9	2.519	10350.0	32.80	11990	35.00	13740	37.60	15620	39.80	17610	42.20	19720
10	2.817	11570.0	36.80	13410	39.20	15370	42.00	17470	44.40	19690	47.40	22060
11	3.073	12620.0	40.20	14630	42.80	16770	45.60	19050	48.60	21480	51.60	24060
12	3.338	13710.0	43.60	15890	46.40	18210	49.80	20700	52.80	23340	56.00	26140
14 o.d.	3.663	15050.0	47.80	17440	51.00	19990	54.40	22710	58.00	25610	61.40	28680
16 o.d.	4.188	17200.0	54.80	19940	58.20	22850	62.40	25970	66.20	29280	70.20	32790
18 o.d.	4.716	19370.0	61.60	22450	65.60	25730	70.20	29240	74.60	32970	79.20	36930
20 o.d.	5.235	21510.0	68.20	24920	72.80	28560	78.00	32460	82.80	36600	87.80	40990
24 o.d.	6.286	25820.0	82.00	29920	87.60	34300	93.40	38970	99.60	43950	105.40	49220
30 o.d.	7.854	32260.0	102.60	37390	109.20	42850	117.00	48700	124.20	54910	131.80	61500

Nominal pipe size, inches	Sq. ft. of pipe surface, per lin. ft.	Temperature difference, degrees F. 950°		1000°
½	0.220	3.90	1918	4.10	2123
¾	0.275	4.88	2397	5.14	2654
1	0.344	6.08	2998	6.44	3320
1¼	0.435	7.72	3792	8.12	4198
1½	0.498	8.84	4341	9.30	4806
2	0.622	11.04	5422	11.60	6002
2½	0.753	13.34	6563	14.08	7267
3	0.917	16.26	7993	17.12	8849
3½	1.047	18.56	9126	19.50	10100
4	1.178	20.90	10270	22.00	11370
4½	1.309	23.20	11410	24.40	12630
5	1.456	25.80	12690	27.20	14050
6	1.734	30.60	15110	32.40	16730
7	1.996	35.40	17400	37.20	19260
8	2.257	40.00	19670	42.20	21780
9	2.519	44.80	21960	47.00	24310
10	2.817	49.80	24550	52.60	27180
11	3.073	54.60	26790	57.40	29660
12	3.338	59.20	29100	62.20	32210
14 o.d.	3.663	65.00	31930	68.40	35350
16 o.d.	4.188	74.20	36500	78.20	40410
18 o.d.	4.716	83.60	41110	88.00	45510
20 o.d.	5.235	92.80	45630	97.80	50520
24 o.d.	6.286	111.40	54790	117.40	60660
30 o.d.	7.854	139.20	68460	146.60	75790

Flat, Curved and Cylindrical Surfaces

Heat losses given in B.t.u. per hour, per square foot of bare surface, at various temperature differences.

Temp. difference, degrees F.	Total heat loss at temp. indicated	Increments per degree for total losses	Loss per degree temp. difference
50	97.5	2.35	1.950
100	215.2	2.90	2.152
150	360.0	3.46	2.400
200	533.0	4.10	2.665
250	737.8	4.80	2.951
300	978.0	5.83	3.260
350	1269.5	6.89	3.627
400	1614.0	7.87	4.035
450	2007.5	9.05	4.461
500	2460.0	9.87	4.920
550	2953.5	11.10	5.370
600	3510.0	11.96	5.850
650	4108.0	13.04	6.320
700	4760.0	13.93	6.800
750	5456.3	14.87	7.275
800	6200.0	15.83	7.750
850	6991.3	16.77	8.225
900	7830.0	17.73	8.700
950	8716.3	18.67	9.175
1000	9650.0		9.650

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Dimensions of Standard Wrought Iron and Steel Pipe

Diameter			Nominal thickness, inches	Circumference		Transverse area			Length pipe per sq. ft.		Length of pipe containing 1 cu. ft., feet	Nominal weight per ft., pounds	Number of threads per inch	Area of external surface per linear foot, sq. ft.
Nominal internal, inches	Actual external, inches	Actual internal, inches		External, inches	Internal, inches	External, square inches	Internal, square inches	Metal, square inches	External surface, feet	Internal surface, feet				
⅛	.405	.269	.068	1.272	.845	.129	.057	0717	9.431	14.199	2533.000	.244	27	.106
¼	.540	.364	.088	1.696	1.144	.229	.104	.1249	7.075	10.490	1383.300	.420	18	.141
⅜	.675	.493	.091	2.121	1.549	.358	.191	.1670	5.657	7.747	754.300	.567	18	.177
½	.840	.622	.109	2.639	1.954	.554	.304	.2500	4.547	6.141	473.900	.850	14	.220
¾	1.050	.824	.113	3.299	2.589	.966	.533	.3327	3.637	4.635	270.000	1.115	14	.275
1	1.315	1.049	.133	4.131	3.296	1.358	.864	.4940	2.904	3.641	166.600	1.678	11½	.344
1¼	1.660	1.380	.140	5.215	4.333	2.164	1.496	.6680	2.301	2.768	96.250	2.244	11½	.435
1½	1.900	1.610	.145	5.969	5.058	2.835	2.036	.7990	2.010	2.372	70.730	2.717	11½	.498
2	2.375	2.067	.154	7.461	6.494	4.430	3.356	1.0740	1.608	1.848	42.910	3.609	11½	.622
2½	2.875	2.469	.203	9.032	7.757	6.492	4.788	1.7040	1.328	1.547	30.070	5.793	8	.753
3	3.500	3.068	.216	10.996	9.638	9.621	7.393	2.2280	1.091	1.245	19.470	7.575	8	.917
3½	4.000	3.548	.226	12.566	11.146	12.566	9.887	2.6790	.955	1.077	14.570	9.001	8	1.047
4	4.500	4.026	.237	14.137	12.648	15.904	12.730	3.1740	.849	.949	11.310	10.665	8	1.178
4½	5.000	4.506	.247	15.708	14.156	19.635	15.947	3.6880	.763	.847	9.030	12.538	8	1.309
5	5.563	5.047	.258	17.477	15.856	24.306	20.006	4.3000	.686	.756	7.198	14.671	8	1.456
6	6.625	6.065	.280	20.813	19.054	34.472	28.888	5.5840	.577	.630	4.980	18.762	8	1.734
7	7.625	7.023	.301	23.955	22.063	45.664	38.738	6.9260	.501	.544	3.720	23.271	8	1.996
8	8.625	7.981	.322	27.096	25.073	58.426	50.027	8.3990	.442	.478	2.878	28.544	8	2.257
9	9.625	8.941	.342	30.238	28.089	72.760	62.786	9.9740	.396	.427	2.294	33.907	8	2.519
10	10.750	10.020	.365	33.772	31.479	90.763	78.855	11.9080	.355	381	1.826	40.483	8	2.817
11	11.750	11.000	.375	39.914	34.558	108.434	95.033	13.4010	.325	.347	1.510	45.028	8	3.073
12	12.750	12.000	.375	40.055	37.700	127.677	113.098	14.5790	.299	.319	1.270	48.985	8	3.337
14 O. D.	14.000	13.250	.375	43.982	41.626	153.938	137.887	16.0510	.273	.288	1.040	54.560	8	3.663
16 O. D.	16.000	15.250	.375	50.266	47.909	201.062	182.655	18.4070	.239	.250	.750	62.570	8	4.188
18 O. D.	18.000	17.250	.375	56.549	54.193	254.470	233.253	21.2170	.212	.221	.620	70.580	8	4.716
20 O. D.	20.000	19.250	.375	62.832	60.476	314.159	291.040	23.1190	.191	.198	.495	78.590	8	5.235
22 O. D.	22.000	21.250	.375	69.115	66.759	380.134	354.657	25.4770	.174	.180	.406	86.600	8	5.747
24 O. D.	24.000	23.250	.375	75.398	73.042	452.390	424.558	27.8320	.159	.164	.340	94.610	8	6.286

Some Properties of Saturated Steam

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Gauge* press. lb.	Absol. press. lb.	Temp. deg. F.	Sp. Vol. cu. ft. per lb.	Latent heat of evap.	Total heat of steam
....	0.2	53.14	1526.00	1063.8	1085.0
....	0.5	79.58	641.40	1048.8	1096.4
....	1.0	101.74	333.60	1036.3	1106.0
....	2.0	126.08	173.73	1022.2	1116.2
....	3.0	141.48	118.71	1013.2	1122.6
....	4.0	152.97	90.63	1006.4	1127.3
....	5.0	162.24	73.52	1001.0	1131.1
....	6.0	170.06	61.98	996.2	1134.2
....	8.0	182.86	47.34	988.5	1139.3
....	10.0	193.21	38.42	982.1	1143.3
....	14.0	209.56	28.04	971.9	1149.5
.0	14.696	212.00	26.80	970.3	1150.4
.3	15	213.03	26.290	969.7	1150.8
5.3	20	227.96	20.089	960.1	1156.3
10.3	25	240.07	16.303	952.1	1160.6
15.3	30	250.33	13.746	945.3	1164.1
20.3	35	259.28	11.898	939.2	1167.1
25.3	40	267.25	10.498	933.7	1169.7
30.3	45	274.44	9.401	928.6	1172.0
35.3	50	281.01	8.515	924.0	1174.1
40.3	55	287.07	7.787	919.6	1175.9
45.3	60	292.71	7.175	915.5	1177.6
50.3	65	297.97	6.655	911.6	1179.1
55.3	70	302.92	6.206	907.9	1180.6
60.3	75	307.60	5.816	904.5	1181.9
65.3	80	312.03	5.472	901.1	1183.1
70.3	85	316.25	5.168	897.8	1184.2
75.3	90	320.27	4.896	894.7	1185.3
80.3	95	324.12	4.652	891.7	1186.2
85.3	100	327.81	4.432	888.8	1187.2
90.3	105	331.36	4.232	886.0	1188.1
95.3	110	334.77	4.049	883.2	1188.9
100.3	115	338.07	3.882	880.6	1189.7
105.3	120	341.25	3.728	877.9	1190.4
110.3	125	344.33	3.587	875.4	1191.1
115.3	130	347.32	3.455	872.9	1191.7
120.3	135	350.21	3.333	870.6	1192.4
125.3	140	353.02	3.220	868.2	1193.0
130.3	145	355.76	3.114	865.8	1193.5
135.3	150	358.42	3.015	863.6	1194.1
145.3	160	363.53	2.834	859.2	1195.1
155.3	170	368.41	2.675	854.9	1196.0
165.3	180	373.06	2.532	850.8	1196.9
175.3	190	377.51	2.404	846.8	1197.6
185.3	200	381.79	2.288	843.0	1198.4
210.3	225	391.79	2.0422	833.8	1199.9
235.3	250	400.95	1.8438	825.1	1201.1
260.3	275	409.43	1.6804	816.9	1202.1
285.3	300	417.33	1.5433	809.0	1202.8
335.3	350	431.72	1.3260	794.2	1203.9
385.3	400	444.59	1.1613	780.5	1204.5
435.3	450	456.28	1.0320	767.4	1204.6
485.3	500	467.01	0.9278	755.0	1204.4
585.3	600	486.21	0.7698	731.6	1203.2
685.3	700	503.10	0.6554	709.7	1201.2
785.3	800	518.23	0.5687	688.9	1198.6
885.3	900	531.98	0.5006	668.8	1195.4
985.3	1000	544.61	0.4456	649.4	1191.8
1235.3	1250	572.42	0.3450	602.4	1181.0
1485.3	1500	596.23	0.2765	556.3	1167.9
1985.3	2000	635.82	0.1878	463.4	1135.1
2485.3	2500	668.13	0.1307	360.5	1091.1
2985.3	3000	695.36	0.0858	217.8	1020.3
3191.5	3206.2	705.40	0.0503	0	902.7

*Gauge pressures are indicated to the nearest tenth of a pound at "sea level" (one standard atmosphere = 14.696 lb. per sq. in.). The author's tables do not include a column of gauge pressures.

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Total Radiation Areas of Fittings*

Standard flanged fittings

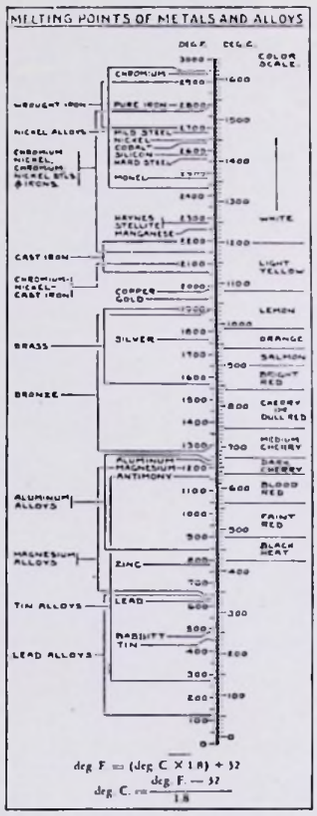
Nominal pipe size	Equivalent pipe length in linear feet — Flanged coupling	90-degree ell	Long-radius ell	Tee	Cross
1"	0.93	2.31	2.59	3.59	4.72
1¼"	0.88	2.20	2.49	3.40	4.47
1½"	0.95	2.35	2.68	3.64	4.78
2"	1.08	2.65	2.96	4.08	5.34
2½"	1.12	2.78	3.08	4.26	5.56
3"	1.03	2.60	2.93	3.99	5.70
3½"	1.07	2.85	3.13	4.28	5.56
4"	1.14	2.90	3.36	4.59	5.97
4½"	1.13	3.01	3.38	4.63	6.01
5"	1.11	3.049	3.43	4.67	6.06
6"	1.049	2.950	3.45	4.53	5.81
7"	1.097	3.090	3.697	4.69	6.01
8"	1.067	3.090	3.790	4.67	5.96
9"	1.190	3.457	4.200	5.23	6.66
10"	1.220	3.610	4.380	4.47	6.95
12"	1.320	3.920	4.900	5.89	7.45
14" O.D.	1.465	4.470	5.470	6.78	8.60
15" O.D.	1.572	4.720	5.830	7.10	9.04
16" O.D.	1.600	4.820	6.070	7.23	9.15

Extra heavy flanged fittings

1"	1.273	2.950	3.148	4.578	6.020
1¼"	1.172	2.524	3.080	4.425	5.816
1½"	1.459	2.674	3.762	5.381	7.108
2"	1.363	3.230	3.473	4.968	6.528
2½"	1.463	3.410	3.665	5.378	6.865
3"	1.619	3.807	4.080	5.815	7.582
3½"	1.570	3.782	4.087	5.768	7.535
4"	1.624	3.938	4.236	6.001	7.843
4½"	1.558	3.834	4.170	5.897	7.692
5"	1.497	3.756	4.131	5.851	7.534
6"	1.603	4.031	4.475	6.136	7.929
7"	1.733	4.318	4.874	6.177	8.431
8"	1.670	4.324	4.913	6.531	8.405
9"	1.762	4.511	5.228	6.840	8.773
10"	1.846	4.820	5.538	7.245	9.322
12"	2.010	5.310	5.622	7.987	10.222
14" O.D.	2.260	6.080	7.020	9.180	11.750
15" O.D.	2.430	6.430	7.470	9.680	12.400
16" O.D.	2.400	6.475	7.575	9.775	12.500

* Figures indicate number of linear feet of pipe having an area equivalent to that of the fittings. Area calculated includes accompanying flanges.

Industrial Temperature Data



Melting points shown in chart as single temperatures are for elements. Alloys have a range of melting points due to variable composition.

Temp.	Heating Process
	Above 2000 Deg. F.
2800	Melting Refined Steel
2600	Porcelain Burning
	Melting Heat-Resisting Glass
2550	Burning Fire Brick
2500	Welding Steel Tubes
2450	Copper Refining
2400	Forging Mild Steel
2300	Melting Copper and Bronze
	Melting Lead Glass
2250	Billet and Rivet Heating
2200	Brass Melting
2100	High Speed Steel Hardening
	Below 2000 Deg. F.
1900	Brazing
1850	Vitrification of Sewer Pipe
1800	Blue Annealing Sheets
	Stainless Steel
1700	Vitreous Enameling
	Glazing China
1650	Carburizing
	Lead Hardening
	Annealing Steel Castings
1600	Annealing Springs
1500	Annealing Dies
	Porcelain Enameling
	Hardening Carbon Steel
1450	Annealing Malleable Castings
	Annealing Rolled Steel
1400	Annealing Nickel
	Annealing Hi-Carbon Steel
1300	Annealing Band Steel
	Annealing Wire
1200	Aluminum Melting
	Glass Annealing
1100	Tempering Hi-Speed Steel
	Annealing Nickel Silverware
1000	Annealing Glass Lenses
	Reducing Iron Ore

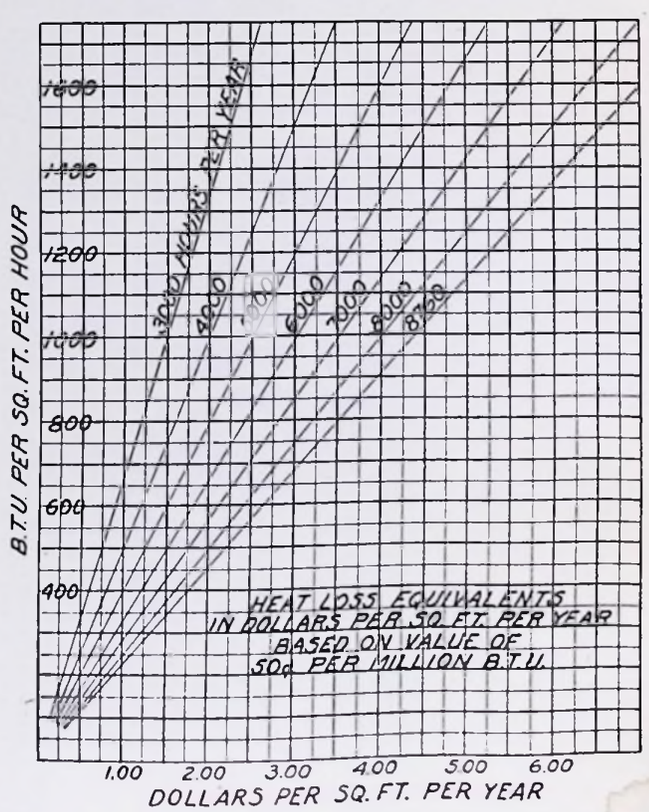
Coal Wasted by Heat Loss from Uninsulated Surfaces

Steam pressure	Temperature (deg. F.)	Temp. Diff. (deg. F.)	B.t.u. Loss per sq. ft. per hour	Coal Wasted, lb. per sq. ft. per year	Area in sq. ft. wasting 1 ton coal in 1 year
0	100	30	56.6	49.6	40.3
0	120	50	97.5	85.4	23.4
0	140	70	142	124.3	16.1
0	160	90	190	166.3	12.03
0	180	110	242	212	9.44
0	200	130	298.5	261.5	7.65
0	212	142	334	293	6.82
10	240	170	425	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820	718	2.79
150	366	296	960	840	2.38
200	388	318	1,079	945	2.12
250	406	336	1,184	1,036	1.93

The table shows the amount of heat energy lost, and coal consequently wasted, by the dissipation of heat through uninsulated surfaces. The calculations are based upon an available heat value per pound of coal of 10,000 B.t.u., which is equivalent to a boiler efficiency of 70 percent using coal with a calorific value of approximately 14,000 B.t.u. per pound.

The figures are based also on continuous service, 24 hours per day, 365 days per year, with the average temperature of surrounding air at 70 deg. F.

These computations are very conservative, as both the boiler efficiency and the heat value of the coal are high; a lesser boiler efficiency or inferior grade of coal would show even greater waste of fuel.



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JOHNS-MANVILLE INDUSTRIAL PRODUCTS

In addition to Insulation, Packings and Refractory Cements, described herein, complete information and engineering data on the following materials may be had on request.

Transite Roofing and Siding

Transite products, composed of asbestos fibre and portland cement, are fireproof, weather-proof, corrosion-resistant and have great strength and durability. In the form of corrugated sheets Transite is used for maintenance-free roofing and siding.

Transite Ventilators

Moulded stationary roof ventilators, with or without dampers, for fume-proof, weather-proof and fireproof construction.

Flat Transite Sheets

The outstanding fireproof and corrosion-resisting building sheet for partitions, ceilings, sidings and casings.

Transite Pipe

For vents and flues, as well as pressure lines for water, gas and process liquors. Free from tuberculation and electrolysis.

Roofing and Roof Insulation

Bonded Built-up Roofs, Ready-to-Lay Roofing, Insulated and Rot-Proof Roofs, for every type of industrial building.

Industrial Flooring Plank

The popular type of resilient industrial flooring. Made up of preformed asphalt slabs in red, brown or black.

Industrial Friction Materials

Asbestos brake linings, friction blocks and clutch facings of great durability, strength and heat resistance.

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