

PLAINTIFF'S
EXHIBIT
AL-832

60. General correspondence
regarding asbestos
replacement - ingot casting

Ingot Casting

RESISTOR
RESISTOR

60

F I L E

HAIG G. SAKOIAN

ME. E. L. ROOY

PITTSBURGH OFFICE - 7

PITTSBURGH OFFICE - 23

1979 May 07

RE: ASBESTOS USES IN ALCOA INGOT PLANTS

Thank you for your help in explaining some of the details regarding asbestos replacement materials available in our ingot casting areas. Please find attached the summary of the results of our asbestos use poll, specifically in ingot casting, that you requested.

It is evident that much work has been done in this area. However, it is also clear that much work still lies ahead. A complete asbestos use and available substitution summary is being prepared to aid the plants in their replacement efforts. If you would be interested in seeing a copy, I would be happy to send you one.

Your support in this endeavor is greatly appreciated.

HAIG G. SAKOIAN

HGS/eds

cc: E. E. Rumberger - Pgh. 7

*08/14-cc to J. Hener (ATC)
and M. Caprio (Pgh.) / ELLC*

COPIES



MOLTEN METAL MARINITE USES IN ALCOA PLANTS -
INGOT CASTING

<u>PLANT</u>	<u>SPECIFIC APPLICATION AS REPORTED FROM PLANTS</u>
<u>ATC</u>	-Ingot casting items - Manufacturing Section
<u>Davenport</u>	-Variable head distributor float #2 DC pit -Float - 18X50 and 18X60 DC molds -Float - 12X48, 16X50, 16X43 DC molds -Float - Flow control DC casting unit -Float - 24X72 ingots #9 DC pit -Trough Plug - pouring troughs -Support - DC pits -Trough dam - pouring troughs -Trough dam - 503 and 528 filter boxes -Skim stick - DC pits -Float - DC pits -Float support - DC pits -Blinder - DC pits -(Marinite board) Doorframe insulation on melting and holding furnaces
<u>Lafayette</u>	-Casting tools
<u>Massena</u>	-Insulator - part for chip melter, side bay -Headers (sanding of Marinite headers in mold shop) -Float used for HDC sheet ingot tooling, 30 complex, level flow control, cast units -Miscellaneous Marinite: Spare parts for 30 complex; insulators; inserts; bearing housings; couplings; covers; etc.
<u>Pt. Comfort</u>	-Basins for HDC casting
<u>Rockdale</u>	-Pre-cut Marinite for molten metal casting
<u>Tennessee</u>	-HDC headers - South Plant
<u>Tifton</u>	-DC casting floats and spouts
<u>Vancouver</u>	-Headers (Note: ceramic molds replace 2/3 of Marinite heads at present time.)

<u>PLANT</u>	<u>SPECIFIC APPLICATION AS REPORTED FROM PLANTS</u>
<u>Vernon</u>	-Marinite board (Non-asbestos Marinite now being substituted on trial basis) -Also use asbestos rope for door seals (being replaced with ceramic) -Also use asbestos-containing block or brick
<u>Warrick</u>	-Trough liners; headers (partial substitution of plastic trough lining continues)
<u>Wenatchee</u>	NO REPORT

FROM A. A. KRON
MECHANICAL ENGINEERING DIVISION
PITTSBURGH - 3 WPH

TO MR. R. P. CARTER
PITTSBURGH OFFICE - 7

1979-03-21

RE: PLANT USAGE OF ASBESTOS PRODUCTS

Please refer to our letter dated 1978JUL06 under the subject heading. This letter refers to a search for substitute furnace burner radiant tube gland packing materials.

We are attaching 3 samples for your observation. The square brownish piece is probably Johns-Manville 869 asbestos, which has been our standard for many years. This piece has seen service in a Davenport preheat furnace for some time. The loose braided piece is ceramic fiber, and has been tried in a Davenport annealer with minimal success. The third piece, the square white one, is Anchor Packing Co. ANKO-TEX 1551, which is supposed to be satisfactory for plant use, and is the material in general use at the present time in new Davenport installations.

We checked the temperatures to which this packing is exposed. At a preheat furnace temperature of 1160°F, the packing is exposed to a maximum temperature of 500°F on the radiant tube burner leg gland and 780°F on the exhaust leg gland.

Davenport is presently in the process of investigating a non-asbestos packing material made by Pyrotek Inc. of Spokane, Washington under the designation of P-13. This is a carbon yarn material impregnated with graphite.

Our present course of action is to work with the plants in the field testing of available products.



A. A. KRON

AAK/ccw

Attachments

cc: L. D. Tanis/J. F. Sanders/D. C. Allebach - Davenport
J. D. Breazeal - Davenport
M. J. Caprio - Pgh. 19
R. M. Trimble - ATC-B

file: Asbestos Containing
Materials or Asbestos
Replacement

A her
Sh

30

PIT 243 1 MSW 0088 01/27/72 16.16 16.24

PIT 1/27

R W KNAPP

L W DANFORTH

W S BARR

REURLET 1/25/72. MARINITE DOES CONTAIN 50% ASBESTOS. RECENTLY JOHNS MANVILLE SALESMAN ADVISED PITTSBURGH PURCHASING THAT THE HEAT TREATING EMPLOYED FOR OUR MARINITE REDUCES TOXICITY SIGNIFICANTLY. WE ARE ASKING FOR DOCUMENTATION OF THIS BUT ARE NOT AWARE OF ANY SUCH WORK. THEREFORE TOM BONNEY FEELS WE MUST PROCEED AT PRESENT ON BASIS THAT FINES FROM MARINITE CUTTING OPERATIONS ARE SUBJECT TO PROVISIONS OF THE EMERGENCY STANDARD PER MY LET 12/7/72 AND ADOPT REQUIRED ENGINEERING AND PROTECTION ACTION.

ROBERT P CARTER PGH ES

File - Asbestos

Substitutes
(Molten Metal Marinite)

83-08-25

Ken Karsten reported that an asbestos substitute for Molten Metal Marinite for HDC, Metal Mover (from Johns Manville), was unsuccessful due to:

1. Poor strength (13 hrs. was longest run)
2. Difficult to fabricate.

They will continue to search for a suitable replacement.

FROM R. E. MILLER
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

TO DR. P. R. BRIDGEMAN
ALCOA TECHNICAL CENTER - C

CONFIDENTIAL

1982 November

PSB	
TJR	
PSB	
29	
DATE	
SAFETY DEPT.	

RE: INGOT CASTING DIVISION WEEKLY HIGHLIGHTS
Week of 1982 November 22

Technical Highlights

1. Designed low pressure nozzle for Al-Li fluxing to be used until the R798 nozzle is available. This nozzle was designed to operate in the unstable jet flow regime ($Re > 12,000$) with a reduced outside diameter for smaller bubble formation. (CEE)
2. Visited Drexel University to complete filter bed flow visualization formation. A video tape was made that clearly illustrates the flow of liquid (salt) inclusions through a filter bed and total lack of capture. The modelling system was chloroform - ethyl phthalate continuous phase, borosilicate glass media, and propylene glycol inclusion phase. We are planning to determine conditions leading to filter release effects using the model in December 1982. (CEE)
3. A video tape of molten steel filtration modelling was made while at Drexel. This tape will be shown to Jim Everts (Pgh) for the purpose of possibly establishing a program. (CEE)
4. In-line alloying, R798, and cake mode filter program were discussed with Warrick visitors. (CEE)
5. Attended a meeting at Arkansas Operations with H.G. Reavis to discuss tabular alumina bed filter media quality requirements (RE: C.E.Eckert report to H.G.Reavis, 1982 October 20). The people at Arkansas are now cognizant of our quality needs and will reply with an intended action plan. (CEE)
6. Skim Cooler ("Remetal") performs very well. The product is separated in "rechargeable for metal recovery" and fine fractions. Good recovery from charge into toilet bowl. Tests continue. (JVL)
7. The skim busting machine ("Geneco" from McBride Co.) is performing exceptionally well. Cooler product and skim patties are enriched in preparation for charging in the toilet bowl. The skim formation from the "rich skim fraction" is less than 30%! (JVL)
8. Demonstrated all facets of the comprehensive skim treatment scheme to Warrick personnel with good results. Plans are to expand the proposal and provide test results to substantiate the potential savings. (JVL)
- ✓ 9. Warrick recently had best run ever casting with a non-asbestos header. A Lumi N-12 header ran for 75 hours on 21X42" 5182 and terminated for non-header related reasons. Lubricant consumption was normal. Trials will continue. (RB/VLH)

R. Barhowski

R. E. MILLER
cc: See page 2



ALCOA

Analytical Chemistry Div., ATC
MONTHLY PROGRESS - OCTOBER, 1982

65M41008 - Technical Support of Operations - RCS

Summary:

A standard infrared method for the determination of butylated hydroxytoluene in the coolants from the Tennessee cold mills (10/12 and Tandem) was written and distributed. Additional quantitative methods were developed for cold and hot mill coolants. A plant trip to Tennessee was made to review and set up these methods.

Statement:

- 1) A standard analytical method entitled "Determination of Butylated Hydroxytoluene (BHT) in the Tandem and 10/12 Mills by Infrared Spectrophotometry" was written and distributed to those personnel performing this analysis. This procedure is found under the heading "Analysis of Cold Rolling Lubricant" #479.5.
- 2) Cold Mill Lubricants - Quantitative infrared methods were developed for the determination of XL-5476 (10/12 mill) and XL-1468 (Tandem Mill) in their respective coolants.
- 3) Hot Mill Lubricants - An infrared procedure was developed for the analysis of XL-6082.
- 4) Several days (1982 October 26-28) were spent at the Tennessee Operations lab to check the operation of a recently purchased infrared spectrometer. The current method for determining the components of XL-2178 was reviewed. In addition, procedures were demonstrated for determining the constituents in XL-6082, 10/12 and Tandem mill oils (other than BHT in the latter).

B. J. SPARR

FROM P. S. BUSSEY
SAFETY & INDUSTRIAL HYGIENE DEPT.
ALCOA TECHNICAL CENTER - D

TO MR. E. E. RUMBERGER
HEALTH & SAFETY DEPARTMENT
PITTSBURGH OFFICE - 06

DATE - 9/20/83
FILED - 9/20/83
1983 September 26

1983 September 26

SEP 29 1983
SC
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LMN
EDS

RE: POTENTIAL USE OF CALCINED ASBESTOS ORE AT ADDY

This is to confirm our recent conversation on the captioned subject. To promote good communications on the industrial hygiene implications of the captioned project, attached is a copy of the 1983-09-12 Ingot Casting Division Highlights report (see Item 9).

In talking with Ken Bowman of ATC Ingot Casting, I learned that a sample of the calcined ore has been submitted to Dennis Balya, Environmental Health Lab, for analysis for toxic components.

Please let me know if there are any questions on this subject or if I can be of assistance in evaluating industrial hygiene concerns.

P.S. Bussey
P. S. BUSSEY

PSB:al

Attachment

cc: Info. Dept., ATC - D
T. B. Bonney/J. E. Sanders, Pittsburgh 6 AB
D. E. Huddleston, Pittsburgh 6 AB
R. S. Danchik/D. R. Balya, ATC - C
L. D. Tanis/J. A. Shockey, ATC - D
R. M. James, Pittsburgh 6 AB



32 33
R. A. BONEWITZ - CONFIDENTIAL
1983-September 12
Page 2

9. For controlling slag composition Northwest Alloy (Addy) has a need to add SiO_2 and MgO to the Magnetherm furnace without adding additional CaO . Union Carbide is offering to sell asbestos ore from California. Chemically this source of magnesium silicate is compatible with NWA's process but the asbestos hazard is prohibitive. Carbide is so anxious to market the material that they have agreed to consider calcining the ore at the quarry. This causes crystalline phase transformations which produce a non-hazardous material. With this issue resolved, NWA and Union Carbide are talking pricing and quantities before entering into an agreement. (K. A. Bowman & M. W. Leeper, Pgh. Procurement)
10. Small amounts of CO_2 added to the protective argon atmosphere for Al-Li alloy melts have been found to make a more desirable form of skin while also reducing the choking fumes. Carbon dioxide reacts with lithium oxide to form lithium carbonate which is molten at molten metal temperatures. This reaction was also hoped to minimize fogging of the viewing windows so that casting operators could better watch and control the cast. Unfortunately, significant quantities of poisonous carbon monoxide are found to be formed as a side reaction. This will have to be handled or the approach may be abandoned. (K. A. Bowman)

R. E. MILLER

des

cc: ID, ATC-D
D. K. Ai, ATC-C
A. Alexander, ATC-C
W. S. Cebulak/J. T. Staley, ATC-C
J. D. Dowd, ATC-C
N. L. Lawson, ATC-B
J. L. Prohaska, ATC-D
M. A. Rawlinson, ATC-C
R. Rolles, ATC-C
E. L. Rooy, Pittsburgh-23
A. J. Sartschev, WPH-3
R. E. Spear, ATC-C
L. D. Tanis, ATC-D
C. E. West, ATC-B
W. G. Zelley, ATC-A
Ingot Casting Engineers

VIRGINIA L. HAMMERSMITH
CHEMICALS AND CERAMICS DIVISION
ALCOA TECHNICAL CENTER - B

MR. ELWIN L. ROOY H&S
PITTSBURGH - Industrial Hygiene Section

COMES TO:

HINCKLE

1981 JUNE 15

BDD
EER
TBB
RMJ
BLS
PHS
BEP

JUN 22 1981

MLF
RWF
CD
PW
LMN
EDS

RE: ASBESTOS REPLACEMENT - MOLTEN METAL MARINITE

Alcoa's ongoing policy for several years now has been "to actively replace any asbestos containing material wherever possible". As we are all aware, the largest usage of such materials by Alcoa has still been with asbestos containing molten metal marinite manufactured by John's Manville at their Billerica, Massachusetts, plant. For the past few years, regular grade asbestos marinite has been no more than 5% of their total business, with the prime type, header grade molten metal marinite, no more than 2%. Certainly, it is in both John's Manville's and Alcoa's interest to remove these from their product line and, more specifically, to replace the materials with an asbestos-free type prior to any government edict.

Comparable performance of their new Marinite C (a calcium silicate, fiberglass reinforced refractory board) to the regular grade molten metal marinite is certainly welcomed by some of our ingot operations. However, it has been brought to my attention that some locations are exceedingly slow to recognize a need to change quickly and to implement the new material across the board.

OSHA maximum limitations presently are no more than 2 fibers/cc air averaged over an eight hour period without being in violation. The OSHA action level, maximum of 0.1 fiber/cc, requires that we monitor the persons exposed for physical symptoms of lung damage and disease. In the case of our plants and most exposures, the short term limit is a maximum of 10 fibers/cc air over a 15 minute period. Most countries have reduced this limit much further. How we, as a corporation, can afford this slowness of implementation is questionable.

Many people feel that OSHA, Alcoa Safety, and Alcoa Research are overly concerned and, hence, they have turned their ears and eyes away from citing violations such as the continuing use of asbestos materials when an alternative is available and to assume that "small" infractions (drilling, sanding, air hammer removal, etc.) should go unnoticed. Also, the notion is unfounded that as long as we, as a corporation, are not actively machining the material, the asbestos fibers are tied up in the matrix and pose no health hazard. Even transporting a small item of asbestos marinite can release surface fibers, especially in the lengths most often associated with future lung disease. Certainly, I and other workers do not appreciate the fact that we are all exposed unknowingly due



ALCOA

Mr. Elwin L. Rooy
1981 June 15
Page 2

to these practices. Hence, I do not feel personally that removal and proper disposal of the asbestos containing marinite, which can be replaced with a more safe material in our operations, is any longer "only a moral issue" and to be taken lightly.

Items of premium grade asbestos marinite which should temporarily be exempt due to the unsuitability of the asbestos-free grade are really limited to only a few and necessarily must be handled very cautiously:

1. Sheet Ingot Headers (Tennessee South and Warrick)
2. Hunter Caster Tips (Badin)
3. Small round HDC Headers (Badin)
4. Tool and Jig Plate Headers (Vernon)

The pursuit of our evaluations of the newer Marinite H and Pyrotek T-12 takes on increasing importance in the removal of those few items from the list also.

However, your assistance and insight as to how we, as a corporation, can more swiftly attack the implementation of the suitable asbestos-free materials at all locations would certainly benefit the program. Certainly, the seriousness of curtailing the purchase of marinite effective September 1 has not penetrated deep enough yet into operations and needs to be addressed.

Virginia L. Hammersmith
VIRGINIA L. HAMMERSMITH

VLH:dlw

cc: ID, ATC-D
T. L. Francis/File 8.140, ATC-B
Ceramic Engineers, ATC-B
K. E. Buchovecky, ATC-B
J. R. Stemler, ATC-C
R. E. Miller, ATC-B
H. Sakoian, Tennessee South
H. E. Ellis, Badin
R. L. Parsons/K. P. Karsten, Warrick
A. L. Piecka, Vernon
J. A. Thompson, Wenatchee
M. J. Caprio, Pittsburgh-19
H. G. Reavis, Pittsburgh-23

M. J. CAPRIO

M E M O R A N D U M

PROCUREMENT DEPARTMENT - 19

1981 MARCH 30

RE: JOHNS-MANVILLE'S MARINITE PRODUCTS

With the exception of the critical header applications for both HDC and FDC ingot operations, Johns-Manville's (J.M.) asbestos-free Marinite-C board should replace the asbestos Molten Metal Marinite.

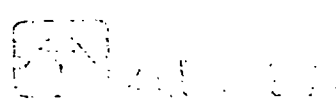
By means of this letter we are advising all plants to replace asbestos Molten Metal Marinite (S/N 094-210-xxxx) with asbestos free Marinite-C (S/N 094-218-xxxx) by 1981 September 01. The applications for Marinite-C include molten metal transfer troughs, baffles, basins, dams and floating skimmers. J-M's asbestos-free Marinite-I is not recommended for molten aluminum operations. In certain applications, an acceptable alternate for Marinite-C is Pyrotek's asbestos-free Pyrotherm B-3 manufactured by Cape Boards of England. Any questions on the acceptance of this board should be directed to Mrs. Virginia Hammersmith at ATC or the writer. If all things are equal, we favor the use of J-M's domestically produced Marinite-C.

An asbestos-free material for the critical HDC and FDC header applications has yet to be developed for commercial use. Until this product is available, we will continue to use asbestos Header Grade Molten Metal Marinite, (S/N 094-220-xxxx). To insure continued availability of the header grade material, we request your estimated usage through 1982 June 30. In this manner J-M can be advised of our needs and insure adequate supplies of the S11-65 amosite fiber. Your cooperation in forwarding the estimated usage for Header Grade Molten Metal Marinite to my attention by 1981 April 30 will be appreciated.

If there are any questions on this matter, please contact me directly.

M. J. CAPRIO

MJC:gih



DISTRIBUTION

J.D. Boyce - ATC
W.K. Benefield - Badin
T.W. Lee - Davenport
R.C. Miessler - Lafayette
H.L. Gallop - Lebanon
T.E. Klenske - Massena
D.J. Fisher - Point Comfort
J.R. Fry - Rockdale
W.S. Zuber - Tennessee
M.D. Wooden - Vancouver
J. Heron - Vernon
W.V. Pataki - Warrick
D. Lutz - Warrick
J.R. Pargman - Wenatchee

C.J. Cox - 3 WPH
A.J. Sartschev - 3 WPH
V.L. Hammersmith - ATC-B
R.W. Flanagan - AB 6

RECEIVED
MAR 31 1981
INDUSTRIAL HYGIENE

FROM MICHAEL J. VAUDREUIL
PITTSBURGH OFFICE - 6

TO MR. C. A. WHITING
PITTSBURGH OFFICE - 20



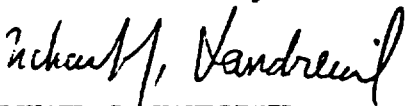
1980 September 23

RE: SUBSTITUTES FOR TRANSITE IN INGOT CONTAINERS

As per your request, I have attached some technical data and cost information on a number of asbestos-free products. Glass reinforced cement (GRC) sheet is probably closest to transite in overall performance. It's major drawback is very low interlaminar shear strength. However, since compressive strength is of greater importance than shear strength in your application, GRC sheet may prove to be a viable alternative to transite.

Marinite I and Pyrotherm B-2 have excellent high temperature resistance, but very low bending strength. Data on compressive strength is not available. Should GRC sheet prove to be unsuitable, I would recommend that you take a look at these materials.

If I can be of any further assistance, please don't hesitate to call.



MICHAEL J. VAUDREUIL

MJV:mlf

cc: M. J. Caprio, Pittsburgh Office - 19
P. H. Scott, Pittsburgh Office - 6

Attachments

COMPARATIVE DATA ON CHEMFIL GRC 125/S
& JOHNS-MANVILLE'S FLAT TRANSITE

<u>Technical Data</u>	<u>CHEMFIL GRC-125/S</u>	<u>JOHNS-MANVILLE FLAT TRANSITE</u>
Max. Service Temperature	320°C (600°F)	320°C (600°F)
Density, Kg/m ³	2000	1600
Pcf	125	100
Water Absorption % of Dry Weight	Max. 16%	Max. 22%
Modulus of Rupture, MPa	27.6	27.6
Psi	4000	4000
Compressive Strength, MPa	69.0	82.8
Psi	10,000	12,000
Shear Strength, MPa	2.4 Interlaminar	
	9.7 In-plane	24.1
Psi	350 Interlaminar	3500
	1400 In-plane	
Thermal Expansion cm/cm/K	7x10 ⁻⁶	5x10 ⁻⁶
in/in/F	12x10 ⁻⁶	8.6x10 ⁻⁶
Thermal Conductivity, W/m ² K	1	.9
Btu in/hr Ft ²	5	4.5

Cem-FIL GRC SHEET 125/

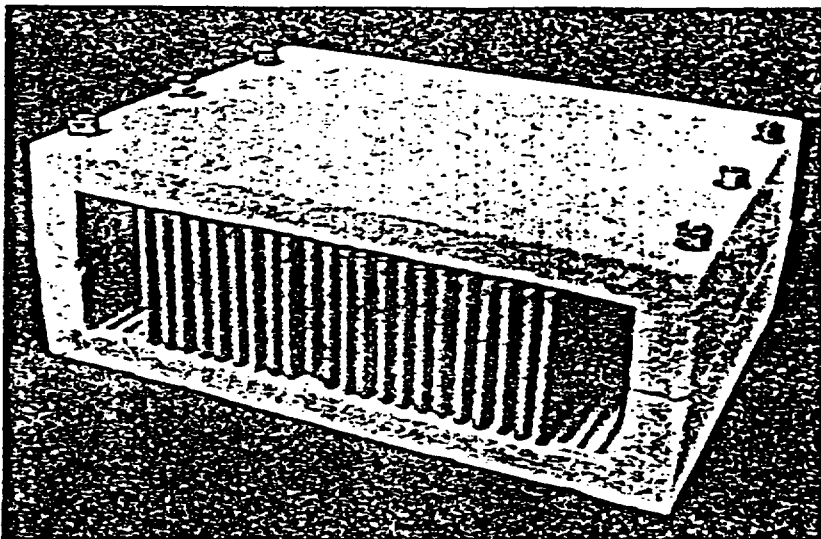
CORPORATION

GLASSFIBER REINFORCED CEMENT

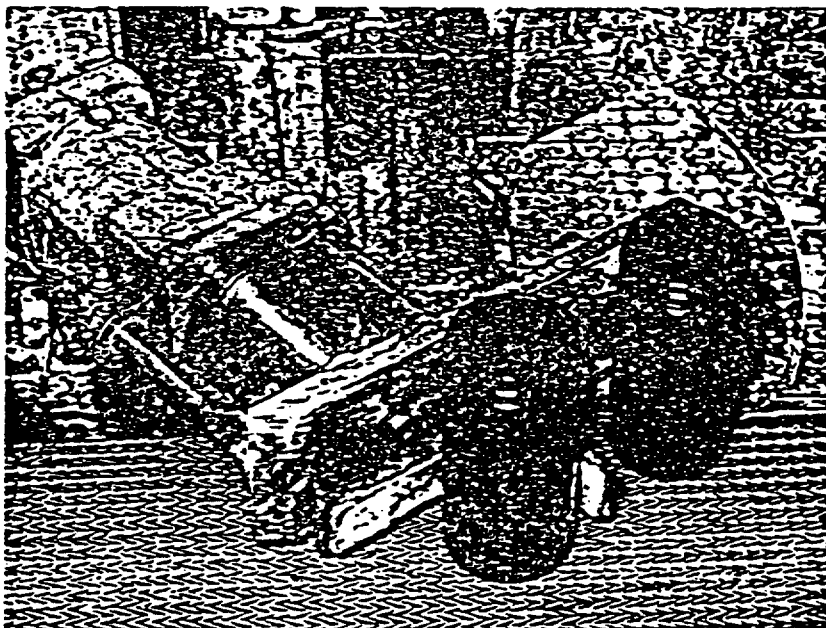
The rigidity and toughness imparted by Cem-FIL® glass fibers enable tensile and flexural strength to be designed into cement based products. GRC has already found many applications in the construction and allied industries, where it has been used as an alternative material to precast concrete, sheet metal, cast iron, wood, plastics and asbestos cement. Many existing products make use of the inherent advantages and manufacturing flexibility which, combined with the fact that GRC is non-combustible and rot, corrosion and fire resistant, make it an ideal material for many engineering applications.

The properties of GRC are influenced by factors such as fiber content and distribution, type of matrix and method of manufacture: The properties can therefore be tailored to meet the design requirements of particular components.

This data sheet gives typical property values for Cem-FIL® GRC sheet/125S which is a high density sheet material manufactured by the spray dewatering process.



Prototype arc chute box



Hot bottle pusher bar and dead plate

TECHNICAL DATA

1. Product Description

Glassfiber reinforced cement (GRC) is the generic term for the composite material which consists of a matrix of portland cement and fine aggregate reinforced with alkali resistant glass fibers. The fibers, trade name Cem-FIL® AR, are manufactured by Pilkington Brothers Limited, St. Helens, England and are marketed in the USA by Cem-FIL Corporation.

2. Manufacture

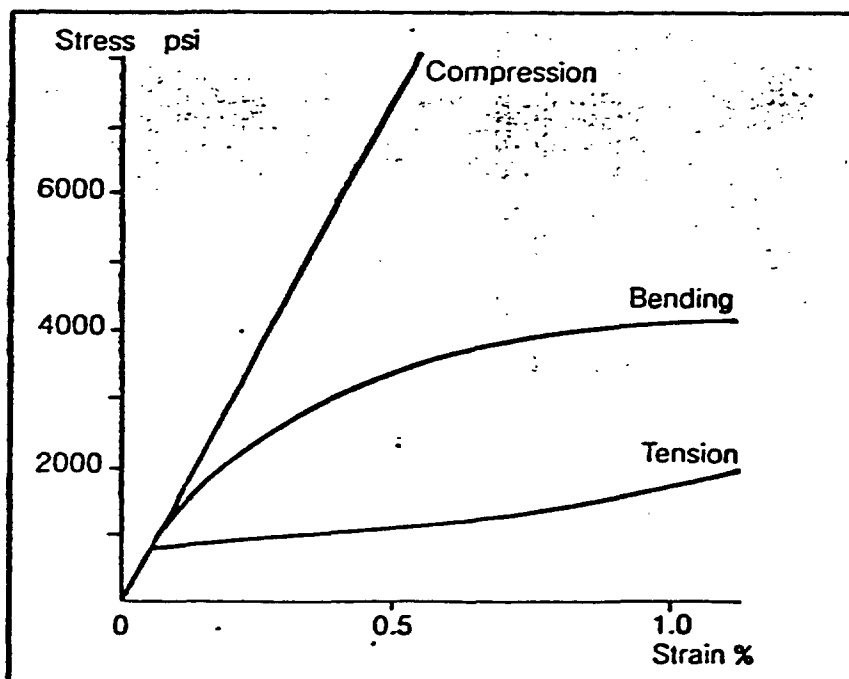
Cem-FIL® GRC Sheet/125S is manufactured by a mechanical process which involves the spray deposition of the cement/sand slurry and chopped glass fibers on to a special table through which the so formed GRC sheet can be dewatered to provide maximum density and optimum physical properties.

3. Mechanical Properties

Typical Properties at 28 days:*

70 N/mm ²	Compressive Strength	10,000 psi
15 kN/mm ²	Young's Modulus	2 x 10 ⁶ psi
24 N. mm/mm ²	Izod Impact Strength	120 in. lb/in ²
11 N/mm ²	Ultimate Tensile Strength	1600 psi
7 N/mm ²	Effective Tensile Elastic Limit	1000 psi
	Ultimate Bending Strength	
28 N/mm ²	(Modulus of Rupture in 4 point-bending)	4000 psi
12 N/mm ²	Effective Bending Elastic Limit	1700 psi
1.0%	Strain to Failure	1.0%
2 N/mm ²	Interlaminar Shear Strength	350 psi
10 N/mm ²	In-Plane Shear Strength	1400 psi
41 N/mm ²	Punch-through Shear Strength	6000 psi
2.0 tonne/m ²	Density	125 lbs/ft ³
0.20-0.25	Poisson's Ratio	0.20-0.25

* The initial mechanical properties of GRC can vary with time depending upon the working environment. In dry or hot and dry conditions there is little change. In moist or wet conditions there is some loss of tensile and impact strength over a number of years to levels which are well above the normal working range. Conditions of use should therefore be taken into consideration at the design stage, and further information and advice is available from Cem-FIL Corporation.



4. Creep and Stress Rupture

In common with other cementitious materials GRC components exhibit some creep under a maintained load. Creep strains are small (basically those associated with the matrix) and the creep strain rate decreases with time.

Stress rupture has not been noted at stress levels in the normal working range of the material. Creep and stress rupture information is available from Cem-FIL Corporation.

5. Fatigue

At the normal working stress levels fatigue lives greater than 10^6 cycles are obtained in both bending and tension.

At stress levels close to the elastic limit fatigue lives of 10^5 cycles in bending and 10^4 cycles in tension are obtained.

6. Thermal Properties

Effect of high temperatures:

GRC has been used successfully at elevated temperatures. Although the precise maximum working temperature depends on duration of exposure at elevated temperatures and the prevailing environment, 600° F. is the maximum service temperature advised for prolonged exposure in air.

Thermal Conductivity:

4.95 Btu. in/h. ft.² °F (0.7 W/m °K)

Thermal Expansion:

7×10^{-6} per °F (12×10^{-6} per °K)

Freeze/Thaw:

No visible deterioration or change in mechanical properties has been recorded for GRC tested to the following standards.

British Standard 4624 (1970)—25 cycles.

ASTM C666—25 cycles, DIN 274 (1936)-8 cycles with vacuum impregnation.

7. Effect of Moisture

Shrinkage/expansion:

Maximum linear movement in going from completely wet to completely dry is 0.14%.

Vapor permeability:

Less than 2 perms.

Moisture absorption:

Maximum 16% of dry weight.

8. Chemical Resistance

The chemical resistance of GRC is largely dependent upon the resistance of the portland cement to the particular chemical. In general GRC is least resistant to acid attack but is quite satisfactory when exposed to alkaline solution and organic solvents.

9. Fire

GRC is classified as non-combustible when tested to ASTM E136-73.

Cem-FIL GRC SHEET 125/S

CORPORATION

TECHNICAL DATA

10. Electrical

Arc Resistance (ASTM D495/73) 406 seconds
Volume Resistivity (ASTM D257/75) 1.26×10^7 ohm. inch
Dielectric Strength (ASTM D149/64) 295 volts per mil
(In all tests the samples were conditioned at 50% R. H. and 73° F)

11. Acoustical

GRC follows the mass law for sound reduction. $\frac{3}{8}$ " GRC sheet/125S has a surface mass of 4 lbs/ft² and yields a sound reduction index of 22db at 350hz rising to 39db at 4000hz.

12. Cutting and Machining

GRC can be cut and machined with tools suitable for masonry use, eg tungsten carbide tipped blades etc. As GRC is based on cement and silica sand, dry cutting or machining will create dust and dust control equipment should be used.

13. Availability

Cem-Fil® GRC sheet/125S is available in standard thicknesses from $\frac{1}{4}$ " to 4" and a standard sheet size of 97" x 49" untrimmed. Sheets trimmed to 96" x 48" can be supplied.

Approved fabricator/distributors are located throughout the country who can supply sheet cut to size and who also provide a complete range of fabrication services.

Your local distributor is:

For further information about
Cem-FIL® GRC sheet/125S and
other sheet products produced by
Cem-FIL Corporation write:-

cem-FIL
CORPORATION

120 Spence Lane
Nashville, Tennessee 37210
Telex: 55-5120
Phone: (615) 883-7563

ASBESTOS-FREE PRODUCTS

	<u>MARINITE I</u>	<u>PYROTHERM B-2</u>	<u>INSURAL</u>	<u>MOLTEN METAL MARINITE</u> contains asbestos 609
Density, Kg/m ³	736	960	1134	
pcf	46	60	70	38
MOR				
Rm Temp MPa	4.93	5.93	3.93	6.44
Psi	715	860	570	933
705°C(1300°F) MPa	3.15	3.17	--	2.21
Psi	456	460	--	320
Shrinkage, 705°C(1300°F), %	0.89	0.04	0.32	0.43
L.O.I., 705°C(1300°F), %	13.8	6.4	--	6.1
Corrosion	E	E	E	G to E
Handability (X10 ³)	$\frac{4.72}{736}$	$\frac{3.78}{960}$	$\frac{3.93}{1134}$	$\frac{6.44}{609}$
(Strength at Heat Treatment/ Density)	6.4	3.9	3.5	10.6
Price/Board Ft	\$2.48	\$5.32	\$6.00	\$3.69
				\$7.38 (header grade)

G = Good

E = Excellent

FROM JAMES E. HINES
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

TO MR. HAIG SAKOIAN
PITTSBURGH OFFICE - 7

1980-01-21

RE: ASBESTOS USE IN ALCOA INGOT PLANTS

In review there is only one application within the ingot plants where asbestos needs to be used; that is, for header applications. This is in the area of the mold where a thermal break is required to control the solidification of the metal. There are adequate replacements in Johns-Manville's Marinite I and Pyrotek, Inc.'s Pyrotherm B-2 board products, and R-680 for almost all other melting and casting needs. Asbestos-containing Molten Metal Marinite need not be used for floats, basins, troughing, dams, etc.; and therefore, plants such as Davenport, Rockdale and Tennessee North should be asbestos free.

Even in header-related areas much of the asbestos can be replaced. It has been proven that R-680 can be used for all FDC ingot 635 mm (25 in) in diameter and below. The switch to R-680 takes some time because it involves header design modification and the fabrication of molds before the R-680 ceramic headers can be made. Plants which do FDC casting (Badin, Lafayette, Massena, Vancouver and Vernon) should begin or continue ordering more R-680 headers. —> By this substitution Lafayette, Massena and Vancouver will become asbestos free.

✓ To date no adequate substitute for HDC and tool and jig headers has been found. R&D programs at ATC address this need by (1) continuing a cooperative effort with suppliers of insulating boards, (2) starting our own board development, and (3) testing R-680 in these areas. Molten Metal Marinite must still be used for all sheet ingot made at Point Comfort, Tennessee South, Warrick and Wenatchee; small HDC headers (152.4 and 177.8 mm [6 and 7 in]) at Badin and Wenatchee; and tool and jig headers at Vernon.

Hopefully, the goal for this year in the ingot plants and at ATC is to have replaced asbestos in those areas identified and to find or develop an adequate substitute for those other applications.

If there are any questions regarding substitutes, please contact Mario Caprio or myself.

James E. Hines

JAMES E. HINES

JEH:bls

cc: ID - ATC, D
M. J. Caprio - Pittsburgh 19
H. G. Reavis/E. L. Rooy - Pittsburgh 19
E. E. Rumberger - Pittsburgh 7
J. E. Jacoby/R. Bachowski - ATC, B
R. E. Miller - ATC, B
W. G. Truckner/T. Fujioka - ATC, B

R. G. LaBar/R. E. Spear/
File: 10.300 - ATC, B



ALCOA

FROM WES HARVEY
INGOT CASTING DIVISION

TO JAMES E. HINES & JOHN E. JACOBY
ALCOA TECHNICAL CENTER ~~Industrial Hygiene~~ **H&S**

1980 JANUARY 07

BDD
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W

JAN 1 1980

V F
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CCD
DB
LMN
EDS

RE: FIBERSEAL A-1 ROPE - PYROTEK INCORPORATIVE

Please refer to your letter of 1979 December 14. Vernon has been successfully using Ceramic Rope for over two years. The 6.35mm (1/4") size is used for sealing the gap between the mold and the bottom block, and the 25.4mm (1") size is used for sealing joints, for pouring troughs. Our findings confirm the good results mentioned in your recent letter.

WES HARVEY

1gg/5978

cc: D. O. Collins - Lafayette
M. J. Caprio - Pgh. 19
E. L. Roy/H. G. Reavis - Pgh. 23
W. K. Dalton - Lafayette
M. L. Redhair - Vernon
H. C. Sakoian - Pgh. 07
W. G. Truckner - ATCB
R. E. Miller/R. G. Labar/File - Alcoa Technical Center

FROM

D. O. COLLINS
METALLURGY & DEVELOPMENT
LAFAYETTE WORKS

H & S
Industrial Hygiene

J. E. HINES
J. E. JACOBY

BOD
EER
TBB
RMJ
HGS
PHS
MJV

JAN - 9 1980

MLF
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CCD
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EDS

ALCOA TECHNICAL CENTER

1980 January 2

RE: FIBERSEAL A-1 ROPE - PYROTEK, INC.

Lafayette Works ingot plant evaluated 6 mm (1/4") diameter Fiberseal rope supplied by Pyrotek, Inc., in 1979 July as part of our asbestos substitute program. The primary use of this product is to seal the gap between the mold and bottom blocks in DC and FDC tooling. Of the several substitutes received and evaluated we found this product to be the best. The one disadvantage noted was the high strength of the product which prevents breaking by hand.

We currently have two additional substitutes from NewTex Industries, Inc., and Frederickseal, Inc., on order in trial quantities. We anticipate making a final selection after evaluating these two new materials.

D. O. COLLINS

DOC:et

cc: E. L. Rooy/H. G. Reavis - Pittsburgh
M. J. Caprio - Pittsburgh
H. C. Sakoian - Pittsburgh
M. L. Redhair - Vernon
W. G. Truckner - ATC
R. E. Miller/R. G. Labar - ATC
W. K. Dalton - Lafayette



ALCOA

FROM JAMES E. HINES
JOHN E. JACOBY
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

TO MR. DARWIN O. COLLINS
LAFAYETTE WORKS

MR. WESLEY C. HARVEY H & S
VERNON WORKS Industrial Hygiene

1979-12-14

BDD
EER
TBB
RMJ
HGS
PHS
MJV
DEC 17 1979
MLF
JD
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EDS

RE: FIBERSEAL A-1 ROPE - PYROTEK, INC.

Enclosed with this letter is a piece of Fiberseal A-1 rope distributed by Pyrotek Incorporated. As you can see, the rope is flexible and has good mechanical stability. It also resists molten aluminum and can be used continuously up to 760°C (1400°F). Because of these properties, this product may replace asbestos rope in a number of applications. This rope is supplied in diameters of 6.35, 12.7, and 25.4 mm (0.25, 0.5, and 1 inch). See attachment for pricing.

One particular area where you may have interest is for sealing the gap between the mold and bottom block by placing rope in the periphery of the bottom block. Massena has found that it prevents metal leakage and is thermally stable enough to be reused numerous times in this application because molten aluminum does not attach itself to the fibers and the material does not disintegrate in water.

If you are currently using asbestos rope, this material should be a suitable substitute. Your comments concerning this rope will be appreciated.

James E. Hines
JAMES E. HINES

John E. Jacoby
JOHN E. JACOBY

JEH/JEJ:dsm

Attachments

cc: I.D. - ATC, D
M. J. Caprio - Pittsburgh 19
W. K. Dalton - Lafayette Works
M. L. Redhair - Vernon Works
E. L. Rooy/H.G. Reavis - Pittsburgh 23
H. C. Sakoian - Pittsburgh 7
W. G. Truckner - ATC,B
R. E. Miller/R. G. LaBar/File 10.322- ATC,B

SPECIFICATION SHEET ASBESTOS SUBSTITUTES

8. FIBERSEAL ROPES

<u>Type</u>	<u>Lbs/Cu.Ft.</u>	<u>Color</u>	<u>Max.^oF</u>	<u>Diameter</u>	<u>Price/Lin.Ft.</u>
A-1	49	White	1400	1/4"	\$0.40
A-1	49	White	1400	1/2"	.90
A-1	49	White	1400	1"	2.50
A-1	49	White	1400	1-1/2"	5.00
A-1	49	White	1400	2"	8.70
D-1	49	Red	2000	1/4"	0.66
D-1	49	Red	2000	1/2"	1.24
D-1	49	Red	2000	1"	3.01
D-1	49	Red	2000	1-1/2"	5.80
D-1	49	Red	2000	2"	9.44
F-10		Red	2000	1" square	6.20
S-10		Yellow	1200	1" square	5.80

9. PYROSEAL TROUGH LINING MATERIAL

Z-1	Grey	1800	50 lb. bags	\$0.48 per lb.
-----	------	------	-------------	----------------

10. COMPOSITE MATERIAL

Fiberseal Fabric H-3, Aluminum Foil plus Fiberseal Felt 1/4" M-6.
Airtight blanket to withstand high temperatures and corrosive gasses.

Price \$1.95 per square foot

Many combinations of these materials are available to fit particular requirements.

11. NOTE Sizes listed are for stocked items. Other widths, thicknesses, densities, etc., are usually available other than the stocked items.

Pyrotek
INCORPORATED

E. 9601 Montgomery Avenue • Spokane, Washington 99206 • (509) 926-6211
Box 77, RD - 1 Claremont Road • Carlisle, Penna. 17013 • (717) 249-2075

Telex 326404

H.G.SAKOIAN - PGH, 7

FROM JAMES E. HINES
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

TO MEMORANDUM

H & S
Industrial Hygiene

1979-12-13

BDD	DEC 17 1979	MLF
EER		JD.
TBB		CCD
RMJ		DB
<u>HGS</u>		<u>LMN</u>
PHS		<u>EDS</u>
MJV		

DATA LETTER

RE: GRC SHEET 62S, 125S, AND CA BOARDS - Cem-FIL CORPORATION

Summary

The subject products are cement reinforced with glass fibers. These composite materials possess such properties as high impact strength, high strength-to-weight ratios, and good heat resistance. They also can be machined with carbide tools.

Portland cement based 62S and 125S boards, although limited in temperature exposure and molten metal resistance, are suitable for replacing Transite, a structural, fire-retardant, asbestos-containing board used extensively in construction. These new materials do not contain any known health hazard.

The third product, CA board, is difficult to manufacture. But because of its promising high temperature attributes and molten metal resistance, it is recommended that Alcoa provide some assistance to Cem-FIL Corporation in solving their production problems. This material has potential as a Molten Metal Marinite substitute.

Introduction

GRC (glass-reinforced cement) is a trade name for a group of products developed by Pilkington Brothers Limited, England, and manufactured in the United States by Cem-FIL Corporation. GRC boards consist of cement, sand and glass. The principle ingredients are ordinary portland or calcium aluminate cements, silica sand and water. The matrix is mixed with alkali-resistant glass fibers to produce an inorganic composite. The products formed do not consist of a single material composition but are composed from different formulations according to the properties required. Typically, the boards consist of between 5 and 6% by weight of zirconium borosilicate glass fibers mixed into a cement/sand mortar. The resulting composite normally has a cross-section of 3-12 mm in thickness. Methods of manufacturing vary and include spraying, casting, spinning, extruding, and pressing. Each technique imparts different characteristics to the end product. Spraying, either by simple hand equipment or mechanically on a production line, is the most commonly used method.

Products GRC 62S, 125S, and CA board were received for testing. All boards were prepared by spraying. Products 62S and 125S are portland cement based, whereas CA board contains Universal Atlas'



Lumnite calcium aluminate cement. The difference between the 62S and 125S materials were their densities, 992 kg/m³ (62 pcf) and 2000 kg/m³ (125 pcf), respectively.

Experimental Procedures

Testing was limited to measuring densities, firing shrinkages, loss on ignitions, and determining molten aluminum resistance. Physical properties were performed on 25.4 X 127 X 6.35-mm (1 X 5 X 0.25-in) samples according to ASTM methods, whereas larger specimens (101.6 X 152.4 X 12.7 mm [4 X 6 X 0.5 in]) were subjected to Alcoa's Modified B-Immersion test.

Simply, the immersion experiments consisted of the following steps:

1. Weigh the sample to the nearest gram.
2. Preheat to 540°C (1000°F).
3. Immerse three-fourths of the sample length in molten 7075 alloy at 760°C (1400°F).
4. If results are warranted, repeat cycle a second time.

Results are reported as percent weight retained. A nonwetting material will have zero weight loss.

Results and Discussion

ATC test results are listed in Tables I and II. The 62S and 125S boards had relatively low shrinkages and weight losses when heating to only 260°C (500°F). However, when tested at 540°C (1000°F), large changes were noted. Firing shrinkages and loss on ignition values increased by nearly a factor of two. These results indicate their temperature limitation above 260°C (500°F). The molten metal tests were poor, primarily because the samples cracked. The molten aluminum did not adhere to the materials, but when removing them from the 540°C (1000°F) preheat, they fractured.

These limitations can be explained by the breakdown of the portland cement binder. The set cement contains hydrated calcium compounds, particularly calcium hydroxide. When heated, calcium hydroxide loses its water and becomes calcium oxide above 400-450°C (752-842°F). If this calcium oxide becomes wetted after cooling or exposed to high humidity, it rehydrates to calcium hydroxide accompanied by an expansion in volume which will disrupt the material.

Although the temperature limit is below 320°C (600°F) and the molten aluminum is poor, the excellent rigidity and toughness of these composite asbestos-free materials makes them important for many industrial construction applications. GRC 125S seems to be a direct replacement for Transite (asbestos fibers bonded with portland cement). Table III gives comparative data of the Cem-FIL

and Johns-Manville products. Note that both have a 320°C (600°F) temperature restriction. All properties are very similar except for the shear strengths. It is believed that the lower strength of 125S can be engineered so it will not be in that mode of failure during service.

The last product, CA board, has different properties from both the 62S and 125S boards. The difference is in the calcium aluminate cement. This board did not degrade with temperature as the portland cement boards. Although some shrinkage and weight loss occurred at 260°C (500°F), the board remained structurally sound at 540°C (1000°F). The decomposition of the cement hydrates C_2AH_8 and C_3AH_6 takes place below this temperature. These hydrates form CA which does not rehydrate on exposure to moisture. In the B-Immersion (Figure 3), some hairline cracks did form at the metal line but the metal adherence was minimal. The results are very promising if manufacturing problems of this board are solved by the Cem-FIL Corporation.

Safety Statement

Cem-FIL board products do not contain asbestos; however, dust is created when cutting or machining. Therefore, it is advised that dust control equipment be employed during those operations. No special precautions are required when disposing of these materials.

Conclusions and Recommendations

Although Cem-FIL GRC 62S and 125S boards are not suitable for high temperature or molten metal contact, they do have properties comparable to asbestos-containing Transite. Their only drawback is low shear strength. With proper engineering design, however, this can be resolved. Application areas where these boards should find use are architectural panels, fire resistant components, pipework, furnace shells, etc.

CA board, on the other hand, possesses good molten metal resistance, but it also has temperature stability problems and is difficult to fabricate. Because of its potential for molten metal applications, it is suggested that a cooperative effort be made between Alcoa and Cem-FIL Corporation to help solve these shortcomings.

James E. Hines

JAMES E. HINES

JEH:bls

Attachments - 9

*was this?
2/11/80*

Memorandum
1979-12-13
Page 4

cc: ID - ATC, D
G. L. Baker - Pittsburgh 3 WPH
M. J. Caprio - Pittsburgh 19
C. J. Cox - Pittsburgh 3 WPH
C. F. Hartley, Jr. - Pittsburgh 3 WPH
R. C. Holtz - Pittsburgh 3 WPH
W. A. Keith - Pittsburgh 3 WPH
J. W. McIntee - Pittsburgh 3 WPH
E. L. Rooy/H. G. Reavis - Pittsburgh 23
E. E. Rumberger - Pittsburgh 7
H. G. Sakoian - Pittsburgh 7
A. J. Sartschev - Pittsburgh 3 WPH
D. L. Schaffer - Pittsburgh 23
AL Division/Department Managers
R. E. Miller/V. L. Hammersmith - ATC, B
M. B. Thomas/D. J. St. Jacques - ATC, C
H. A. Traenkner - ATC, D
D. J. Wainer - ATC, D
R. G. LaBar/R. E. Spear/File: 10.322 - ATC, B
J. E. Jacoby/R. J. Ormesher/R. Bachowski - ATC, B

TABLE I

PROPERTIES OF Cem-FIL CORPORATION'S GRC 62S, 125S AND CA BOARDS

	<u>62S</u>	<u>125S</u>	<u>CA</u>
Color	Gray	Gray	Brown
Density, kg/m ³	992	2000	2240
pcf	62	125	140
Firing Shrinkage, %			
After 110°C (230°F)	0.03	0.19	0.07
260°C (500°F)	0.02	0.40	0.21
540°C (1000°F)	0.40	1.00	0.22
Loss on Ignition, %			
After 110°C (230°F)	9.10	4.95	1.40
260°C (500°F)	9.70	7.20	8.98
540°C (1000°F)	16.60	12.00	11.25

JE Hines
1979-12-13

TABLE II

MODIFIED B-IMMERSION TESTS ON
Cem-FIL CORPORATION'S GRC 62S, 125S AND CA BOARDS

62SWeight Before

-

Weight After

2 Cycles

-

% Weight

Retained

-

Physical Appearance:

Sample cracked upon cycling between 540°C (1000°F) and room temperature.

125SWeight Before

746.6 g

Weight After

2 Cycles

645.3 g

% Weight

Retained

64.3 g

Physical Appearance:

No metal penetration occurred, cracking was also severe below metal line.

CAWeight Before

362.3 g

Weight After

2 Cycles

303.6 g

% Weight

Retained

83.8 g

Physical Appearance:

After cooling to room temperature, most of the metal skull could be removed. Sample below metal line looked excellent, but has many hairline cracks at and above metal line.

TABLE III

COMPARATIVE DATA ON
Cem-FIL'S GRC 125S AND JOHNS-MANVILLE'S FLAT TRANSITE

<u>Technical Data</u>	<u>Cem-FIL GRC 125S</u>	<u>Johns-Manville Flat Transite</u>
Max. Service Temp.	320°C (600°F)	320°C (600°F)
Density, kg/m ³	2000	1600
pcf	125	100
Water Absorption % of Dry Weight	Max. 16%	Max. 22%
Modulus of Rupture, MPa	27.6	27.6
psi	4000	4000
Compressive Strength, MPa	69.0	82.8
psi	10,000	12,000
Shear Strength, MPa	2.4 interlaminar 9.7 in-plane	24.1
psi	350 interlaminar 1400 in-plane	3500
Thermal Expansion, cm/cm/K	12 X 10 ⁻⁶	8.6 X 10 ⁻⁶
in/in/°F	7 X 10 ⁻⁶	5 X 10 ⁻⁶
Thermal Conductivity, W/m·K	1	9
Btu·in/h·ft ²	5	4.5

JE Hines
1979-12-13

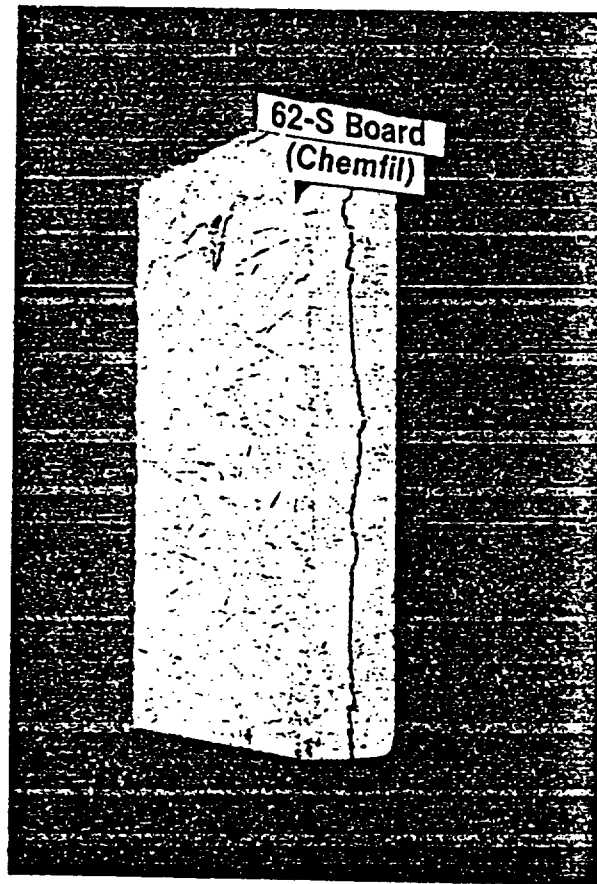


FIGURE 1.

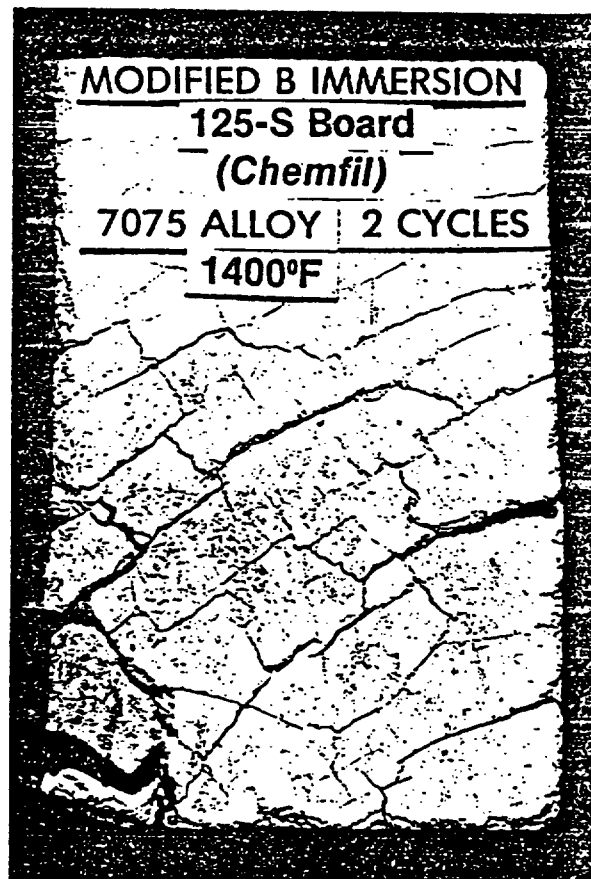


FIGURE 2.

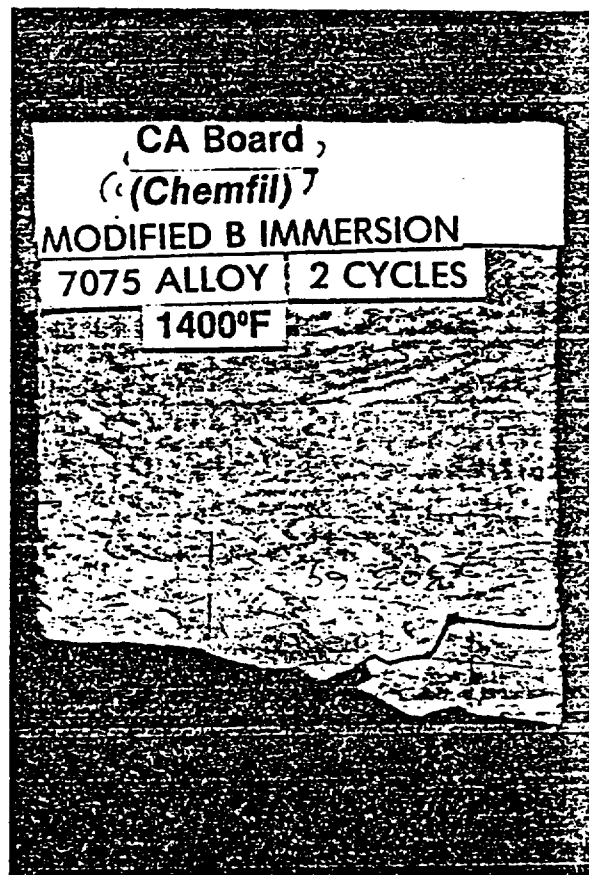


FIGURE 3.

cem-FIL GRC SHEET 125/S

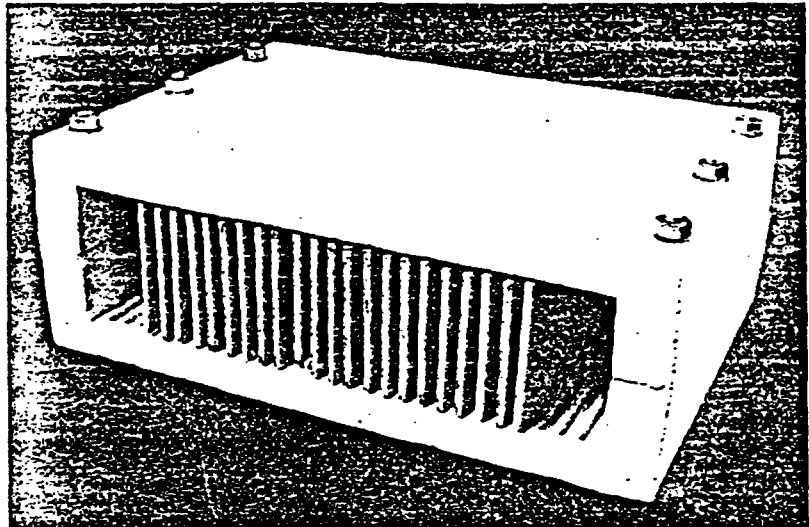
CORPORATION

GLASS FIBER REINFORCED CEMENT

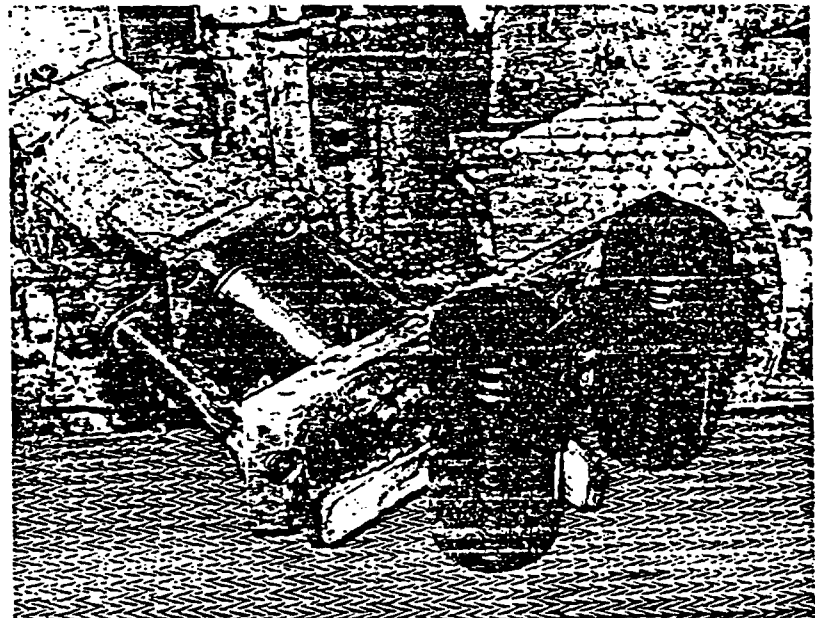
The rigidity and toughness imparted by Cem-FIL[®] glass fibers enable tensile and flexural strength to be designed into cement based products. GRC has already found many applications in the construction and allied industries, where it has been used as an alternative material to precast concrete, sheet metal, cast iron, wood, plastics and asbestos cement. Many existing products make use of the inherent advantages and manufacturing flexibility which, combined with the fact that GRC is non-combustible and rot, corrosion and fire resistant, make it an ideal material for many engineering applications.

The properties of GRC are influenced by factors such as fiber content and distribution, type of matrix and method of manufacture: The properties can therefore be tailored to meet the design requirements of particular components.

This data sheet gives typical property values for Cem-FIL[®] GRC sheet/125S which is a high density sheet material manufactured by the spray dewatering process.



Prototype arc chute box



Hot bottle pusher bar and dead plate

TECHNICAL DATA

1. Product Description

Glassfiber reinforced cement (GRC) is the generic term for the composite material which consists of a matrix of portland cement and fine aggregate reinforced with alkali resistant glass fibers. The fibers, trade name Cem-FIL® AR, are manufactured by Pilkington Brothers Limited, St. Helens, England and are marketed in the USA by Cem-FIL Corporation.

2. Manufacture

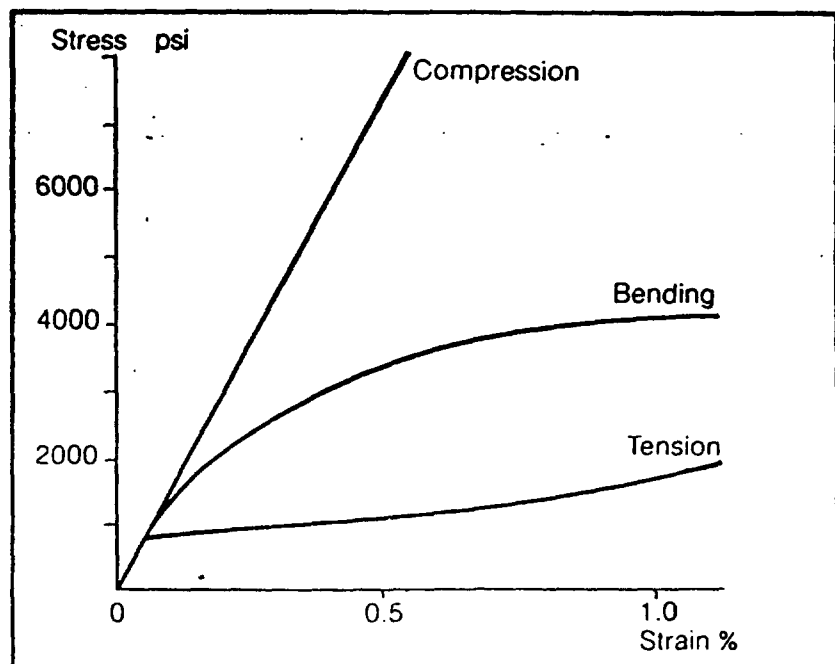
Cem-FIL® GRC Sheet/125S is manufactured by a mechanical process which involves the spray deposition of the cement/sand slurry and chopped glass fibers on to a special table through which the so formed GRC sheet can be dewatered to provide maximum density and optimum physical properties.

3. Mechanical Properties

Typical Properties at 28 days:*

70 N/mm ²	Compressive Strength	10,000 psi
15 kN/mm ²	Young's Modulus	2 x 10 ⁴ psi
24 N. mm/mm ²	Izod Impact Strength	120 in. lb/in ²
11 N/mm ²	Ultimate Tensile Strength	1600 psi
7 N/mm ²	Effective Tensile Elastic Limit	1000 psi
	Ultimate Bending Strength	
28 N/mm ²	(Modulus of Rupture in 4 point-bending)	4000 psi
12 N/mm ²	Effective Bending Elastic Limit	1700 psi
1.0%	Strain to Failure	1.0%
2 N/mm ²	Interlaminar Shear Strength	350 psi
10 N/mm ²	In-Plane Shear Strength	1400 psi
41 N/mm ²	Punch-through Shear Strength	6000 psi
2.0 tonne/m ³	Density	125 lbs/ft ³
0.20-0.25	Poisson's Ratio	0.20-0.25

* The initial mechanical properties of GRC can vary with time depending upon the working environment. In dry or hot and dry conditions there is little change. In moist or wet conditions there is some loss of tensile and impact strength over a number of years to levels which are well above the normal working range. Conditions of use should therefore be taken into consideration at the design stage, and further information and advice is available from Cem-FIL Corporation.



Cem-FIL GRC SHEET 125/S

CORPORATION

4. Creep and Stress Rupture

In common with other cementitious materials GRC components exhibit some creep under a maintained load. Creep strains are small (basically those associated with the matrix) and the creep strain rate decreases with time.

Stress rupture has not been noted at stress levels in the normal working range of the material. Creep and stress rupture information is available from Cem-FIL Corporation.

5. Fatigue

At the normal working stress levels fatigue lives greater than 10^6 cycles are obtained in both bending and tension.

At stress levels close to the elastic limit fatigue lives of 10^5 cycles in bending and 10^4 cycles in tension are obtained.

6. Thermal Properties

Effect of high temperatures:

GRC has been used successfully at elevated temperatures. Although the precise maximum working temperature depends on duration of exposure at elevated temperatures and the prevailing environment, 600° F. is the maximum service temperature advised for prolonged exposure in air.

Thermal Conductivity: 4.95

20 Btu. in/h. ft.² °F (1.0 W/m °K)

Thermal Expansion:

7×10^{-6} per °F (12×10^{-6} per °K)

Freeze/Thaw:

No visible deterioration or change in mechanical properties has been recorded for GRC tested to the following standards.

British Standard 4624 (1970)—25 cycles,
ASTM C666—25 cycles, DIN 274 (1936)-8 cycles
with vacuum impregnation.

7. Effect of Moisture

Shrinkage/expansion:

Maximum linear movement in going from completely wet to completely dry is 0.14%.

Vapor permeability:

Less than 2 perms.

Moisture absorption:

Maximum 16% of dry weight.

8. Chemical Resistance

The chemical resistance of GRC is largely dependent upon the resistance of the portland cement to the particular chemical. In general GRC is least resistant to acid attack but is quite satisfactory when exposed to alkaline solution and organic solvents.

9. Fire

GRC is classified as non-combustible when tested to ASTM E136-73.

Cem-FIL CORPORATION GRC SHEET 125/S

TECHNICAL DATA

10. Electrical

Arc Resistance (ASTM D495/73)
Volume Resistivity (ASTM D257/75)
Dielectric Strength (ASTM D149/64)

406 seconds
 1.26×10^7 ohm. inch
295 volts per mil

(In all tests the samples were conditioned at 50% R. H. and 73° F)

11. Acoustical

GRC follows the mass law for sound reduction. $\frac{3}{8}$ " GRC sheet/125S has a surface mass of 4 lbs/ft² and yields a sound reduction index of 22db at 350hz rising to 39db at 4000hz.

12. Cutting and Machining

GRC can be cut and machined with tools suitable for masonry use, eg tungsten carbide tipped blades etc. As GRC is based on cement and silica sand, dry cutting or machining will create dust and dust control equipment should be used.

13. Availability

Cem-FIL® GRC sheet/125S is available in standard thicknesses $\frac{1}{8}$ ", $\frac{1}{4}$ ", $\frac{3}{8}$ ", and $\frac{1}{2}$ " and a standard sheet size of 96 $\frac{1}{2}$ " x 49 $\frac{1}{2}$ ". Thickness tolerance is $\pm 10\%$.

Certain other thicknesses can be supplied to special order.

Approved fabricator/distributors are located throughout the country who can supply sheet cut to size and who also provide a complete range of fabrication services.

For further information about
Cem-FIL® GRC sheet/125S and
other sheet products produced by
Cem-FIL Corporation write:

Cem-FIL

CORPORATION

120 Spence Lane
Nashville, Tennessee 37210
Telex: 55-5120
Phone: (615) 883-7563



120 Spence Lane • Nashville, Tennessee 37210 • Phone (615)883-7563 • Telex 55-5120

Effective Date: March 1, 1979

PRICE LIST FOR Cem-FIL GRC SHEET/125S

Thickness Inches	Price Per Sheet		No. of Sheets Per full Pallet Load
	Full Pallet Load*	Less Than Full Pallet Load	
1/8	\$ 22.07	\$ 30.90	70
1/4	38.40	53.76	35
3/8	49.60	69.44	23
1/2	59.52	83.33	18
5/8	74.65	104.38	14
3/4	86.40	120.96	12
1	115.52	161.73	9
1 1/4	153.88	215.43	7
1 1/2	178.32	249.65	6
1 3/4	205.62	287.87	5
2	234.30	328.02	5
2 1/2	296.39	414.95	4
3	323.39	452.75	3
3 1/2	398.00	557.20	2
4	434.16	607.82	2

Full pallet loads weigh approximately 3,000 lbs.

Truck load (12 pallets) prices are available on request.

* The prices above apply to full pallet loads of one thickness. Prices for mixed thickness pallets are available on request.

Availability

Orders can be supplied direct or from one of the approved fabricator/distributors who are located throughout the USA. Fabricators/distributors also supply sheet cut to size and fabricated sheet. A list of the approved fabricator/distributors is available from Cem-FIL Corporation.

Terms

Net 30 days
FOB Nashville, Freight Collect

Product Description

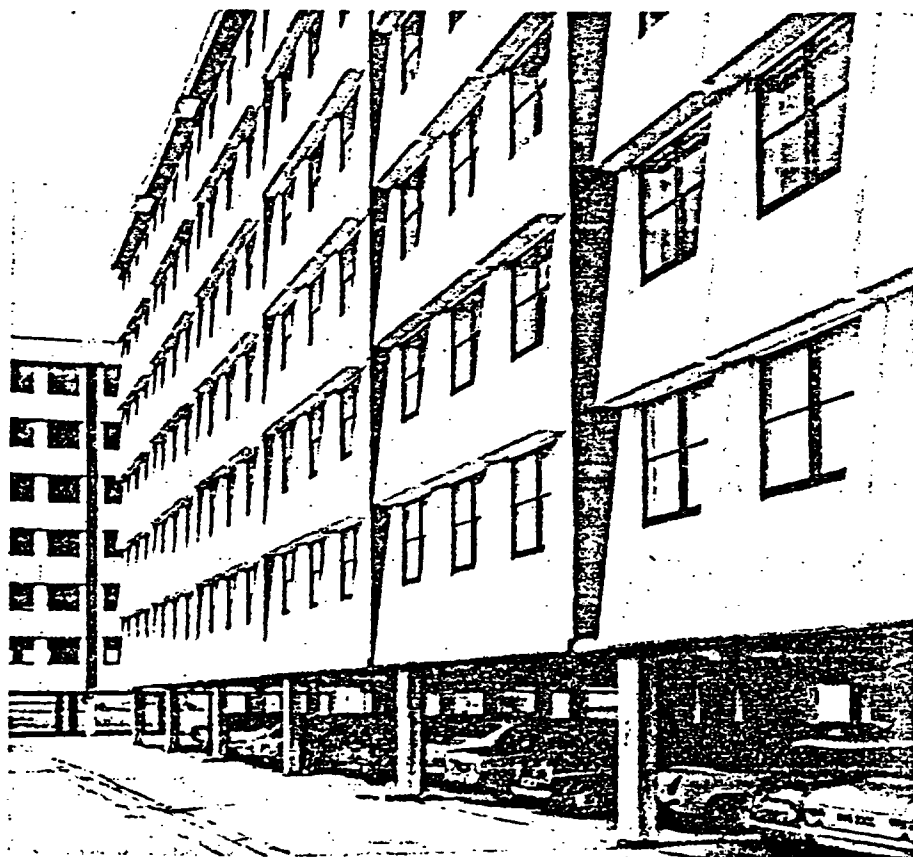
Cem-FIL GRC Sheet/125S is a composite material of portland cement and limestone fines reinforced with Cem-FIL[®] AR glassfibers.

All sheets are 97" X 49" untrimmed.

7.5/Cem

Cem-FIL®
CORPORATION

GRC ARCHITECTURAL PANELS

P. P. PRODUCTS PRESENTATION**GRC CURTAIN WALL AND SPANDRELS**

GRC curtain wall panels can be used almost anywhere pre-cast concrete curtain wall is used but the $\frac{1}{4}$ to $\frac{1}{2}$ lighter weight offers possible structural savings and potential performance benefits in seismic areas. The lighter weight can facilitate installation of the panels with attendant cost savings.

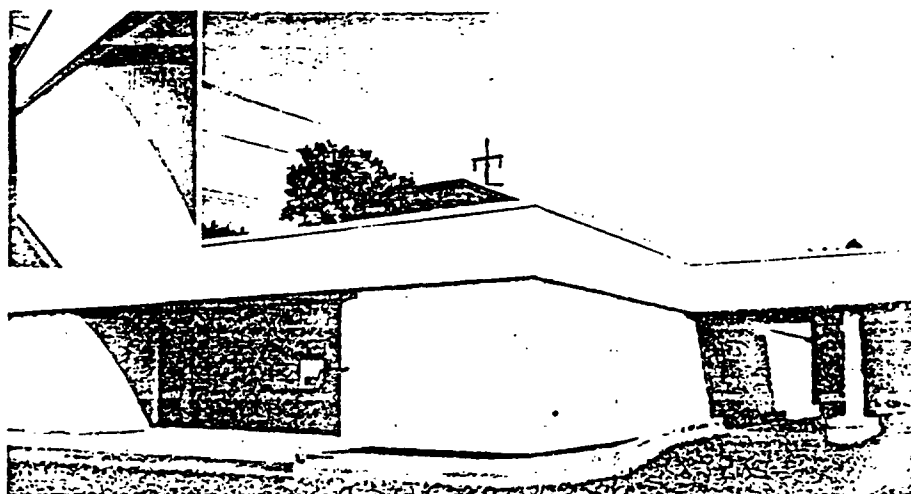
Fiberglass insulation can be built into the back of the panel providing U values up to .05 but without adding to overall panel thickness and thereby saving floor space. Panels can be pre-insulated in the factory.

GRC can often be used to advantage in sun screen spandrels. The deep profiles necessary in these panels can be achieved without weight penalty and they can be installed without the substantial internal steel support generally required.

GRC COMPLETE WALL

When panel design is integrated with design of the building structure, insulation and internal finish requirement, GRC wall panels can offer cost savings over block or brick construction. GRC wall systems will also take up less floor space than blockwork and panels can be designed to hang outside the floor slab. U values up to .05 can be provided without adding to wall thickness.

Only very light structural frames are required.



Architect: Taylor and Crabtree

Cem-FIL[®]

CORPORATION GRC ARCHITECTURAL PANELS

T. S. TECHNICAL SUPPORT

Much of the data is based on British Standard tests of which we can provide copies. A program of tests is in process to establish appropriate ASTM and other U.S. Standards.

Moisture Absorption

Moisture absorption varies according to the density of GRC but will normally be in the range of 12%-16%.

Moisture Permeability

Laboratory tests have shown that no signs of moisture would appear on the inside of a GRC sheet $\frac{3}{8}$ " (10mm) thick with rain blown onto it by a 75 mph wind.

Water Vapor Permeance

Less than 2 perms.

Moisture-Induced Movement

The extent of any dimensional change depends upon the particular GRC formulation and conditions of exposure. Typically, with 25% sand content, laboratory experiments indicate that the maximum linear movement for material going from completely wet to completely dry would be 0.14 per cent. Under most climatic conditions, the maximum expected movement will be around 0.06 per cent.

Thermal Expansion

Coefficient of thermal expansion is 7×10^{-6} per °F. (12×10^{-6} per °K.)

Thermal Conductivity

7.0 Btu. in/hft² deg. F. (1.0 w/m °K.)

Freeze/Thaw

No adverse effects were seen after 25 cycles of 12 hours immersion

TYPICAL 28 DAY PROPERTIES OF Cem-FIL GRC

Flexural Properties		
Limit of Proportionality	1000-1600 psi	(7-11 N/mm ²)
Modulus of Rupture	3000-4600 psi	(21-32 N/mm ²)
Compressive Strength	7200-11,400 psi	(50-80 N/mm ²)
Impact Strength	57-143 in-lb/in ²	(10-25 Nmm/mm ²)
Density	105-130 lb/ft ³	(1.7-2.1 tonne/m ³)
Youngs Modulus	1.5-3 x 10 ⁶ psi	(10-20 KN/mm ²)

MANUFACTURING SPECIFICATIONS

Dimensional Tolerances	Units less than 10 Ft. $\pm \frac{1}{8}$ " Units less than 20 Ft. $+\frac{1}{8}$ " - $\frac{3}{16}$ "
Openings Within One Unit	$\pm \frac{1}{8}$ "
Thickness of Unit	$-\frac{1}{8}$ " + $\frac{1}{8}$ "
Squareness (difference in diagonal lengths)	$\frac{1}{8}$ " per 6' or $\frac{1}{4}$ " whichever is greater
Insert and Accessory Positions	Within $\frac{1}{8}$ " of centerline as shown on drawings
Bowing (after installation)	L/360-Factors relating to bowing including site storage, fastening techniques, and particular finishes.

Specific panel designs & fastening systems often require additional specifications. Contact Cem-FIL Corporation for details.

in water at 60°F. (20°C) and 12 hours at -4°F. (-20°C) (test done in accordance with the Frost Cracking Test to British Standard 4036:1966 for asbestos cement).

Creep

GRC is quite capable of bearing load over prolonged periods and creep behavior is similar to that of other cement and concrete materials.

In general creep strains are smaller than expansion/contraction strains due to moisture. Complete creep and fatigue data is available from Cem-FIL Corporation.

Fire

GRC contains no organic material and when tested in accordance with ASTM E136, GRC has been determined

to be non-combustible.

Panels with up to 4 hours fire rating can be designed where required.

Finishes, Textures

Any type of finish successful with concrete will be acceptable on Cem-FIL GRC architectural panels. Textures available include light texture, such as light sandblast, light vertical shadow tones, etc.; medium textures such as $\frac{1}{4}$ " deep vertical grooves, medium sandblast; and heavy textures such as deep ribs, heavy sandblast simulation, and exposed aggregate. Even a combination of textures, or panels with smooth areas plus exposed aggregate accent areas, can be supplied.

Fasteners

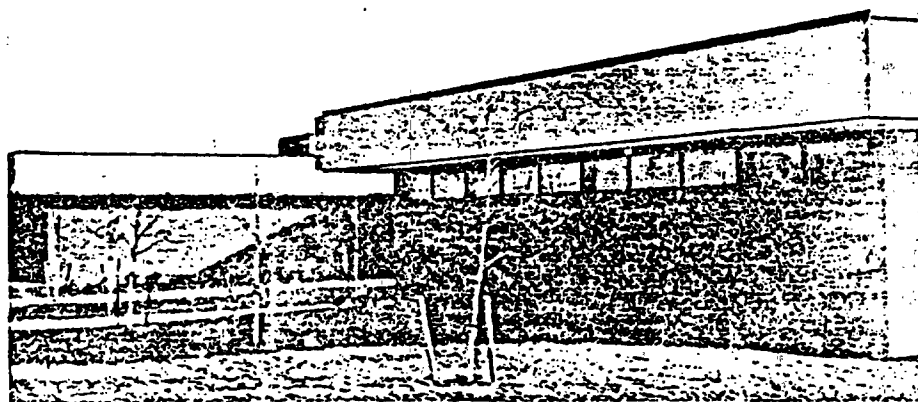
Cem-FIL Corporation always designs and supplies fasteners required for installation of the panels.

Building Codes

Cem-FIL GRC panels are recommended for acceptance by BOCA under Research Report No. 76-60.

Warranty

For many GRC panel designs, Cem-FIL Corporation can provide a replacement warranty against structural failure for a period of up to 10 years for panels it manufactures.



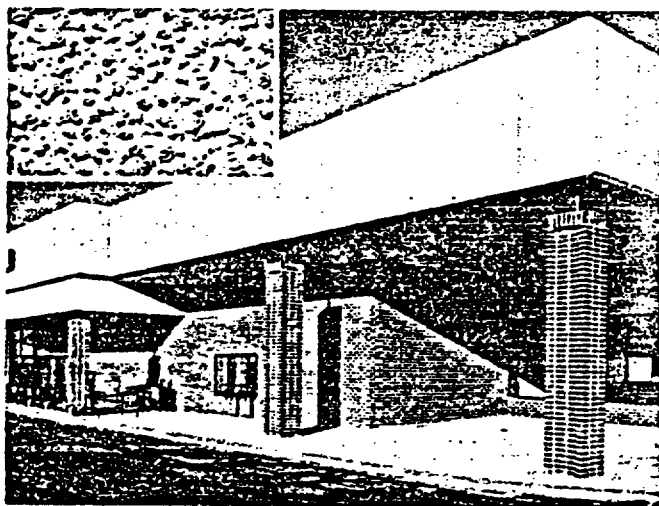
Architect: Nes, Campbell & Associates

Cem-FIL®
CORPORATION

GRC ARCHITECTURAL PANELS

P. P. PRODUCTS PRESENTATION

GRC FASCIA PANELS

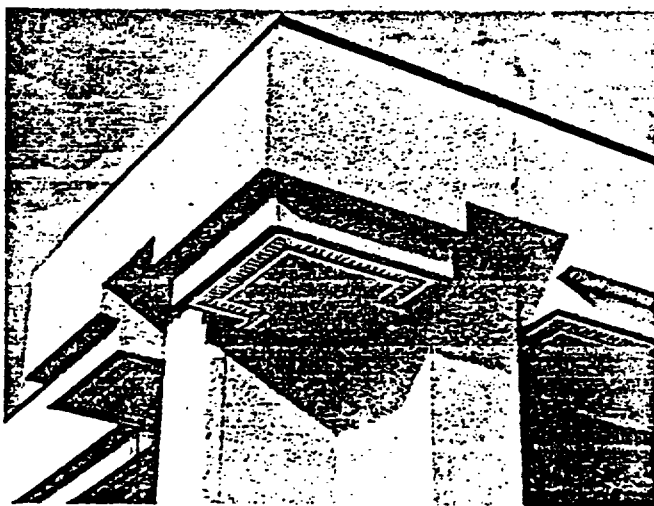


The massive look of concrete without the weight of concrete. Average weight 9 lbs./sq. ft.

Architect: Coupard & Associates

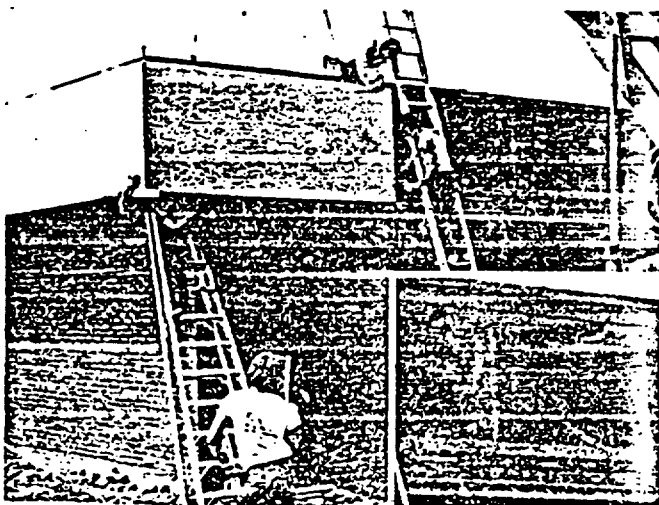
Can be custom molded into a wide variety of shapes and finishes.

Architect: Warren, Knight & Davis



A light metal stud frame, or even wood, will carry the weight. Average weight 12 lbs./sq. ft.

Architect: Nes, Campbell & Associates



WHY USE Cem-FIL GRC ARCHITECTURAL PANELS

1. Lightweight compared with concrete.
2. Will not burn or give off smoke or fumes.
3. Superior resistance to water and vapor penetration than most masonry materials and wood.
4. Less surface porosity than most masonry materials.
5. No embedded metal that can cause rust staining.
6. No plastic resinous materials to yellow.
7. Custom-molding provides integral corners and returns which facilitates complete weatherproofing.
8. All fastening hidden without patching, etc.
9. Custom-molding provides versatility in shape, size and finish.

Costs:

Prices always include:

- 1) Panel and fastener design.
- 2) Shop drawings.
- 3) Delivery of panels and fasteners to job site.

Typically prices will range from \$3.50 to \$7.50 per sq. ft.

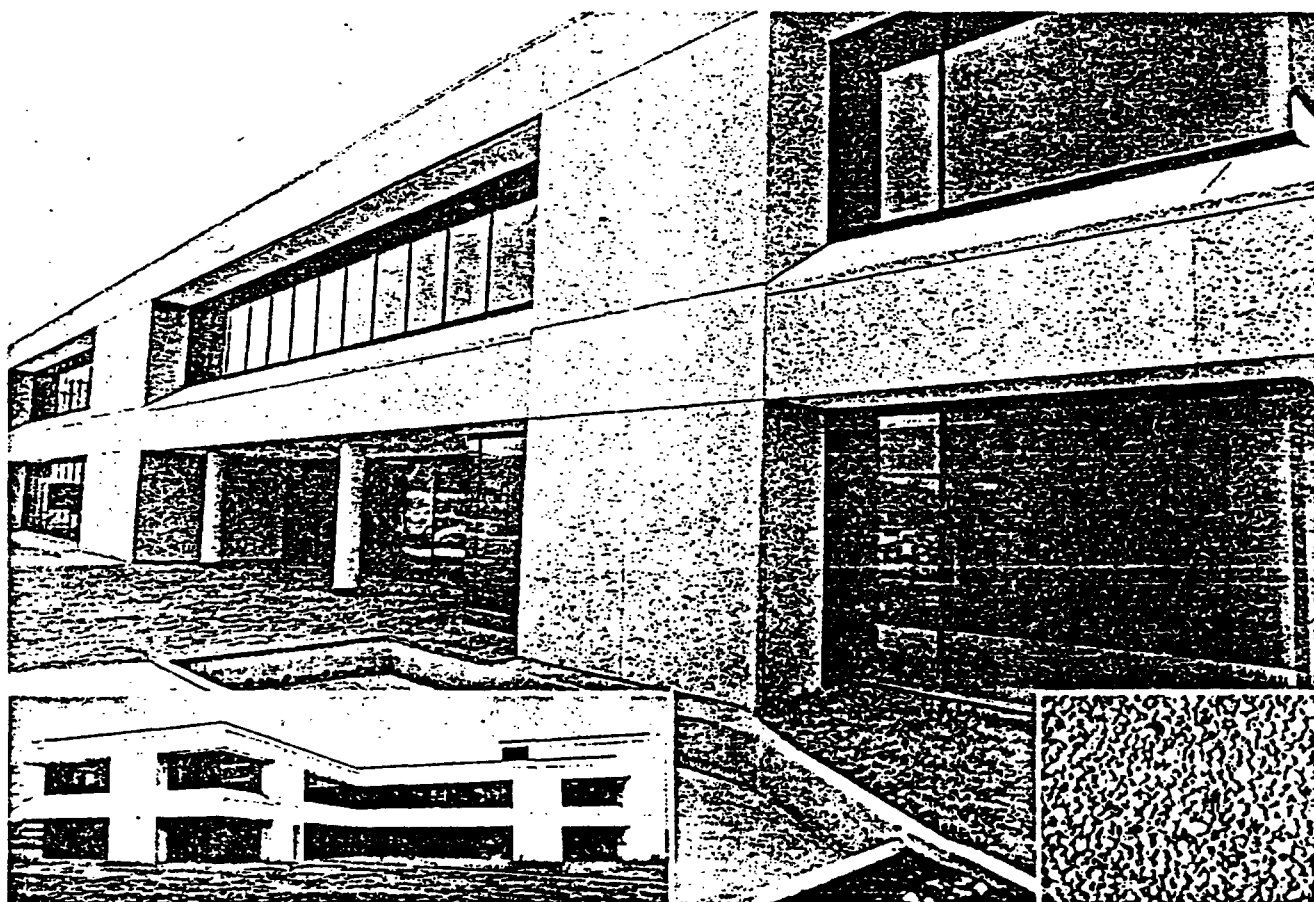
cem-FIL®
CORPORATION

GRC CUSTOM-MOLDED ARCHITECTURAL PANELS

7.5/Cem



Cem-FIL Corporation 9/78 7p COMPOSITE BUILDING PANELS



Project: Nashville House, Metro Center,
Nashville, Tennessee
Finish: Exposed aggregate

Panel Specification: Nominal $\frac{3}{8}$ " thickness
single skin with ribs and 4" returns.
Architect: Hart, Krivatsy and Stube

Cem-FIL Corporation 9/78 7p COMPOSITE BUILDING PANELS

GLASSFIBER REINFORCED CONCRETE

GRC is a composite material consisting of a mix of cement and fine aggregate reinforced with Cem-FIL AR glass fibers.

It is totally inorganic so it will not burn or produce noxious gases or smoke and it provides the performance and durability associated with cement and concrete but at $\frac{1}{4}$ to $\frac{1}{8}$ the weight of concrete.

Cem-FIL Corporation is a jointly owned company of Pilkington Brothers Ltd. — a multinational glass manufac-

turer and developer of the "float glass process" and Cem-FIL AR glass, and Ferro Corporation — a multinational manufacturer of specialty chemicals and coatings.

The GRC panels are produced in our custom-built factory in Nashville, Tennessee, for distribution throughout the U.S.

Cem-FIL GRC architectural panels are custom designed and molded for each project. All panel design and fastening details are provided by Cem-FIL Corporation.

cem-FIL®
CORPORATION

120 Spence Lane • Nashville, Tennessee 37210 • Phone (615) 883-7563 • Telex 55-5120

FROM JAMES E. HINES
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

TO MR. HAIG G. SAKOIAN
PITTSBURGH 7

H & S
Industrial Hygiene

1979-12-07

BDD
EER
TBB
RMJ
HGS
PHS
MJV
DEC 10 1979
MLF
JD
CCD
DB
LMN
EDS

RE: ASBESTOS SUBSTITUTES - INGOT CASTING SEMINAR

I appreciated your participation in the Asbestos Replacement portion of the Ingot Casting Seminar. The metallurgists in attendance are now better informed about existing safety programs throughout the company. Attached for your reference are the overlays that I used during my presentation on asbestos-free boards.

James E. Hines

JAMES E. HINES

JEH:pm

Attachments

cc: ID - ATC, D
E. E. Rumberger - Pittsburgh 7
R. E. Miller/R. G. LaBar/File 10.320



PROPERTY REQUIREMENTS

- NOT WETTED BY MOLTEN ALUMINUM
- "SKULL" EASILY REMOVED
- NO METAL CONTAMINATION
- READILY MACHINED AND FABRICATED
- HOLDS METALS AT UNIFORM TEMPERATURE
- NO PREHEATING REQUIRED
- MAINTAINS STRENGTH AT HIGH TEMPERATURES
- RESISTANT TO LUBRICATING OILS

ASBESTOS-FREE REFRACTORY BOARD PRODUCTS

MARINITE I

PYROTHERM B-2

INSURAL

MARINITE C

GRC PRODUCTS

MARINITE I**— THERMAL AND PHYSICAL PROPERTIES**

Physical Properties: Bulk Density = 736 kg/m^3 (46 pcf)

Properties After Firing To:	M.O.R.		Shrinkage	Weight
	MPa	(psi)	%	Loss %
590°C (1100°F)	4.52	(655)	0.35	2.9
650°C (1200°F)	3.54	(513)	0.37	3.2
705°C (1300°F)	3.15	(456)	0.54	4.3
815°C (1500°F)	4.43	(643)	3.9	5.3
290°C (550°F)	4.72	(685)	0.35	10.5

Modified "B" Immersion: Excellent

PYROTHERM B-1

THERMAL AND PHYSICAL PROPERTIES

Physical Properties: Bulk Density = 960 kg/m^3 (60 pcf)

Properties After Firing To:		M.O.R.		Shrinkage	Weight
		MPa	(psi)	%	Loss %
590°C	(1100°F)	2.48	(360)	0.02	2.9
650°C	(1200°F)	—		0.02	3.5
705°C	(1300°F)	2.97	(430)	0.00	4.1
815°C	(1500°F)	0.83	(120)	0.00	5.5
551°C	(1025°F)	3.78	(548)	0.53	12.1

Modified "B" Immersion: Excellent

ASBESTOS-FREE PRODUCTS

	<u>MARINITE I</u>	<u>PYROTHERM B-2</u>	<u>INSURAL</u>	<u>MOLTEN METAL MARINITE</u>
Density, Kg/m ³	736	960	1134	609
pcf	46	60	70	38
MOR				
Rm Temp MPa	4.93	5.93	3.93	6.44
Psi	715	860	570	933
705°C(1300°F) MPa	3.15	3.17	--	2.21
Psi	456	460	--	320
Shrinkage, 705°C(1300°F), %	0.89	0.04	0.32	0.43
L.O.I., 705°C(1300°F), %	13.8	6.4	--	6.1
Corrosion	E	E	E	G to E
Handability (X10 ³)	$\frac{4.72}{736}$	$\frac{3.78}{960}$	$\frac{3.93}{1134}$	$\frac{6.44}{609}$
(Strength at Heat Treatment/ Density)	6.4	3.9	3.5	10.6
Price/Board Ft	\$2.48	\$5.32	\$6.00	\$3.69
				\$7.38 (header grade)

G = Good

E = Excellent

EVALUATION LOCATIONS

MARINITE I - ATC

VERNON

WENATCHEE

LAFAYETTE

DAVENPORT

MASSENA

TENNESSEE

WARRICK

PYROTHERM B-2 - ATC

ROCKDALE

BADIN

DAVENPORT

WENATCHEE

MASSENA

WARRICK

TENNESSEE

COMPARATIVE DATA ON CHEMFIL GRC 125/S
& JOHNS-MANVILLE'S FLAT TRANSITE

<u>Technical Data</u>	<u>CHEMFIL GRC-125/S</u>	<u>JOHNS-MANVILLE FLAT TRANSITE</u>
Max. Service Temperature	320°C (600°F)	320°C (600°F)
Density, Kg/m ³	2000	1600
Pcf	125	100
Water Absorption % of Dry Weight	Max. 16%	Max. 22%
Modulus of Rupture, MPa	27.6	27.6
Psi	4000	4000
Compressive Strength, MPa	69.0	82.8
Psi	10,000	12,000
Shear Strength, MPa	2.4 Interlaminar	
	9.7 In-plane	24.1
Psi	350 Interlaminar	3500
	1400 In-plane	
Thermal Expansion cm/cm/K	7x10 ⁻⁶	5x10 ⁻⁶
in/in/F	12x10 ⁻⁶	8.6x10 ⁻⁶
Thermal Conductivity, W/m ⁰ K	1	.9
Btu in/hr Ft ²	5	4.5

H. G. Sakoian - Pittsburgh 7

FROM JAMES E. HINES
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

TO MEMORANDUM

H & S
Industrial Hygiene

1979-11-08

DATA LETTER

BOD
EER
TBB
RMJ
HGS
PHS
MJV

NOV 12 1979

MLF
JD
CCD
DB
LMN
EDS

RE: ASBESTOS-FREE MOLTEN ALUMINUM BACKUP INSULATIONS

Summary

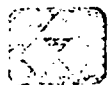
As part of Pittsburgh Mechanical Engineering Division-Furnace Section's and AL Ingot Casting Division's program to better design and construct furnaces and metal transfer equipment, a study was made to find acceptable asbestos-free insulating backup materials to refractories in contact with molten aluminum. Since each application must be considered individually as to the proper amount and type of insulation, this report points out the advantages and limitations of nine commercially available products.

Introduction

Refractory insulating materials offer significant advantages in the construction and operation of furnaces and refractory-lined vessels. Proper selection and application of insulation result in important savings of fuel, time, space and weight. In addition, insulation helps maintain close temperature control and contributes to more comfortable working conditions for operators.

Savings of fuel is one of the most important reasons for insulating. Heat flows through a wall or roof from an inner hot face to the outer cold face where it is dissipated and lost by radiation and convection. The amount of heat lost often constitutes a considerable portion of the total heat input required to maintain the desired operating temperature. Such losses would be greatly minimized by building the walls partly or entirely out of high-temperature insulation, either as backing to denser refractories, or when conditions permit, as an inner lining exposed directly to furnace atmospheres.

When desirable, the use of insulation also allows economy of space, weight and time. If used in place of part of an existing dense refractory wall insulation, it may permit thinner walls and the weight of the refractory structure could be significantly reduced. This would permit both a lighter foundation and a lighter furnace superstructure. At a given rate of heat input with available burner capacity, the time required to bring a cold refractory unit to operating temperature depends on the heating capacity of the refractory lining and upon the heat penetrating it. Through the use of insulation, the heat storage capacity is substantially reduced and the time required to bring the unit to temperature could be considerably decreased.



ALCOA

Copy to H. G. Sakoian on 12/8/79

SF-4503

When selecting high-temperature insulation, many factors must be considered. One determining factor when insulation is used as a backing for a more refractory lining material is the interface temperature. The insulation obviously must be chosen such that it is refractory enough at the interface to withstand the temperature. In addition, one must consider thermal conductivity, weight, and heat capacity of the working refractory as well as destructive factors such as duration of heating, nature of fuel, refractory expansion and growth, and for lower walls, molten metal attack. When choosing an insulation for a melting or holding furnace which operates semicontinuously, high heat storage in the refractories is a definite benefit because of its cushioning effect against excessive fluctuations in temperature. The best construction for these furnaces is with composite walls and roof, consisting of dense refractories backed with compressible insulation. With a high furnace temperature and a high degree insulation, however, the mean temperature may become higher than that which the refractory can withstand. Hence, adding insulation may result in needing a material with higher refractoriness and requiring redesign to reduce deformation. Therefore, heat savings and other benefits of insulation must be carefully balanced against the possible increased costs associated with more rapid refractory degradation or in upgrading the working lining to high quality refractories. If this type of problem is approached in a systematic manner through computerized calculations and selection of proper materials, a refractory system can be designed which will give optimum heat savings and service life.

Insulation Materials

Listed below are the asbestos-free insulations materials examined and a brief description of each:

Eagle-Picher PV Supertemp block is composed of mineral wool fibers with specially prepared inorganic binders which has been one of Alcoa's recommended backup insulations for years. Temperature limit is 1040°C (1900°F).

Keene Mono-Block, also a mineral wool insulation, has fibers which have been specially interlocked to form a lightweight and rigid, yet resilient block. Temperature like PV Supertemp is 1040°C (1900°F).

Keene Delta-T is a felted, spun ceramic clay fibers bonded with inorganic binders. Temperature limitation is higher than mineral wool at 1260°C (2300°F).

Rim Products 410-03, a ceramic fiber product, is made by bonding alumina-silica fibers with high purity alumina. Temperature rating is 1300°C (2372°F). This insulation was reported to be nonwetting to molten metal, making this insulation particularly attractive.

International Vermiculite IV-19 block insulation is manufactured from vermiculite granules and high-temperature bonding inorganics; like the mineral wool insulations, it is good to 1037°C (1900°F).

International Vermiculite IV-20 block insulation is asbestos-free as are all of these other insulations. IV-20 consists of diatomaceous silica with a hydraulic binder for service to 1093°C (2000°F).

Johns-Manville Superex products have been used in combination with Eagle-Picher's PV Supertemp for reverberatory furnaces. A combination of silica, lime, clay and fibers make up these products.

Superex 2000, a high-density, low-calcium oxide content block, was designed for low shrinkage and top performance up to 1100°C (2000°F).

Superex 1600, on the other hand, has a high-calcium oxide content and lower density than Superex 2000. This formulation gives better strength and insulating properties for situations where temperatures do not exceed 870°C (1600°F).

Skamol Skamolex PM-10 (formerly Skamolex GX 1000) is also a white calcium-silicate material. This product is distributed by Dolomite Brick Corp. in the United States but manufactured in Denmark.

See attached manufacturer sheets for more details.

In Table I are the chemical analysis and X-ray diffraction data collected for the nine products studied. The purest material is the Rim 410-03 which contains the highest alumina content and is essentially all amorphous. Three insulations--PV Supertemp, Mono-Block, and Delta-T--are montmorillonite (CaMgSiO_4) based. Delta-T has the lowest impurities, whereas Fe_2O_3 , MgO and alkali are high for both PV Supertemp and Mono-Block. IV-19, as characterized as X-ray diffraction, is largely comprised of talc and silica. IV-20, on the other hand, is identified as a diatomaceous earth composition which has silica and calcite. Cristobalite and alpha quartz forms of silica make up Superex 2000. Superex 1600 and Skamolex PM-10 both are calcium-silicate hydrates.

Evaluation and Test Procedure

Outside of the compressibility testing, all physical property data were determined using ASTM methods. Bulk Density, linear change, and loss on ignition were all examined. Compression tests were accomplished with a Dillon dynamometer. Square samples measuring 50.8 mm (2 inches) were aligned in the Dillon machine and compressed initially to 90% of its original height. (Fibrous materials were positioned so their fibers were perpendicular to the pressing

direction.) The load was then recorded. Compression measurements were continued for every 10% deformation up to a reduction of 40%. Any fracture or unusual behavior was noted.

Corrosion resistance to molten aluminum was determined by Alcoa's modified B-Immersion test. Simply, this test consists of preheating the sample to 540°C (1000°F), then immersing three-fourths of its length into 7075 alloy at 760°C (1400°F) for 24 hours. After being cleaned, the percent sample weight retained is recorded. If possible and results are warranted, a second cycle is performed. Again, percent sample weight retained is determined.

Results

Please refer to Table II for physical property data. Maximum recommended service temperatures are recorded first. As seen, the higher the temperature the fewer materials are available. The major drop-off points were at 875°C (1603°F), 980°C (1800°F), and 1320°C (2400°F). Rim 410-03 had the highest rating at 1300°C (2372°F); Delta-T followed at 1275°C (2300°F). All the other insulations are suggested for less than 1000°C (1832°F), except Superex 1600 which is only rated at 870°C (1600°F).

Other properties which determine allowable exposure temperatures include linear firing shrinkages and loss on ignition. For these measurements, 2.5 X 2.5 X 15-cm (1 X 1 X 6-in.) samples were exposed to temperatures of 540°C (1000°F) and 1100°C (2000°F) after which they were measured and weighed. Photographs of some of the specimens after exposure are given in Figures 1-8. At 540°C (1000°F) only slight dimensional changes were apparent, but loss on ignitions were high for IV-19, Superex 2000, and Skamolox PM-10. (Loss on ignition measurements give an indication of the weight of chemically bonded water and organic materials.) Therefore, these three materials show structural hydrate changes even at this low temperature. At a temperature of 1100°C (2000°F), very few insulations retain their structural integrity. Only Rim 410-03 and Delta-T materials remain relatively unaffected.

Crushing strengths were performed up to a deformation percentage of 60%. For most backup insulations the material should be rigid enough to install but have a crushing strength to meet refractory expansion without overstressing and deforming the furnace outside shell. Eagle-Pichers's PV Supertemp has been the preferred material in melting and holding furnace construction. It compresses steadily up to 50% before its strength suddenly doubles. At no time during the testing did the sample fracture. Other insulations (Mono-Block, Delta-T, and Rim 410-03) behaved similarly. Rim 410-03, although exhibiting an initial lower strength, more closely resembles the compressibility of PV Supertemp than any other insulation. IV-19, IV-20, and Skamolox PM-10 all fractured at

approximately 34.5 MPa (5,000 psi). The Superex products, although not showing a brittle fracture, had exceedingly high strengths up to 345.0 MPa (50,000 psi) after only 40% compression, the highest of all insulations.

The apparent thermal conductivity of mass insulations is a combination of the following heat transfer mechanisms: thermal conductivity of air, thermal conductivity of the solid components of the insulating structure, the convective heat transfer within the pore structure, the radiation heat transfer within the structure, and the interactions of these mechanisms. The thermal conductivity term itself refers to an intrinsic property of a homogeneous material, but because of these many heat transfer mechanisms it is subject to much theoretical questioning when referring to insulations. For comparison purposes however, the manufacturer's thermal data are given. As shown, the thermal conductivities of all the insulations evaluated are nearly the same. The greatest difference is between IV-20 and PV Supertemp, 0.13 W/m·K (0.89 Btu·in/h·ft²·°F) compared to 0.10 W/m·K (0.69 Btu·in/h·ft²·°F), respectively. In this regard, the choice of which insulation to use will be dependent upon other factors discussed.

In many circumstances, molten aluminum may come in contact with the insulation. Molten metal may penetrate to the insulation through lower wall refractories which crack during installation, dryout or other reasons. To evaluate those conditions, the modified B-Immersion test was used. Results are found in Table III and Figures 1-8. Although all the insulations showed good to excellent to molten aluminum resistance as indicated by the high weight retention, the mineral wool products, PV Supertemp and Mono-Block, did shrink and bowed excessively upon metal contact. In actual service conditions, this type of behavior may leave gaps in the lining allowing further metal penetration. For fibrous products, Rim 410-03 and Delta-T, metal resistance was good; both materials remained intact even though some penetration was seen in the Delta-T. The other materials (IV-19, IV-20, Superex 2000, Superex 1600, and Skamolex PM-10) performed excellently; the metal skull retained could be easily removed.

Safety Statement

Although these materials do not contain asbestos, some are composed of free crystalline silica (see Table I for analyses). It is the uncombined silicon dioxide (SiO₂) in these insulations which may lead to lung disease. Of primary concern is silicosis, a noncancerous disease of the lungs. Silicates, although consisting of silicon and oxygen, combined with other elements in a complex molecules. With the exception of asbestos and some talcs, silicate dusts should not ordinarily cause disabling lung conditions such as produced by free silica. It is uncombined or free silica

however that is most important in industrial dust exposure. To detect an exposure properly, the percentage of uncombined silica must be determined by petrographic analysis, preferably by X-ray diffraction or infrared techniques.

It is generally stated that the size of the offending dust particles is of extreme importance in determining the concentration of particles that may be suspended in the air. The size of particles also determines the depth to which these particles penetrate into the lung along with the quantity that may become deposited and retained. Particulates less than 10 microns in size are potentially the most harmful. Generally, when airborne particles are larger than 10 microns, they are not of concern because they are unable to penetrate into the lung where they could be damaging. Instead they are removed and collected by the nasal passages or upper respiratory system.

Also, it has been generally stated that the duration of dust inhalation is of extreme importance. Persons who for many years have continuously inhaled free silica dust have a great likelihood of contracting a silica-related disease. Those who only intermittently inhale the dust have less risk of injury. In addition, those persons who smoke will increase the risk which otherwise exists.

It is important to be aware that exposure to silica dust can occur during the installation of some of these products that contain free silica as well as during tear-out and repair of facilities where these products were previously installed. It is recommended that personnel working with these insulations wear respirator and eye protection, and that the area be properly ventilated. Periodic safety monitoring of the free silica should be scheduled also.

Conclusions

1. Major insulation materials in the high temperature range are (listed in ascending order of temperature resistance):
 - a. Mineral Fiber, 540 to 1040°C (1000 to 1900°F)--PV Supertemp and Mono-Block.
 - b. Calcium Silicate and Silica, 870 to 1100°C (1600 to 2000°F)--IV-19, IV-20, Superex 2000, Superex 1600, and Skamolex PM-10.
 - c. Ceramic Fibers Based on the $Al_2O_3-SiO_2$ Systems, 1100 to 1260°C (2000 to 2300°F)--Delta-T and Rim 410-03.
2. High compression strengths were found for IV-19, IV-20, Superex 2000, Superex 1600, and Skamolex PM-10, whereas fibrous materials (PV Supertemp, Mono-Block, Delta-T, and

Rim 410-03) show the least resistance to deformation or high compressibility.

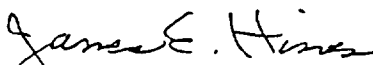
3. Thermal conductivity values did not vary significantly between the insulation types examined.
4. Although exhibiting nonwettability, mineral wool insulations (PV Supertemp and Mono-Block) do shrink excessively in contact with molten aluminum. Other products (calcium silicate, silica or ceramic fiber materials) all have good-to-excellent resistance.
5. Products IV-19, IV-20, Superex 2000, Superex 1600, and Skamolex PM-10 have been identified as containing free crystalline silica. Largest contents were found in Superex 2000, IV-20 and IV-19.

Recommendations

Again, each application must be considered individually when recommending insulation. One must consider the thermal conditions imposed by service along with each particular insulation's qualities of mechanical strength, chemical compatibility, weight, compactness, heat flow resistance, and so forth. In many cases it must be recognized that local availability and delivery will at times necessitate the use of a product in a specific class.

For ingot melting and holding furnaces, one of the most important developments by Pittsburgh Mechanical Engineering in the past year was the development of a computer program to investigate temperature profiles. On the basis of a computer study and this present work, lower furnace walls are now being backed up with 50.8 cm (2 in.) of Rim 410-03 or Delta-T insulation in place of 50.8 cm of PV Supertemp and 50.8 cm of Superex 2000. This design has established a more realistic metal freeze plane with insulations that are both compressible and molten metal resistant. This construction should prevent frequency of furnace bleedouts and conserve energy. Other ingot applications such as troughing, filter units, etc., are being reviewed, and better materials and designs are being plant tried. With proper design and material selection, improved service life and more comfortable working conditions should be realized.

Finally, in handling some of these products studied, particularly Superex 2000 and IV-20, special precautions must be taken to minimize dusting. Without adequate ventilation and respirators, a safety problem does exist.


JAMES E. HINES

Memorandum
1979-11-08
Page 8

JEH:bls

Attachments - 18

cc: ID - ATC, D
G. L. Baker - Pittsburgh 3 WPH
M. J. Caprio - Pittsburgh 3 WPH
C. J. Cox - Pittsburgh 3 WPH
C. F. Hartley - Pittsburgh 3 WPH
R. C. Holtz - Pittsburgh 3 WPH
W. A. Keith - Pittsburgh 3 WPH
A. J. Magnussen - Pittsburgh 3 WPH
J. W. McIntee - Pittsburgh 3 WPH
E. L. Rooy/H. G. Reavis - Pittsburgh 23
H. G. Sakoian - Pittsburgh 7
A. J. Sartschev - Pittsburgh 3 WPH
D. L. Schaffer - Pittsburgh 23
L. D. Tannis - Davenport Wks.
J. Damiano - ATC, C
M. B. Thomas/D. J. St. Jacques, Jr. - ATC, C
M. B. Dell - ATC, C
R. K. Dawless/F. N. Smith - AL, NK-44
S. K. Das/P. A. Fyala/A. L. LaCamera - AL, NK-44
M. J. McMonigle - AL, NK-44
R. E. Miller/V. L. Hammersmith - ATC, B
R. G. LaBar/R. E. Spear/File: 10.160 - ATC, B

TABLE I
ANALYSES OF ASBESTOS-FREE INSULATIONS — MANUFACTURER'S DATA

Manufacturer and Product	Chemical Analyses, %								X-ray Diffraction Analyses
	Al ₂ O ₃	SiO ₂	CaO	Fe ₂ O ₃	TiO ₂	MgO	ZnO	Alkalies	
Eagle-Picher PV Supertemp	13-17	39-43	23-27	10-14	--	4-8	2-4	Lge montmorillonite; Sml unidentified.	
Keene Mono-Block	10	50	17	9		5	1.4	1.5 Montmorillonite.	
Keene Delta-T	44.5	51.4	1.3	1.2	1.2	0.4	-	V Lge montmorillonite; V Sml alpha quartz.	
Rim Products 410-03	54	46						Amorphous.	
International Vermiculite IV-19	9.2	54.4	11.5	5.4	--	13.2	4.6	Lge Mg ₃ Si ₄ O ₁₀ (OH) ₂ (talc); Sml SiO ₂ (cristobalite); Trace α-SiO ₂ (alpha quartz).	
International Vermiculite IV-20	3.9	79.0	6.8	1.3	--	3.8	--	Med SiO ₂ (cristobalite); Sml CaCO ₃ (calcite); V Sml α-SiO ₂ (alpha quartz); Trace unidentified; Balance amorphous.	
Johns-Manville Suparex 2000	4.3	74.8	6.0	2.0	0.3	0.8	2.7	Med SiO ₂ (cristobalite); Sml α-SiO ₂ (alpha quartz); V Sml unknown; Balance amorphous.	
Johns-Manville Suparex 1600	1.2	49.6	37.6	0.3	Trace	0.2	--	Lge Ca ₅ (OH) ₂ Si ₆ O ₆ ·4H ₂ O (tobermorite); Sml α-SiO ₂ (alpha quartz).	
Skamol Skamolox PH-10	1.4	47.2	48.3	0.6				Lge Ca ₆ Si ₆ O ₁₇ (OH) ₂ ; V Sml α-SiO ₂ (alpha quartz).	

incorrect
no α-SiO₂

TABLE II

Eagle-Piel
PV Supert.

Price/board ft.	\$0.50
Max Recommended Service Temp, °C	1037
°F	1900
Bulk Density, kg/m ³	256-288
, pcf	16-18
Compressive Strength, MPa (psi)	
After 10% deformation	0.07 (
20%	0.09 (
30%	0.10 (
40%	0.14 (
50%	0.20 (
60%	0.44 (

Linear Change, %

After:

540°C (1000°F)	-0.30
1100°C (2000°F)	-4.2

L.O.I., %

After:

540°C (1000°F)	-3.6
1100°C (2000°F)	-2.5

*Thermal Conductivity, W/m·K
(Btu·in/h/ft²/°F)

100°C (200°F)	0.04 (
210°C (400°F)	0.06 (
320°C (600°F)	0.07 (
430°C (800°F)	0.09 (

PROPERTIES OF ASBESTOS-FREE INSULATIONS

Character	Keene		Keene		Rim Products		International Vermiculite		International Vermiculite		Johns-Manville		Johns-Manville		Skamol	
	Mono-Block		Delta-T		410-03		IV-19		IV-20		Superex 2000		Superex 1600		Skamol PX-10	
	\$0.55		\$2.90		\$3.80		\$1.04		\$1.19		\$0.76		\$0.72		\$0.96	
1037			1275		1300		1037		1093		1100		870		1000	
1900			2300		2372		1900		2000		2000		1600		1832	
192			288		256-288		328		392		384		224		250	
12			18		16-18		20.5		24.5		24		14		156	
(1512)	0.07	(1512)	0.05	(1098)	0.03	(720)	1.01	(21 060)	1.25	(25 999)	0.95	(19 800)	2.12	(44 100)	0.87	(17 900)
(1836)	0.12	(2448)	0.11	(2378)	0.05	(1080)			0.80	(16 714)	1.30	(27 000)	1.86	(38 700)	0.75	(15 400)
(2160)	0.21	(4284)	0.18	(3842)	0.09	(1764)			0.76	(15 725)	1.81	(37 800)	1.94	(40 500)		
(2880)	0.31	(6516)	0.27	(5671)	0.12	(2520)					2.59	(54 000)	2.42	(50 400)		
(4248)	0.53	(11 124)	0.38	(7866)	0.20	(4104)					4.58	(95 400)	3.59	(74 700)		
(9108)	1.11	(23 040)	1.04	(21 585)	0.49	(10 296)					8.21	(171 000)	5.62	(117 000)		
-0.30			-0.10		-0.01		-0.50		-0.30		-0.2		-0.4		-0.3	
-3.9			-2.3		-1.2		-5.8		-2.7		-2.8		-4.3		-2.0	
-1.5			-1.7		-0.64		-8.0		-3.4		-5.4		-6.2		-7.0	
-2.6			-2.4		-2.6		-11.6		-6.1		-8.9		-11.8		-12.0	
0.05	(0.36)	(0.36)	0.06	(0.43)	0.04	(0.26)	0.08	(0.56)	0.08	(0.57)	0.08	(0.58)	0.07	(0.46)	0.06	(0.45)
0.06	(0.42)	(0.42)	0.08	(0.52)	0.05	(0.36)	0.09	(0.64)	0.09	(0.65)	0.09	(0.62)	0.07	(0.48)	0.07	(0.45)
0.07	(0.51)	(0.51)	0.09	(0.60)	0.07	(0.46)	0.10	(0.72)	0.10	(0.70)	0.09	(0.65)	0.08	(0.55)	0.09	(0.65)
0.09	(0.62)	(0.62)	0.11	(0.74)	0.08	(0.57)	0.12	(0.80)	0.11	(0.77)	0.10	(0.70)	0.10	(0.68)	0.10	(0.70)
0.11	(0.75)	(0.75)	0.13	(0.84)	0.10	(0.67)	0.13	(0.88)	0.13	(0.89)	0.12	(0.80)	0.13	(0.87)	0.12	(0.80)

TABLE III
MOLTEN ALUMINUM CORROSION RESISTANT INSULATIONS

Material and Manufacturer	Weight % Retained	Rating	Comments
PV Supertemp Eagle-Picher	87.5	Very Poor	Sample badly shrunk below metal line, little penetration.
Mono-Block Keene	93.1	Very Poor	Metal easily removed but sample shrunk and bowed out of shape.
Delta-T Keene	92.0	Good	Metal penetrated into sample from traces to 1/8".
410-03 Rim Products	91.4	Good to Excellent	Metal skull easily removed, however some fibers do pull loose.
IV-19 International Vermiculite	90.1	Excellent	Metal easily removed.
IV-20 International Vermiculite	94.0	Excellent	Metal very easy to remove.
Superex 2000 Johns-Manville	87.6	Excellent	No visible penetration.
Superex 1600* Johns-Manville	86.3	Excellent	No visible penetration.
Skamolex PM-10* Skamol	87.2	Excellent	No visible penetration.

*Photos not shown due to fragile nature.

EAGLE PICHER
J. P. AUSTIN

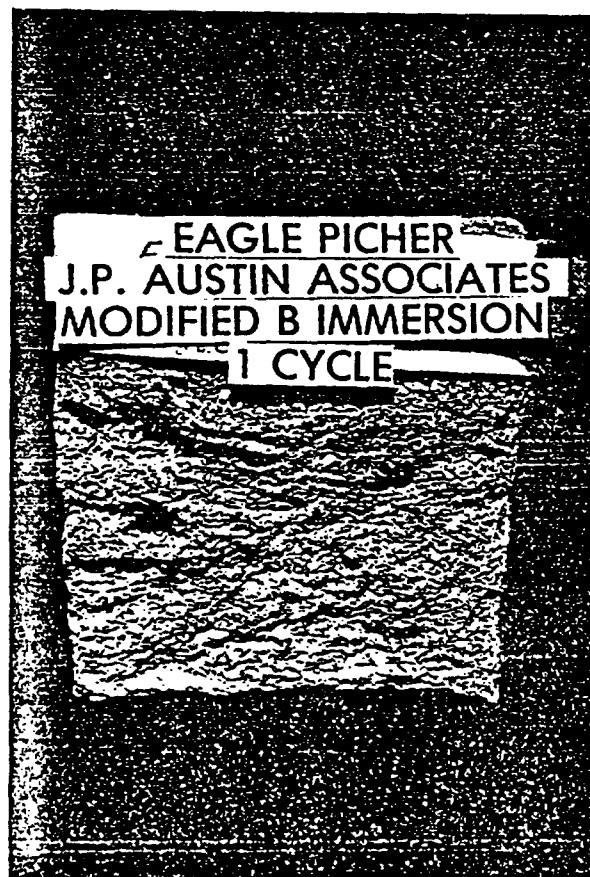
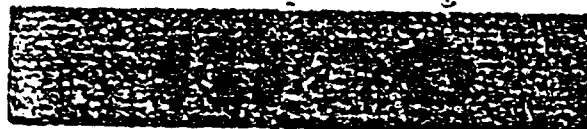


FIGURE 1

MONO - BLOCK
KEENE CORPORATION

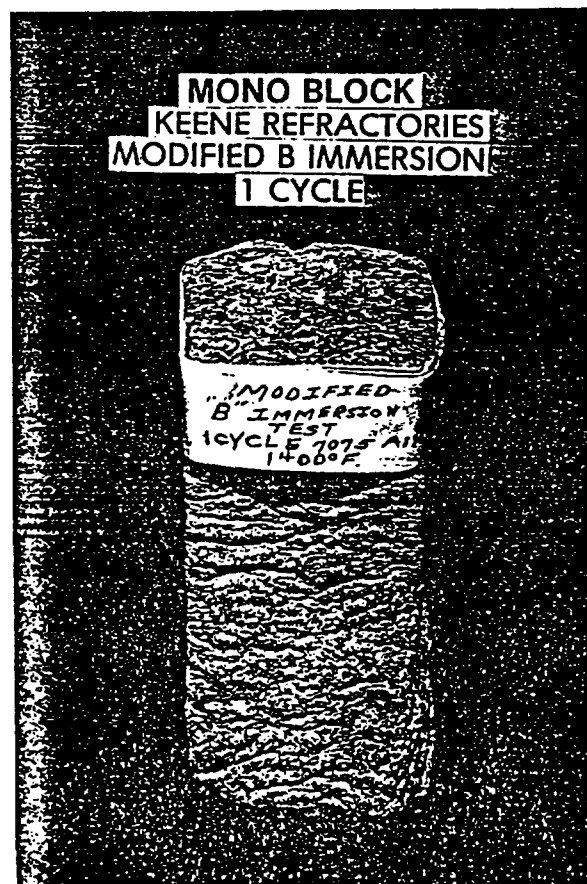


FIGURE 2

DELTA T
KEENE CORPORATION

DELTA T

1000

DELTA T

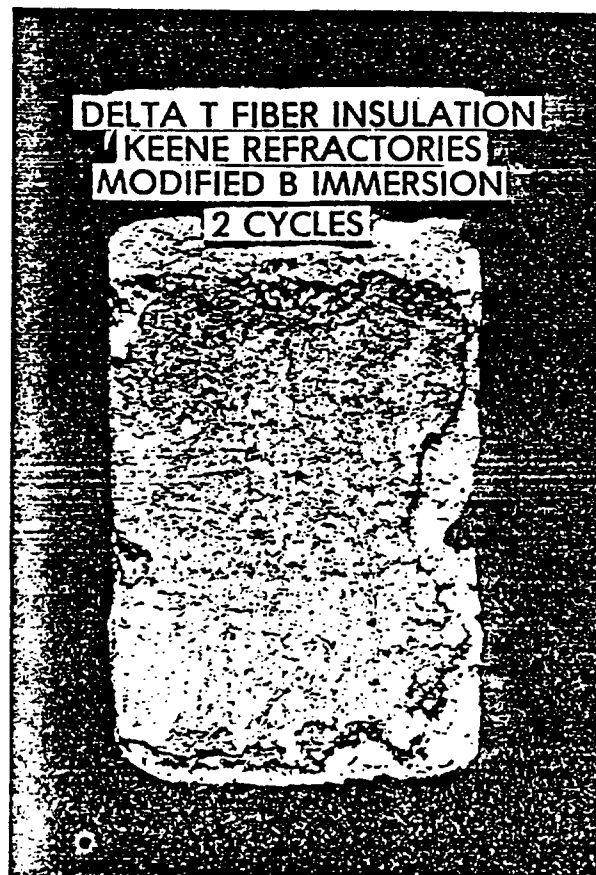


FIGURE 3

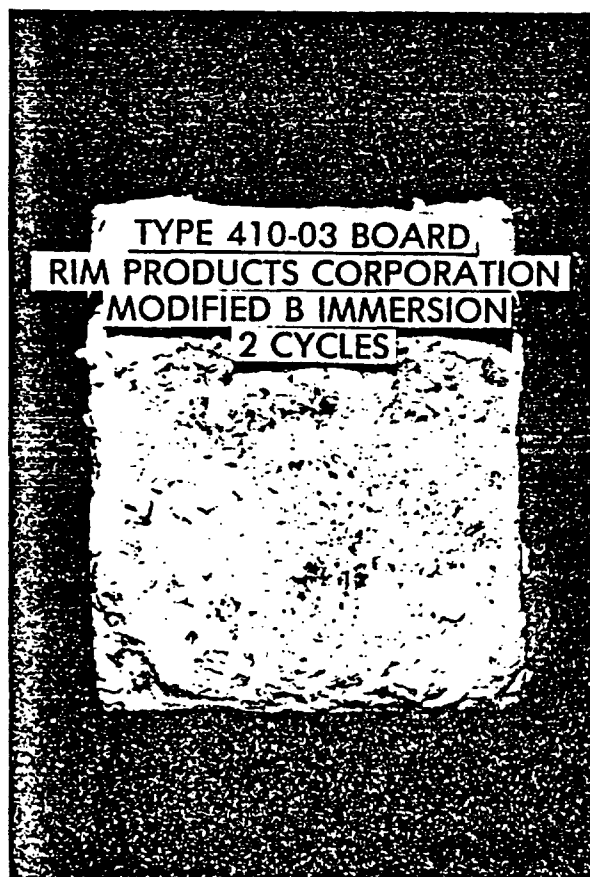
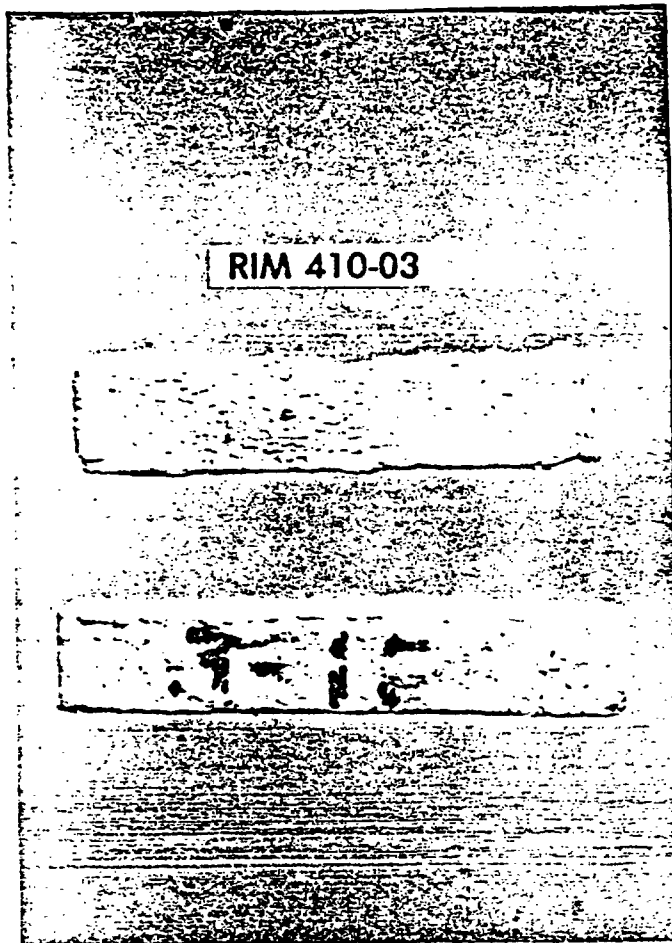


FIGURE 4

IV 19
INTERNATIONAL
VERMICULITE CO.

IV 19

1000

IV 19

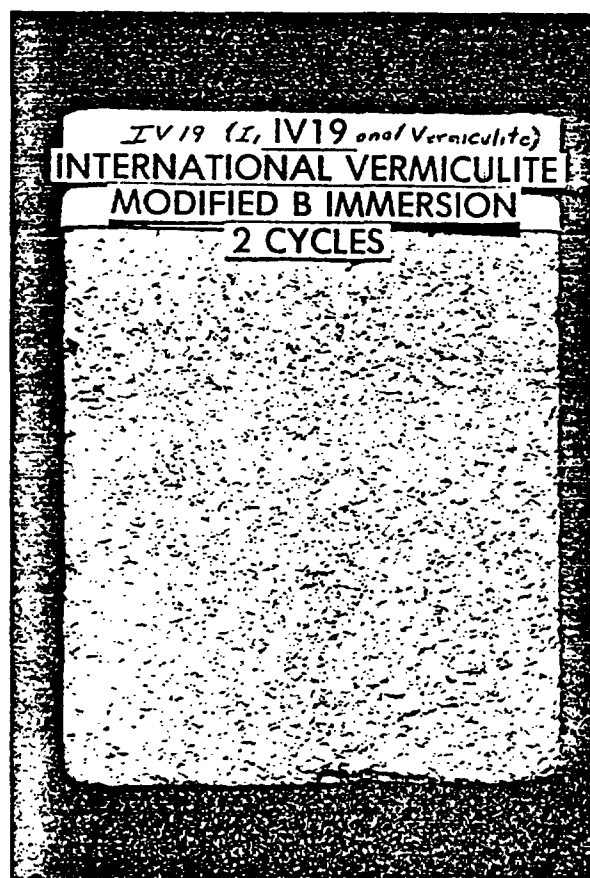


FIGURE 5

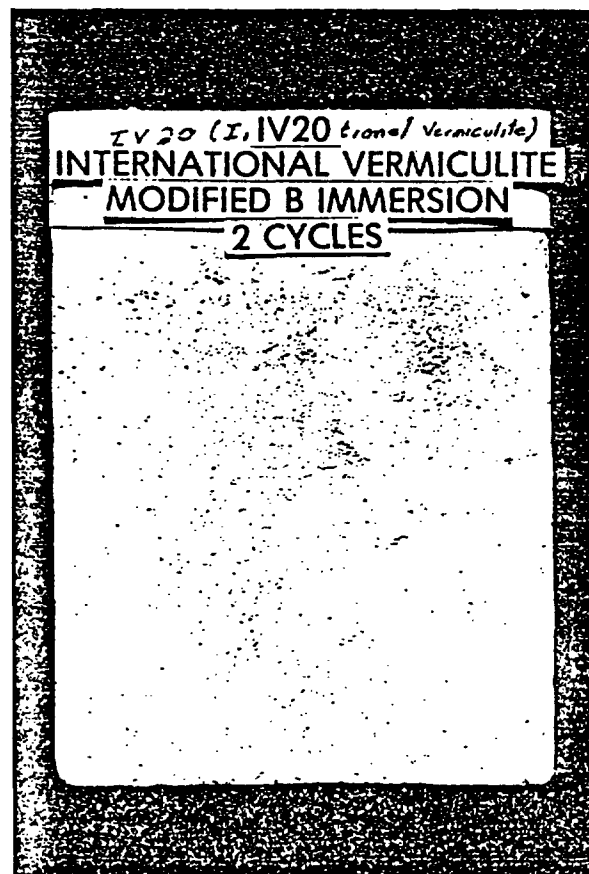
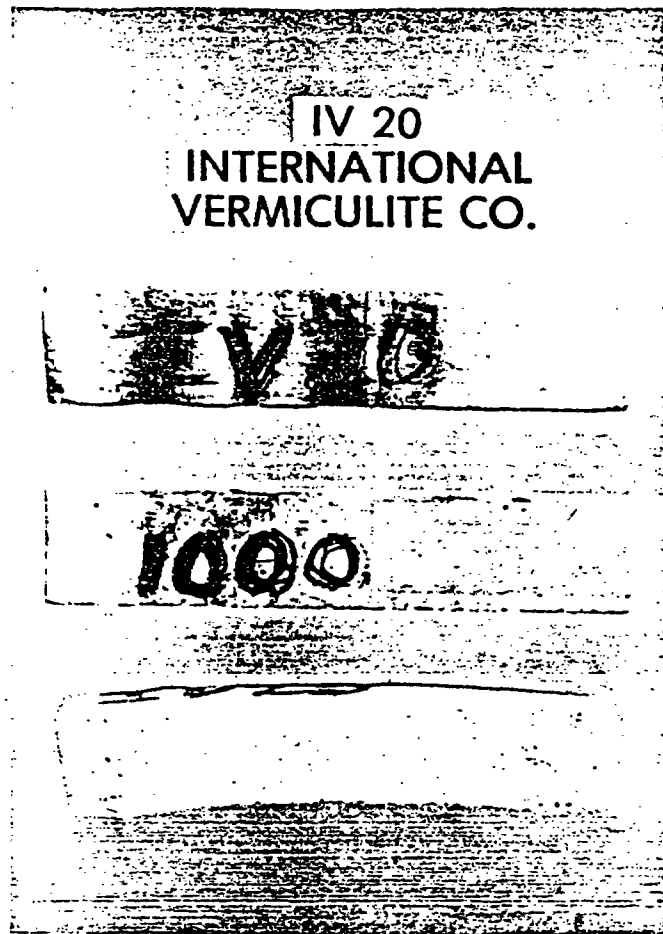


FIGURE 6

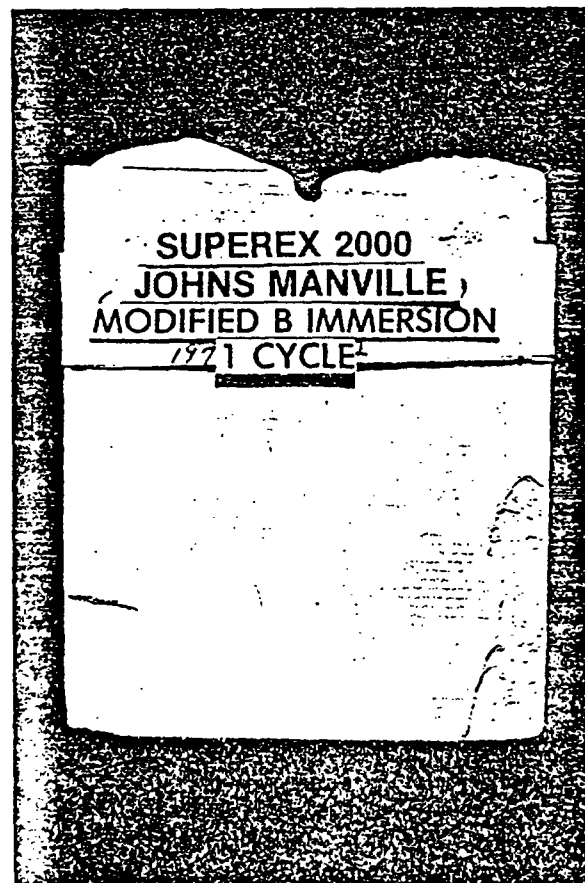
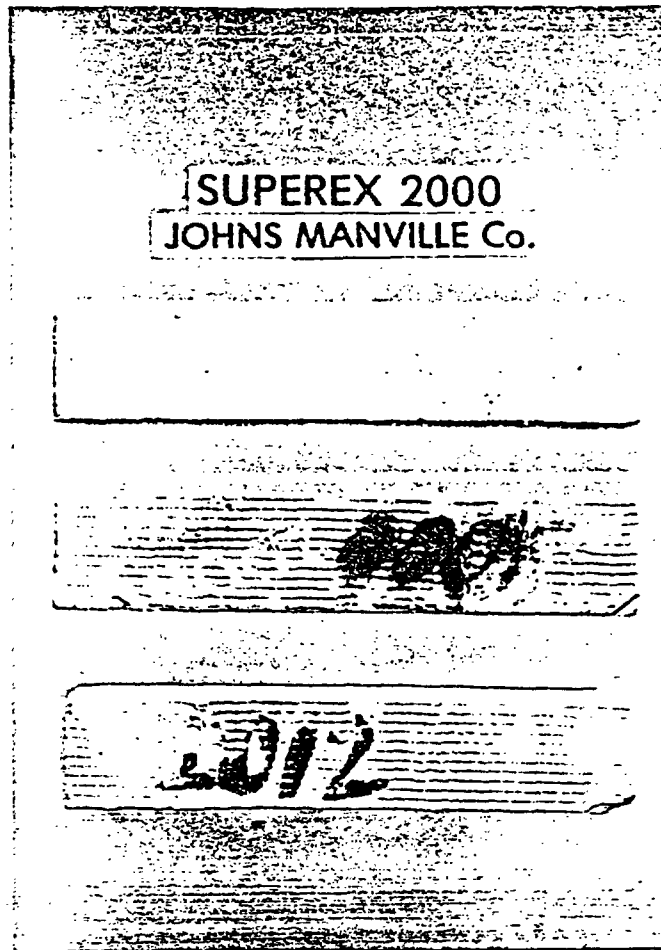


FIGURE 7

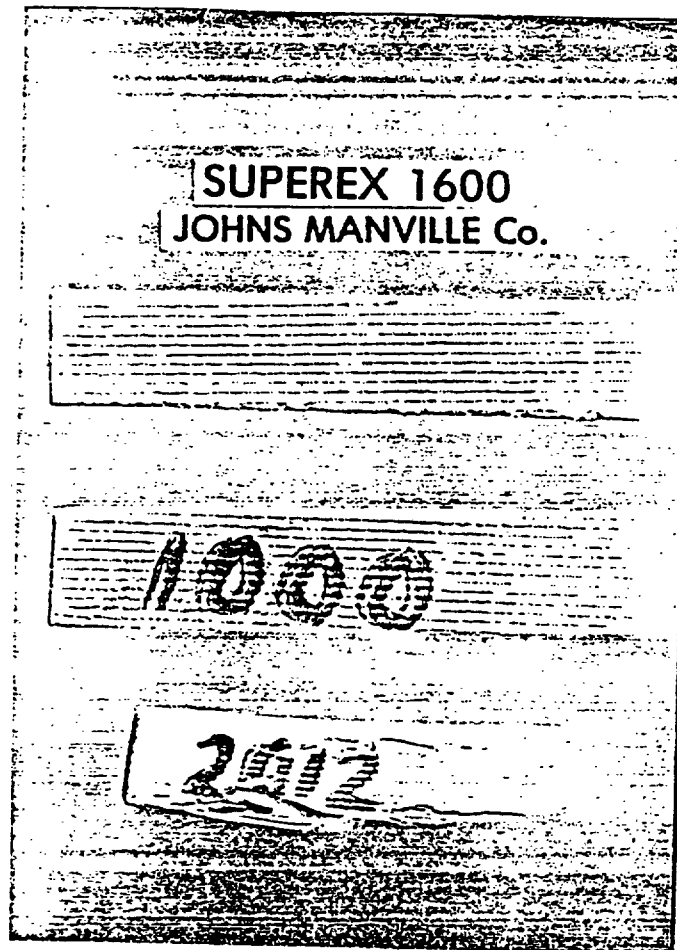


FIGURE 8

TYPE: Block

TEMPERATURE: to 1900°F

EAGLE-PICHER

"PV"
SUPERTEMP BLOCK

Description: Eagle-Picher "PV" Supertemp Block is composed of high temperature mineral fibers bonded with specially prepared binders to form a block insulation having optimum properties during both installation and service. Fibers are oriented to insure maximum strength and thermal efficiency. The blocks are "wet-sawed" by a patented process to provide precise dimensional tolerances and freedom from dust.

Uses: Recommended for direct application or refractory back-up insulation in petroleum and process units, power generation equipment, ovens, furnaces, kilns and other related equipment requiring an insulation that is economical, efficient and dimensionally stable.

Advantages:

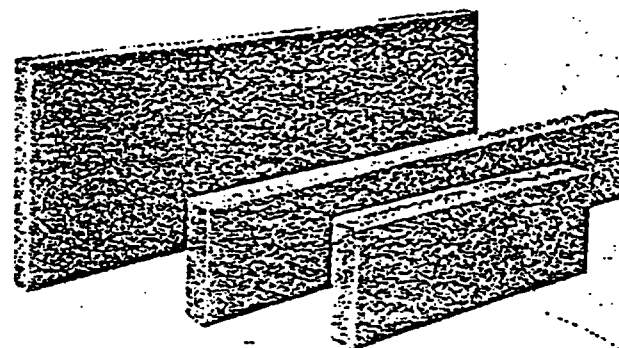
Durability: Strong yet resilient, processed to maintain structural integrity during field application.

Absorption: Allows placement of castable refractories in direct contact with the block without degradation.

Installation: Can be impaled on pins without predrilling. Easily field fabricated with knife or saw. Standard sizes up to 24" x 36" permit rapid installation.

Physical Properties:

Service Temperature to 1900°F.
Density 16-18 lbs./cu. ft.
Moisture Absorption Nil
Fire Resistance Incombustible
Corrosion Does not cause or accelerate



Physical Properties (cont'd):

Linear Shrinkage
at 1600°F. 2.0%
1800°F. 2.2%
Modulus of Rupture 40.0 lbs./sq. in.
Compressive Strength 2,600 lbs./sq. ft.
at 10% Deformation

Thermal Conductivity:

Mean Temperature °F.	"K" (Btu-in./hr./ sq. ft./°F.)
200	0.28
400	0.38
600	0.49
800	0.59
1000	0.69



Superglas® INSULATION

EAGLE-PICHER

"PV" SUPERTEMP BLOCK

Applicable Specifications:

Commercial Standard CS-117

ASTM C612-67T, Class D

Federal HH-1-558, Form A, Class 5

Packaging:

Board Feet per Carton

	1"	1½"	2"	2½"	3"	3½"	4"	4½"
6 x 18	48	45	48	45	45	42	48	40.5
12 x 18	48	45	48	45	45	42	48	40.5
6 x 36	48	45	48	45	45	42	48	40.5
12 x 36	48	45	48	45	45	42	48	40.5
18 x 36	54	54	54	45	54	47.25	54	40.5
24 x 36	48	54	48	45	54	42	48	54

Standard Sizes:

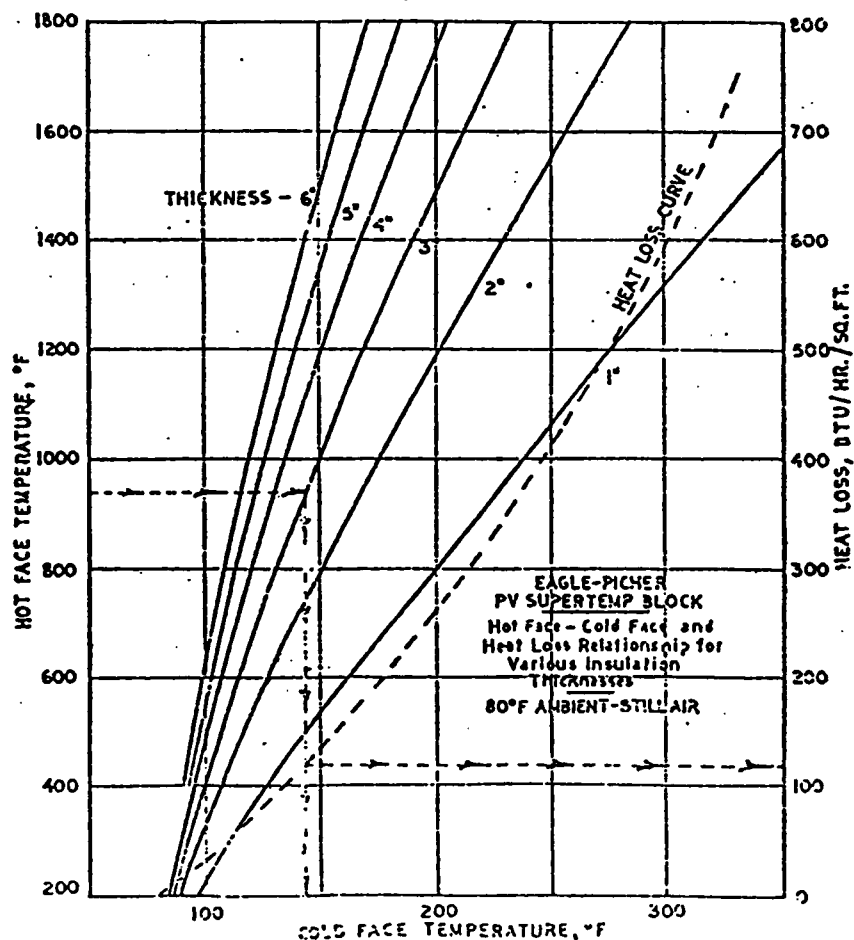
Thickness: 1" to 4½" in ½" increments

Width: 6", 12", 18" and 24"

Length: 18" and 36"

Special sizes and shapes are available and are quoted on request.

Heat Loss Chart:



Since 1843

Manufactured by

EAGLE-PICHER INDUSTRIES, INC.

Fibers Department

American Building

Cincinnati, Ohio 45202

MONO-BLOCK

Mineral Wool Insulation — For Service to 1900 F — Asbestos Free

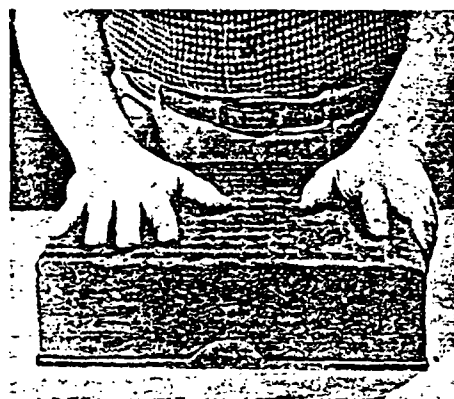
DESCRIPTION:

MONO-BLOCK is composed of spun mineral fibers and inorganic binders especially formulated for resistance to high temperatures. A patented process interlocks the long mineral fibers to form a lightweight and rigid, yet resilient block which is shaped and fitted.

TYPICAL USES:

- Heat Treating Ovens
- Boilers
- Incinerators
- Chemical Treating Tanks
- Refinery Equipment
- Ducts and Breechings
- Feed Water Heaters
- Wind Tunnels¹
- Jet Silencers¹
- Fan Housings¹

¹Acoustical Applications



FEATURES:

- **Easy to Apply** — Easily cut with a knife. Conforms to slight curvatures or projections such as rivet heads, providing a snug fit without cracking or breaking. Can be impaled over welded studs without predrilling holes.
- **High Strength** — Strong because of long mineral fibers and unique manufacturing process which uses inorganic binders. This extra strength guards against breakage loss.
- **Low Chloride/Moisture Resistant** — Acceptable for use on austenitic stainless steel.
- **Effective Acoustical Properties** — High sound absorption efficiency makes this product applicable where acoustical treatment is required at elevated temperatures.

KEENE
CORPORATION
INSULATION

PHYSICAL PROPERTIES:

Density — 12 lbs./cu. ft. minimum
Compressive Strength — 10 lbs./sq. in. @ 10% deformation
Flexural Strength — 40 lbs./sq. in.
Linear Shrinkage after heating 24 hrs. at 1900°F
Soaking Heat — Less than 5%
Single Face — Less than 5%

THERMAL CONDUCTIVITY:

Mean Temp. °F	200	400	600	800	1000	1200
K	.36	.42	.51	.62	.75	.90

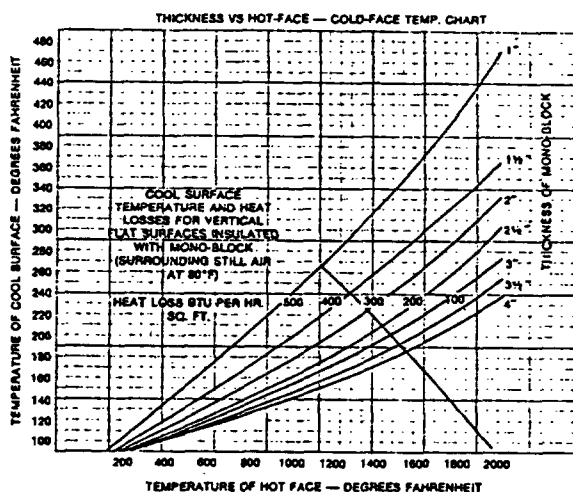
STANDARD SIZES AVAILABLE:

Length — 18, 36 inches
Width — 6, 12, 24 inches
Thickness — 1-4 inches in ½ inch increments

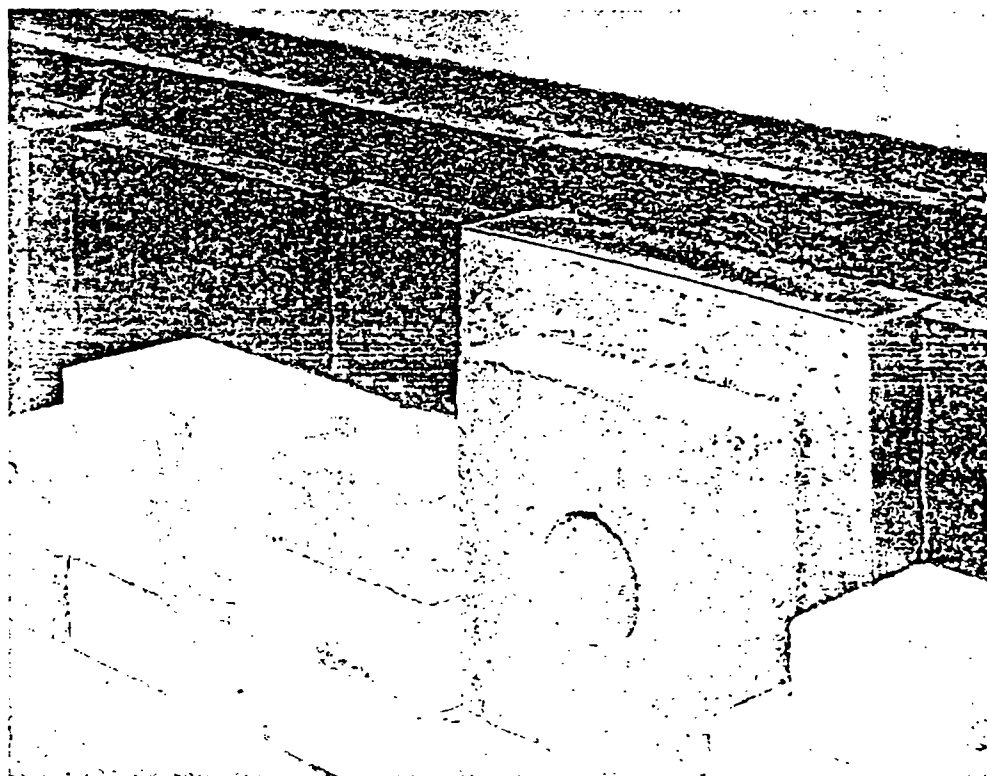
SPECIFICATION COMPLIANCE:

Military: MIL-I-24244A*
Federal: HH-I-558B Form A Class 5
ASTM: C612-70 Class 5

*Indicate on order when specification compliance is required.



1979 JAN 73



Delta-T specifications

Description	felted, spun ceramic fiber with inorganic binders	Anchor Materials	S.S. studs
Color	off-white	Specific Heat, B.T.U./lb. °F (2000° F)	.24
Use Limits, F (C)		Loss on Ignition, % (max.)	1.6
Continuous Intermittent Melting Point	2300° (1275°) 2400° (1333°) 3200° (1775°)	Chemical Analysis, % Alumina Al ₂ O ₃ Silica SiO ₂ Calcium oxide CaO Ferric oxide Fe ₂ O ₃ Titanium oxide TiO ₂ Magnesium oxide MgO	44.5 51.4 1.3 1.2 1.2 .4
Density, lb./cu. ft.	18	Atmospheres	resists oxidation and reduction
Modulus of Rupture, psi.	65	Standard sizes available Thickness (1/2" increments) Length Width Tolerances Custom sizes available	1/2"-4" 36" 24" ± 1/16"
Compressive Strength @ 5% deformation, psi. @ 5% deformation, psi. 400° F @ 5% deformation, psi. 2300° F	20.0 26.2 45.7		
Resiliency, % (to 1400° F)	99		
Linear Shrinkage, % (max.) @ 1600° F @ 2000° F @ 2300° F	0.0 1.15 4.0		

Thermal Conductivity	Mean Temp. °F	200	400	600	800	1000	1200	1400	1600
K		.43	.52	.60	.74	.84	.98	1.15	1.30

Hi-ALUMINA

CERAMIC FIBER INSULATION

Contains No Asbestos

Type AH-50 For 1500°C (2732°F)

Type AH-30 For 1400°C (2552°F)

Type 410 For 1300°C (2372°F)

Hi-ALUMINA ceramic fiber products are made by bonding alumina-silica fibers with high purity alumina. No starch, silica, clays or asbestos are used. As a result, low density insulating products are obtained with high alumina contents. These Hi-ALUMINA products outperform conventional silica-bonded products.

Three products are offered for three temperature ranges with three markedly different costs. In this way, users are able to obtain the most economical insulation for any particular temperature range.

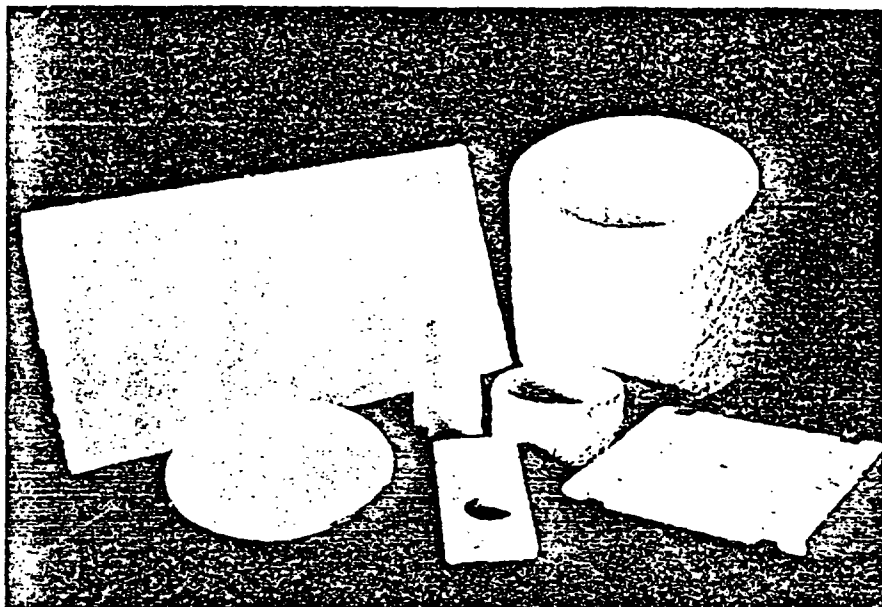
Also available for the 3000°F range are our ALL-ALUMINA products described in a separate bulletin (AA-320).

PRODUCTS AVAILABLE

Type AH-50 77% Al_2O_3 For 1500°C (2732°F)

Type AH-30 61% Al_2O_3 For 1400°C (2552°F)

Type 410 54% Al_2O_3 For 1300°C (2372°F)



All of the above products are available in the form of boards, tubes, cylinders or special shapes. The products can be varied in size, thickness, degree of hardness and surface finish.

APPLICATIONS

The principal use for these products is as a rigid form of a low density, high temperature insulation. The alumina-insulation requires 50% less insulation than conventional brick insulation. Fast heat-up, fast cool down and low heat storage make this insulation ideal because of today's energy shortage.

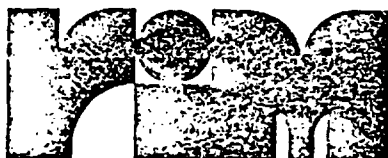
Among the insulation uses are furnace linings, back-up insulation, heat shielding, induction coil liners, combustion chambers, stack insulation and high temperature pipe insulation.

The non-wetting characteristics of alumina binder and alumina-silica fibers to molten metal makes these products desirable for many molten metal applications. Among these are riser sleeves, hot top linings, trough linings and tap out cones.

The low sodium content and high surface area of the alumina binder makes these products ideal catalyst supports for the flameless heater.

The low sodium content makes these products ideal for electrical heating element holders and radiant heater pads.

Other uses include burner blocks, expansion joints, kiln furniture, gaskets, peep hole plugs and seals.



rim products corporation

1605 east ayre street
newport, delaware 19804
phone (302) 995-7194

PROPERTIES	AH-50	AH-30	410
Chemical Composition			
Al ₂ O ₃ (%)	77	61	54
SiO ₂ (%)	23	39	46
Density (lbs./cu. ft.)	11 – 12	14 – 16	16 – 18
Modulus of rupture (psi)	60	75	80
Loss on Ignition (%) (Absorbed Water)	2.3	2.3	2.3
Linear shrinkage (%)*			
1300°C (2372°F)	1.2	2.6	3.6
1400°C (2552°F)	2.0	3.1	—
1500°C (2732°F)	2.5	—	—
Thermal Conductivity (BTU-in./sq. ft. hr. °F)			
1300°C (2372°F)	1.5	1.4	1.4
1400°C (2552°F)	1.7	1.6	—
1500°C (2732°F)	1.8	—	—
Melting Point			
Fibers	Above 3200°F	Above 3200°F	3200°F
Binder	3700°F	3700°F	3700°F
Recommended upper use temperature	1500°C 2732°F	1400°C 2552°F	1300°C 2372°F
Thermal shock resistance	Excellent	Excellent	Excellent

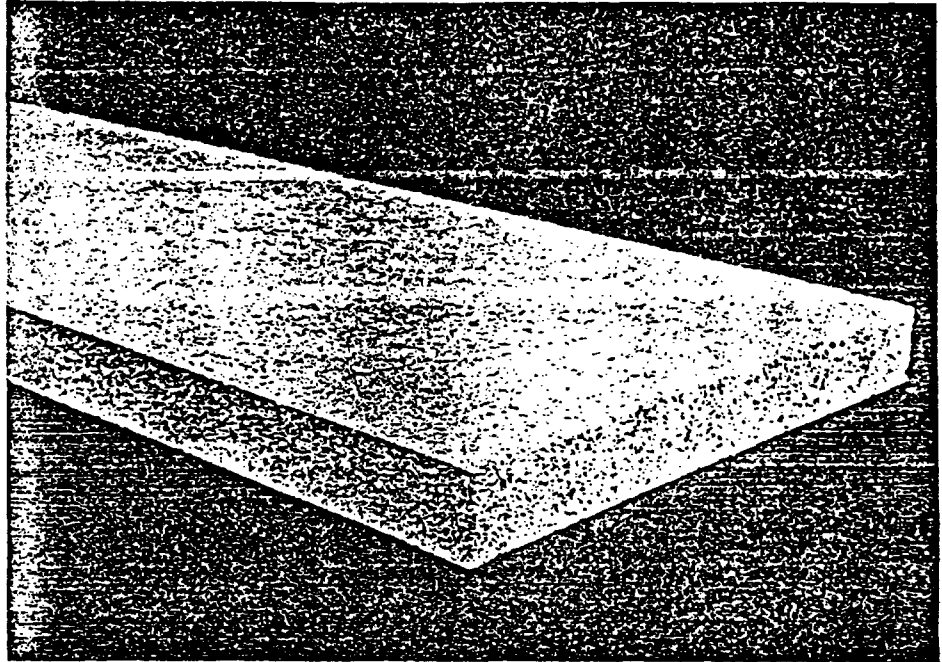
*Two-hour soak

The above information is intended for use by persons having technical skill, at their own discretion and risk. It should not be taken as a warranty nor as a license to operate under, or recommendation to infringe any patent. Some of the above values are averages obtained on developmental material and are subject to change. They should not be used for specification purposes.



IV 19 Block Insulation

Product Data Sheet



IV-19 Block Insulation is an asbestos-free insulation, manufactured from vermiculite granules and high temperature bonding materials. It is a versatile product available in a wide range of sizes.

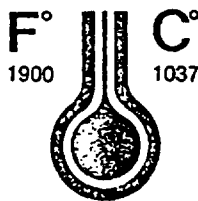
Because of its low conductivity, IV-19 is an economical, energy saving insulation. It exhibits minimal shrinkage at top temperature limits, and will not decompose even when exposed directly to flame at or beyond maximum service temperature.

IV-19 is an excellent back-up insulation as well as a highly efficient hot-face insulation for temperatures at or below 1900° F (1037° C). Its unique composition and hard surface helps insure strong adhesion of cement finishes, and provides superior handling qualities.

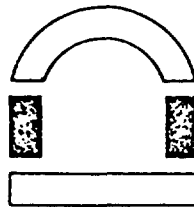
IV-19 can be manufactured with either straight or beveled edges to meet customer specifications. Standard sizes and weights are listed on the price sheet. Prices for custom size blocks will be quoted upon request.



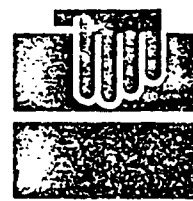
Asbestos-free



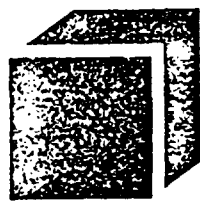
Temperature



Area

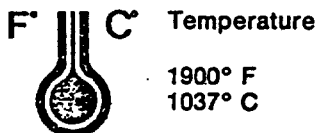


Method

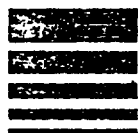


Shipping

Physical Properties:

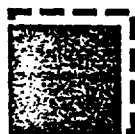


1900° F
1037° C



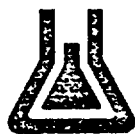
Conductivity

0.56 "k" at 200° F
(.0808 W/m·K at 93° C)
0.64 "k" at 400° F
(.0923 W/m·K at 204° C)
0.72 "k" at 600° F
(.1038 W/m·K at 315.6° C)
0.80 "k" at 800° F
(.1154 W/m·K at 425.7° C)
0.88 "k" at 1000° F
(.1269 W/m·K at 537.8° C)



Linear Shrinkage

At 1900° F (1037° C):
2.25%



Chemical Analysis

Vermiculite, the basic component of IV-19, is a magnesium, aluminum, iron silicate. It contains no free oxides.

Al ₂ O ₃	9.19	CaO	11.51
SiO ₂	54.38	K ₂ O	3.72
As Silicate		Cr ₂ O ₃ , TiO ₂	
Fe ₂ O ₃	5.35	Na ₂ O, Mn ₂ O ₄	0.86
Mg O	13.16	Combined H ₂ O	1.84

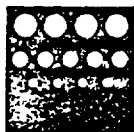
Shipping:



Carton

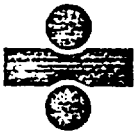
IV-19 is available in standard block thicknesses of 1" to 6" in ½" increments with the other dimensions measuring 6" x 18", 6" x 36", 12" x 18" or 12" x 36". Special sizes available on request.

Area of Application:



Density

Cold: 20.5 lb/ft³
(328.4 kg/m³)
At 1900° F (1037° C):
19 lb/ft³ (304.4 kg/m³)



Crushing Strength

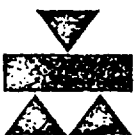
Cold: 125 PSI
(.0878 kg/mm²)
At 1900° F (1037° C):
51 PSI (.0359 kg/mm²)



End/Sidewalls

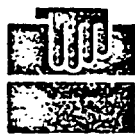
IV-19 has a wide variety of uses in high temperature industrial furnaces including end and side walls of various heating furnaces . . . soaking pits, reheat furnaces, carbonizing furnaces and other annealing furnaces. IV-19 is applied as backup insulation as well as hot face material at temperatures of 1900° F (1037° C) and below, for example IV-19 could be used in duct or flue linings and cyclones.

Method of Application:



Modulus of Rupture

Cold: 73.5 PSI
(.0517 kg/mm²)
At 1900° F (1037° C):
51.5 PSI (.0362 kg/mm²)



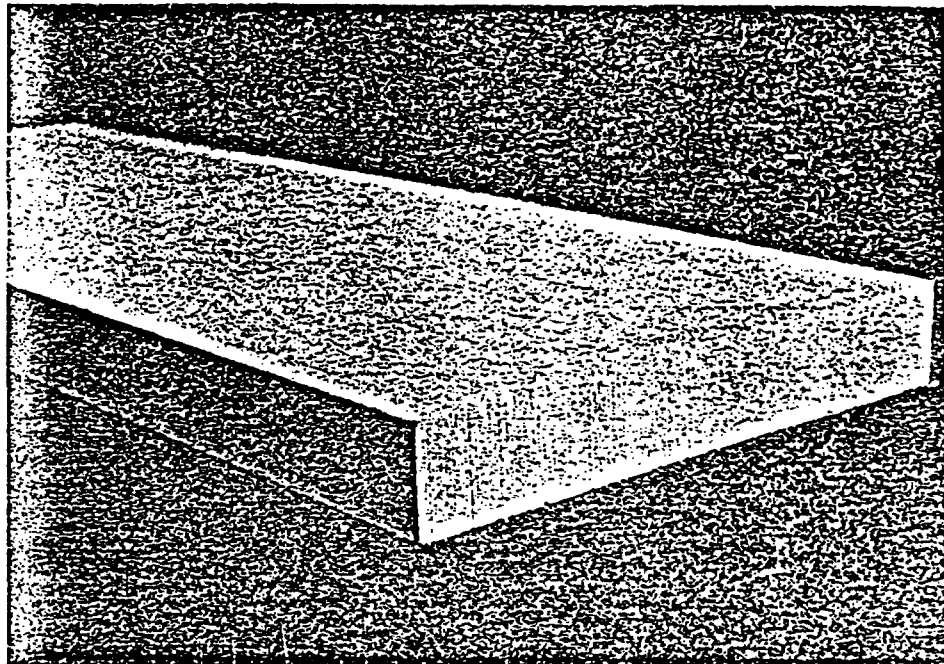
Block Construction

Install, using standard procedures for block construction.



**IV-20
Block Insulation**

Product Data Sheet



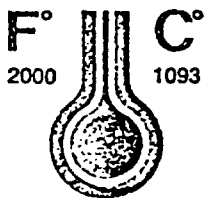
IV-20 Block Insulation, made from diatomaceous silica with a hydraulic binder, is a superior high temperature insulation for service to 2000° F (1093° C). According to ASTM testing procedures, IV-20 exhibits extremely high resistance to breakage at 2000° F (1093° C). Long maintenance-free service and maximum operating efficiency is assured by IV-20's unique combination of low conductivity and high stability. IV-20 is also very low in sulfur and iron, making it highly resistant to attack from atmospheric

conditions and greatly reducing the possibility of product contamination.

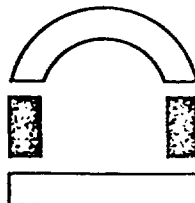
Like other International Vermiculite products, IV-20 is produced in a wide range of standard block sizes, available with either beveled or straight edges. This product can also be manufactured in special shapes to fit customer specifications, saving money on both installation and energy costs.



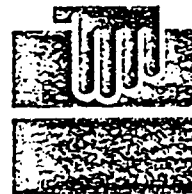
Asbestos-free



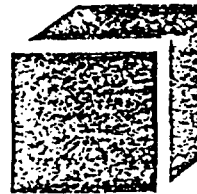
Temperature



Area

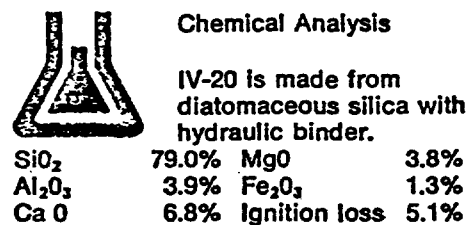
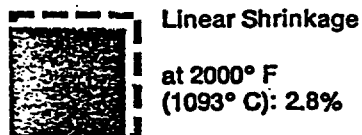
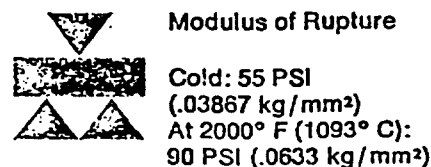
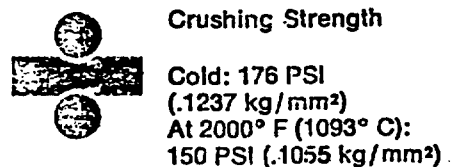
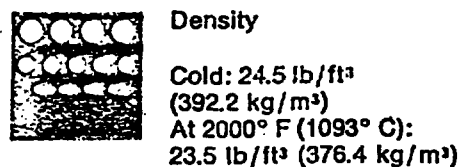
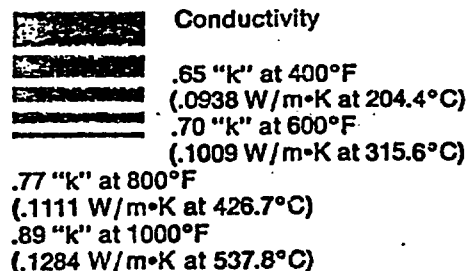
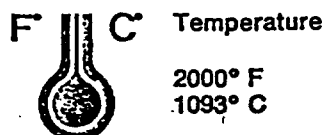


Method

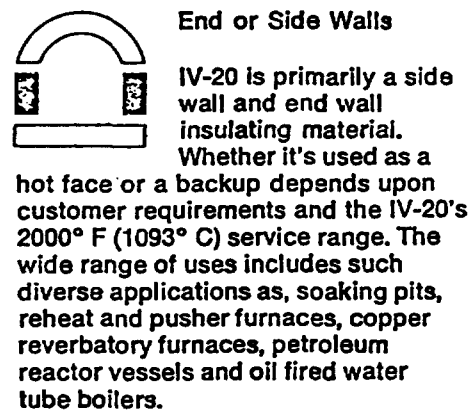


Shipping

Physical Properties:



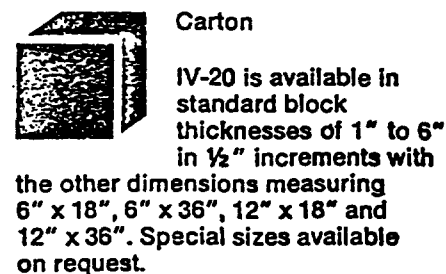
Area of Application:



Method of Application:



Shipping:





Type: Block
Temp. Limit: 2000°F

Description

Superex block insulation products are manufactured from carefully selected combinations of silica, lime, clays, and fibers for reinforcement purposes. These products are characterized by high strength, both cold and at elevated temperatures, and high refractoriness. They can be used right up to their temperature use limits — and in some conditions even beyond — should upset conditions occur. They uniquely combine low thermal conductivity and high stability at elevated temperatures to provide efficiency of construction and thermal performance, and long maintenance-free service. Superex Block products contain no asbestos fibers and are not soluble in water. Repeated wettings have no effect on this insulation.

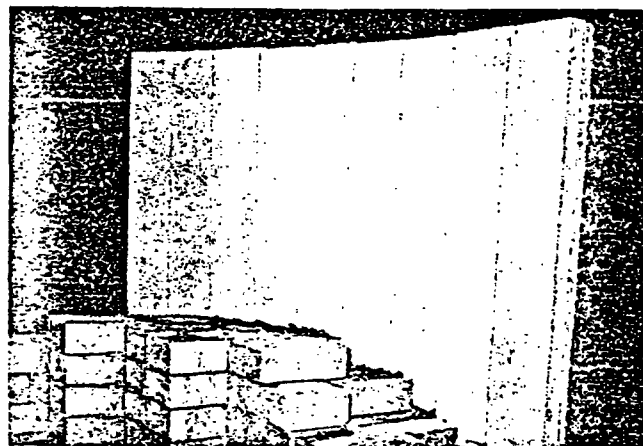
Superex products are not recommended as a furnace lining material exposed to combustion conditions unless a great deal of past experience shows the product to be satisfactory in a particular application.

Typical Applications

Superex block is designed as a backup insulation for all refractory constructions; i.e., insulating firebrick, dense fireclay brick, castables, plastic refractories and also ceramic fiber felts and blankets. All Superex block performs well at high temperatures and efficient designing of a refractory system with Superex as the backup insulation will reduce the amount of hot face refractories required.

The most thermally efficient and cost effective system is obtained when the lowest thermal conductivity materials are placed in the hottest possible location. The excellent heat resistance of Superex block allows this. The most thermally efficient systems utilize Superex 1600 as backup to Superex 2000.

Superex block is good insurance, too. Any refractory construction can be expected to crack in service and allow full furnace temperatures into the back-up insulation. Its high refractoriness will help to prevent catastrophic failure of important equipment and allow operation until a more convenient rebuild or repair time is reached.



Uses

Ovens
Soaking Pits
High Temperature
Mains and Flues
Industrial Boilers
Marine Boilers
Regenerators
Kilns
Roasters
Reverberatory
Furnaces

Reheat Furnaces
Annealing Furnaces
Heat Treating Furnaces
Combustion Air Piping
Bustle Pipes
Blast Furnace Stoves
Glass Lehrs
Car Tops
Forge Furnaces
Laboratory Furnaces
Cooking Equipment

Advantages

Exceptional Heat Resistance. Superex Block can be used to its full temperature use limit. Its high refractoriness also offers some insurance against immediate failure should these temperatures be exceeded.

Excellent Strength. Easy to install; resists damage both in installation and in operation.

Lightweight. Reduces structural steel requirements; ideal for insulating movable equipment.

Special Shapes. Good strength properties make Superex block ideal for cutting and grinding special shapes. J-M can supply these to your specific requirements.

Specification Data

Available Forms

Superex 2000 — A high-density, low-calcium oxide content block, designed for low shrinkage and top performance at temperatures up to 2000°F.

Superex 1600 — Has a higher calcium oxide content and lower density than Superex 2000. This formulation gives better strength and insulating properties for use in situations where temperature will not exceed 1600°F.

Superex 2000 SG — Composite insulation block made up of Superex and a layer of spun-attenuated glass fiber, bonded together at the factory. The fiber glass layer, consisting of 1000 Series Spin Glas®, increase the insulation effectiveness of the Superex block and also serves as a mechanical "cushion" between the block and the steel shell of a furnace

Properties

	Superex 2000	Superex 1600
Normal Service Temperature, °F, (oxidizing atmosphere)	2000	1600
Marking	None	Green strip on end
Density, lbs/cu ft	24	14
Modulus of Rupture, lbs/sq in	45	65
Compressive Strength lbs/sq in to produce 5% deformation (2" thickness)	130	165
Linear shrinkage, % after 24 hours soaking heat	2.7 @ 2000°F	1.4 @ 1600°F
Chemical composition, %		
Silica, SiO ₂	74.8	49.6
Alumina, Al ₂ O ₃	4.3	1.2
Calcium Oxide, CaO	6.0	37.6
Ferric Oxide, Fe ₂ O ₃	2.0	0.3
Titania, TiO ₂	0.3	Trace
Magnesia, MgO	0.8	0.2
Alkalies, as Na ₂ O & K ₂ O	2.7	0.0
Sulphur Trioxide, So ₃	0.0	Trace
Others	—	0.2
Loss on Ignition	9.1	10.9



Johns-Manville

Ken-Caryl Ranch
Denver, Colorado 80217

For information on other J-M Thermal Insulations and Systems, write the Johns-Manville Insulation Center, Drawer 17L, Denver, Colorado 80217 or call (303) 979-1000.

Superex Block Insulation

Compressive Data on Superex 2000 SG

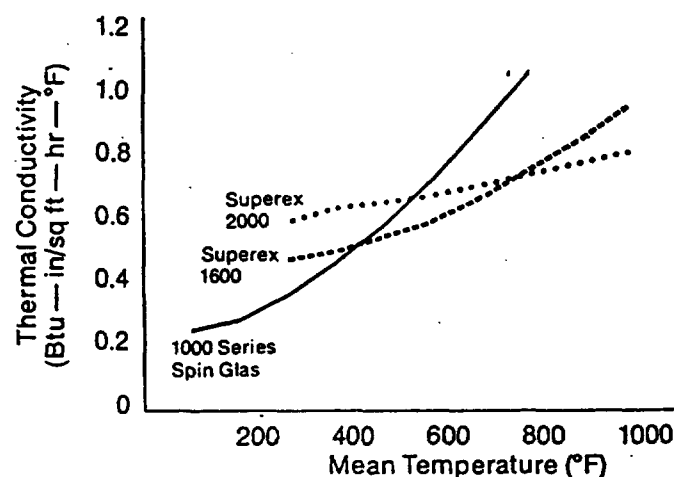
(2 1/4" Superex 2000 plus 3/4" 1000 Series Spin-Glas)

Compressive Strength of 3" Superex 2000 SG

Compressed As Thickness (in.)	Received	Load to Compress, psi Hot Face of Superex (24-hr test)		
		1600°F	1800°F	1900°F
3.00	0	0	0	0
2.90	1.4	0.6	0.4	0.4
2.75	3.5	2.4	1.5	1.6
2.50	22.6	21.1	12.5	13.5
2.25	66.0	29.0	70.0	73.0

Recovery of 3" Superex 2000 SG After Compression

Compressed Thickness	Thickness of Superex 2000 SG after release (Percent of original thickness)				
	Hot Face of Superex (24 hour test)				
Inch	%	As Received	1600°F	1800°F	1900°F
2.90	97	99	99	99	99
2.75	92	99	97	97	97
2.50	83	95	93	93	93



Standard Sizes

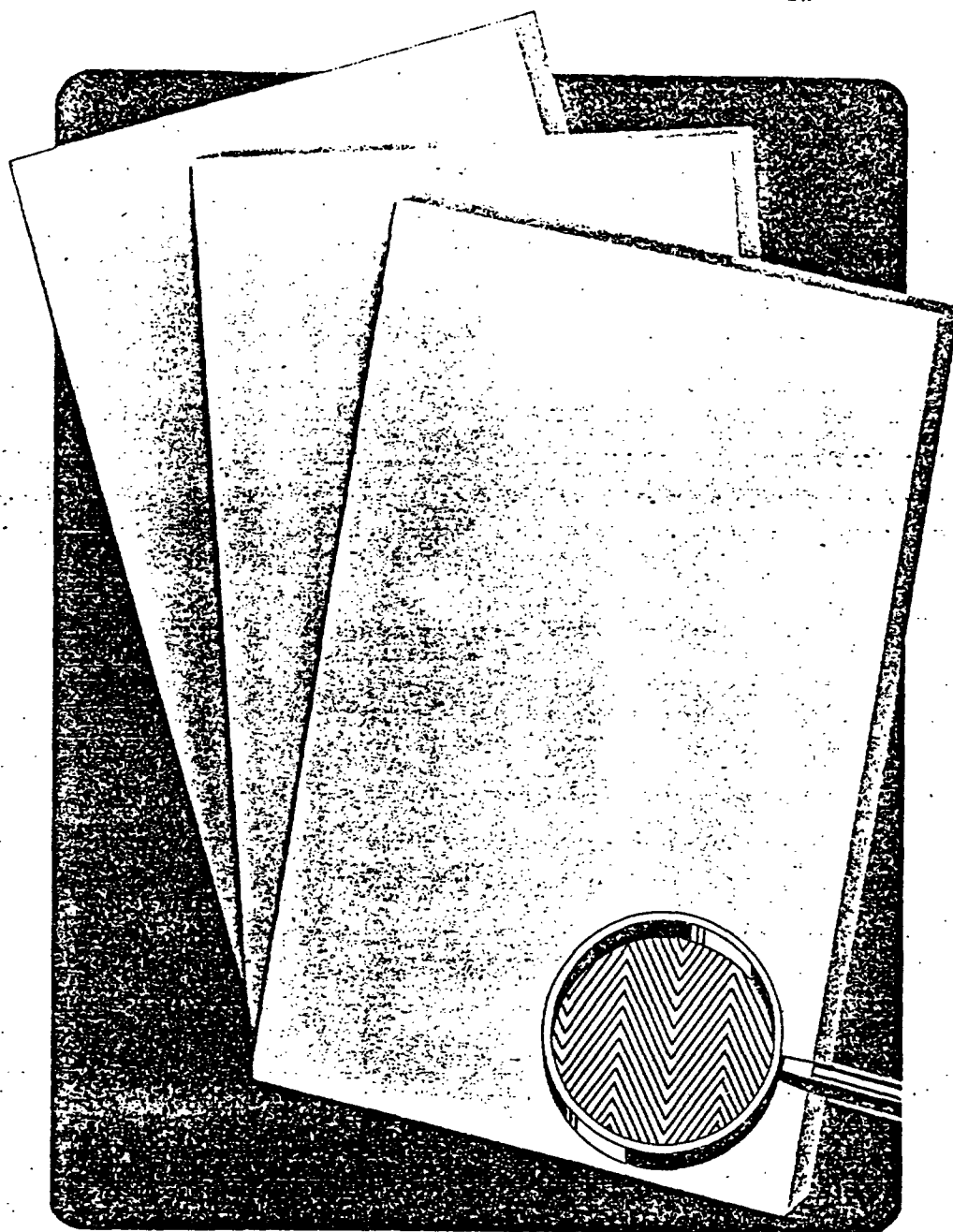
All dimensions in inches

Thicknesses in 1/2 inch increments	Superex 2000	Superex 1600
	1 to 5	1 to 4
	Superex 2000 SG	
	1 1/2 to 6	
Widths and Lengths	12 x 36	18 x 36
	6 x 36	12 x 36
	12 x 18	6 x 36
		18 x 18

Beveled blocks are tapered to specific requirements. Outside diameter of circle is to be specified on order.

The physical properties of Johns-Manville Superex block insulation represent typical, average values obtained in accordance with accepted test methods and are subject to normal manufacturing variations. They are supplied as a technical service and are subject to change without notice. Check the Johns-Manville district office to assure current information.

skamol



SKAMOLEX PM-10

Asbestosfree Calcium Silicate Slab Insulation.

An extremely lightweight calcium silicate slab, fibre reinforced but completely free of any asbestos and crystalline silica. It is designed as a final «back-up» insulation between refractory linings and furnace casing for interface temperatures up to 1000°C. A low density product – 250 kg/m³ – of good strength and low thermal conductivity throughout its temperature range of service. Excellent resistance to carbon monoxide and a number of other gases, and good performance in contact with molten aluminium. The large sized slabs – standard size 1000 × 610 mm – of accurate shape and clean edges speed construction and improve insulation efficiency. The slabs are easy and clean to handle because of a negligible dust emission.

Due to their porous structure the slabs are easily shaped on site by ordinary woodworking tools – fixing can be made with nails or screws. A specially developed adhesive is also available.



SKAMOLEX PM-10

Asbestosfree Calcium Silicate Slab Insulation

PHYSICAL AND THERMAL PROPERTIES

Bulk density (dry)	250 kg/m ³
Porosity	89%
Cold crushing strength	2.0 MN/m ² (20 kp/cm ²)
Compressive strength at 5% deformation	1.7 MN/m ² (17 kp/cm ²)
Modulus of rupture	0.6 MN/m ² (6 kp/cm ²)
Recommended service temperature (back-up)	1000°C
Linear reheat shrinkage DIN 51066 BL.2(12 h 950°C)	<1.5%
Specific heat	0.75 kJ/kg K (0.18 kcal./kg °C)

Thermal conductivity at mean temp.		
	W/m K	Kcal./m. h. °C
10°C.....	0.054	0.046
200°C.....	0.065	0.056
400°C.....	0.087	0.075
600°C.....	0.109	0.094
800°C.....	0.132	0.114

Pyrometric cone equivalent	1400°C
Thermal expansion coefficient 20 - 730°C	0.74×10 ⁻⁶ /K

The above properties represent average test values.
They are given in good faith but no guarantee is im-
plied.

CHEMICAL ANALYSIS

SiO ₂	41 %
CaO	42 %
Fe ₂ O ₃	0.5 %
Al ₂ O ₃	1.2 %
Ignition loss	13 %
(mainly H ₂ O and CO ₂)	

SHAPES & SIZES

Skamolex PM-10 is available as flat boards of stan-
dard size 1000 × 610 mm with thicknesses of 25-
30-40-50-60-75-100 mm. Other sizes or shapes,
e.g. with bevelled edges, can be supplied to suit spe-
cific design requirements.

For agglutination of slabs, or for adhering Skamolex
PM-10 to refractory and metallic surfaces, we recom-
mend the use of SKAMOL FL-06 Mortar. This adhe-
sive is supplied as a dry mix in 25 kg bags, ready for
use after addition of water. Adhesive thickness
should not exceed 5 mm.

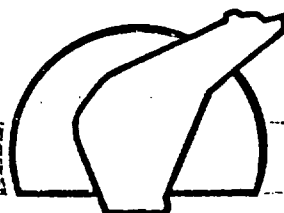
PACKAGING

Skamolex PM-10 in standard size 1000 × 610 mm is
offered in shrink film wrapped packs holding be-
tween 1.83 and 6.10 m² of board depending on thick-
ness. Packs are palletised for shipment on non-
returnable pallets, secured with nylon strapping. One
pallet unit comprises 2.25 m³ shipping volume.

PACKING SPECIFICATION

Thickness mm	Content per pack slabs	Content per pack m ²	Content per pallet packs	Content per pallet m ³
25	10	6.10	14	85.4
30	10	6.10	12	73.2
40	5	3.05	18	54.9
50	5	3.05	14	42.7
60	5	3.05	12	36.6
75	3	1.83	16	29.3
100	3	1.83	12	22.0

Packing in wooden crates or cases quoted upon re-
quest.



skamol

SKARREHAGE MOLERVÆRK A/S

DK-7900 NYKØBING MORS . DENMARK . TEL. INTERN. 45-7-72 15 33 . TELEX 66680

H & S
Industrial Hygiene

FROM M. J. CAPRIO

PITTSBURGH PURCHASING - 19

BDD
EER
TBB
RMI
HGS
PHS
MJV

OCT 23 1979

M45
JD
CCD
DB
LMN
EDS

DR. R. G. LABAR

INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

1979 OCTOBER 22

RE: ASBESTOS-FREE MARINITE

On 1979 October 18, Jim Hines and the writer met with the following Johns-Manville (J-M) personnel for an update on their program to replace asbestos in molten metal grade Marinite.

Howard Konrad: V.P. and General Mkt. Manager Refractory Prod.
Joe Campbell: Sales Manager - Eastern U.S.
Miss Pat Keegan: Sr. Sales Rep. - Pittsburgh

J-M's Corporate objective is to replace asbestos in Molten Metal Marinite by the end of 1980. Although they are making what they call an all out effort to achieve this objective, the results todate are few and not too promising. The latest formulation of asbestos-free molten metal board designated Marinite-C was run at the Billerica, Mass. plant on 1979 October 08; this run, like the others which preceeded it, was discouraging in that it did not produce sound, crack-free boards. Although the Marinite-C formulations have allegedly produced acceptable boards at J-M's Research LAB, they have bombed-out under commercial production facilities. We will not elaborate on the problems associated with the Marinite-C formulations except to say that they forced J-M to add additional Research back-up to Walter Pusch, J-M's perennial group leader for Marinite projects. In addition to the increased input from Research, J-M will also utilize the press facilities at their Nashua, N.H. plant to accelerate the commercial production runs. During this development period it was agreed that Jim Hines will be in direct contact with Walter Pusch in evaluating product and in determing the optimum heat treat temperature.

If J-M's asbestos-free Marinite-C goal is not achieved, we were assured that Molten Metal Marinite with asbestos will be available for as long as it is requested by the aluminum industry.

J-M has a stronger incentive to get rid of asbestos than Alcoa and on that note we are convinced that some how and some way J-M will stumble on to an acceptable Marinite-C material.

M. J. CAPRIO

MJC:guh



ALCOA

FROM JAMES E. HINES
INGOT CASTING DIVISION
ALCOA TECHNICAL CENTER - B

H & S To
Industrial Hygiene

PLANT METALLURGICAL ENGINEERS

BDD

~~FEW~~

TEB

RMI

HGS

PHS

MJV

AUG 14 1979

MLF

JD

CCD

DB

LMN

EDS

1979-08-13

RE: ASBESTOS-FREE MARINITE I

Based on limited plant trials, the most promising asbestos-free candidate for replacing asbestos Marinite has been Marinite I. Although it cannot be used as headers, preliminary results have indicated that, if the board is heat treated to 290°C (550°F), it can be successfully employed in less critical molten metal contact applications such as troughing, basins, dams, and feedboards. These areas would require 50.8-mm (2-in.) thick boards. A 25.4-mm (1-in.) Marinite I has also performed well as D.C. distributors or floats. In this case, no special heat treatment is needed outside of removing atmospheric moisture by a low preheat. In order to substantiate these results and limit the usage of asbestos, a large scale evaluation of Marinite I is requested at Badin, Cleveland, Corona, Davenport, Lafayette, Massena, Rockdale, Tennessee, Vancouver, Vernon, and Warrick ingot plants.

Before boards can be made available however, a list of each plant's requirements are needed since heat treating Marinite I at 290°C (550°F) requires special runs by Johns-Manville. Please try to give an estimate of the number of 50.8 mm (2 in.) and 25.4 mm (1 in.) to either Mario Caprio at the Pittsburgh Office (X4332) or myself (X2815), so that an order can be placed in the very near future. Once the boards have been processed and are available, another letter will be issued.

Only through the cooperative effort of all the plants can Alcoa completely replace asbestos.

James E. Hines
JAMES E. HINES

JEH:bls

(Distribution List - Page 2)



Plant Metallurgical Engineers
1979-08-13
Page 2

LETTER TO
Plant Metallurgical Engineers:

C. T. Barger, Jr. - Badin Wks.
T. F. Arnold - Cleveland Wks.
A. F. Maloit - Corona Wks.
R. J. Stokwicz - Davenport Wks.
D. O. Collins - Lafayette Wks.
D. E. Scott - Lafayette Wks.
M. Scherbak - Massena Oprs.
G. G. Owens - Rockdale Wks.
G. K. Reichelt - Tennessee Oprs.
J. M. Ekenes - Vancouver Oprs.
W. C. Harvey - Vernon Wks.
D. Fleener - Warrick Oprs.
J. B. Gorss - Warrick Oprs.
P. C. Scheble - Warrick Oprs.

INFORMATION COPIES TO:

J. E. Gunn - Wenatchee Wks.

Plant Superintendents

J. N. Rumble - Badin Wks.
M. A. Gambill - Davenport Wks.
W. K. Dalton - Lafayette Wks.
G. L. McCullough - Massena Oprs.
G. L. Williams - Pt. Comfort Wks.
T. J. Randall - Rockdale Wks.
D. W. Freeman - Tennessee Oprs.-S
D. F. Simonis - Tennessee Oprs.-N
D. E. Luckett - Vancouver Oprs.
M. L. Redhair - Vernon Wks.
A. Pearson - Warrick Oprs.
R. S. Grundhoefer - Warrick Oprs (Can Reclamation)
E. T. Vanderheyden - Wenatchee Wks.

M. J. Caprio - Pittsburgh 19
C. J. Cox - Pittsburgh 3 WPH
J. W. McIntee - Pittsburgh 3 WPH
H. G. Reavis - Pittsburgh 23
E. L. Rooy - Pittsburgh 23
H. G. Sakoian - Pittsburgh 7
A. J. Sartschev - Pittsburgh 3 WPH
D. L. Schaffer - Pittsburgh 23
R. E. Spear - ATC, C
R. E. Miller/R. G. LaBar/File: 10.320 - ATC, B
ID - ATC, D

F I L E

MOLTEN METAL MARINITE USES IN ALCOA PLANTS -
INGOT CASTING

<u>PLANT</u>	<u>SPECIFIC APPLICATION AS REPORTED FROM PLANTS</u>
<u>ATC</u>	-Ingot casting items - Manufacturing Section
<u>Davenport</u>	-Variable head distributor float #2 DC pit -Float - 18X50 and 18X60 DC molds -Float - 12X48, 16X50, 16X43 DC molds -Float - Flow control DC casting unit -Float - 24X72 ingots #9 DC pit -Trough Plug - pouring troughs -Support - DC pits -Trough dam - pouring troughs -Trough dam - 503 and 528 filter boxes -Skim stick - DC pits -Float - DC pits -Float support - DC pits -Blinder - DC pits -(Marinite board) Doorframe insulation on melting and holding furnaces
<u>Lafayette</u>	-Casting tools
<u>Massena</u>	-Insulator - part for chip melter, side bay -Headers (sanding of Marinite headers in mold shop) -Float used for HDC sheet ingot tooling, 30 complex, level flow control, cast units -Miscellaneous Marinite: Spare parts for 30 complex; insulators; inserts; bearing housings; couplings; covers; etc.
<u>Pt. Comfort</u>	-Basins for HDC casting
<u>Rockdale</u>	-Pre-cut Marinite for molten metal casting
<u>Tennessee</u>	-HDC headers - South Plant
<u>Tifton</u>	-DC casting floats and spouts
<u>Vancouver</u>	-Headers (Note: ceramic molds replace 2/3 of Marinite heads at present time.)

<u>PLANT</u>	<u>SPECIFIC APPLICATION AS REPORTED FROM PLANTS</u>
<u>Vernon</u>	-Marinite board (Non-asbestos Marinite now being substituted on trial basis) -Also use asbestos rope for door seals (being replaced with ceramic) -Also use asbestos-containing block or brick
<u>Warrick</u>	-Trough liners; headers (partial substitution of plastic trough lining continues)
<u>Wenatchee</u>	NO REPORT

Tingot Costing

Second Day

AGENDA

- 8:00 - 9:00 Asbestos Replacement Program -
J. Damiano, H.G. Sakoian, J.E. Hines
- 9:00 - 9:15 Coffee Break
- 9:15 - 10:00 R-680 Program -
J.E. Hines, W.G. Truckner, T. Fujioka,
J.E. Jacoby, R. Bachowski
- 10:00 - 12:00 Metal Treatment Program:
Objectives and Goals - R.E. Miller
Status of Specific ATC Programs:
- Formation and Interaction of Salts -
R.D. Blackburn
- Precoalescer/Coalescer - H. Yu
- Freon - C.E. Eckert
- Selee Ceramic Foam Filter - C.E. Eckert
- 12:00 - 1:00 Lunch
- 1:00 - 3:00 Metal Treatment Program (continued) and
Joint Alcoa/Drexel Filtration Study -
R.D. Blackburn

J. E. Hines

PROPERTY REQUIREMENTS

- NOT WETTED BY MOLTEN ALUMINUM
- "SKULL" EASILY REMOVED
- NO METAL CONTAMINATION
- READILY MACHINED AND FABRICATED
- HOLDS METALS AT UNIFORM TEMPERATURE
- NO PREHEATING REQUIRED
- MAINTAINS STRENGTH AT HIGH TEMPERATURES
- RESISTANT TO LUBRICATING OILS

ASBESTOS-FREE REFRACTORY BOARD PRODUCTS

MARINITE I

PYROTHERM B-2

INSURAL

MARINITE C

GRC PRODUCTS

MARINITE I**— THERMAL AND PHYSICAL PROPERTIES**

Physical Properties: Bulk Density = 736 kg/m^3 (46 pcf)

Properties After		M.O.R.		Shrinkage	Weight
Firing To:		MPa	(psi)	%	Loss %
590°C	(1100°F)	4.52	(655)	0.35	2.9
650°C	(1200°F)	3.54	(513)	0.37	3.2
705°C	(1300°F)	3.15	(456)	0.54	4.3
815°C	(1500°F)	4.43	(643)	3.9	5.3
290°C	(550°F)	4.72	(685)	0.35	10.5

Modified "B" Immersion: Excellent

PYROTHERM B-1
THERMAL AND PHYSICAL PROPERTIES

Physical Properties: Bulk Density = 960 kg/m^3 (60 pcf)

Properties After Firing To:	M.O.R.		Shrinkage %	Weight Loss %
	MPa	(psi)		
590°C (1100°F)	2.48	(360)	0.02	2.9
650°C (1200°F)	—		0.02	3.5
705°C (1300°F)	2.97	(430)	0.00	4.1
815°C (1500°F)	0.83	(120)	0.00	5.5
551°C (1025°F)	3.78	(548)	0.53	12.1

Modified "B" Immersion: Excellent

ASBESTOS-FREE PRODUCTS

	<u>MARINITE I</u>	<u>PYROTHERM B-2</u>	<u>INSURAL</u>	<u>MOLTEN METAL MARINITE</u> contains asbestos 609
Density, Kg/m ³	736	960	1134	
pcf	46	60	70	38
MOR				
Rm Temp MPa	4.93	5.93	3.93	6.44
Psi	715	860	570	933
705°C(1300°F) MPa	3.15	3.17	--	2.21
Psi	456	460	--	320
Shrinkage, 705°C(1300°F), %	0.89	0.04	0.32	0.43
L.O.I., 705°C(1300°F), %	13.8	6.4	--	6.1
Corrosion	E	E	E	G to E
Handability (X10 ³)	$\frac{4.72}{736}$	$\frac{3.78}{960}$	$\frac{3.93}{1134}$	$\frac{6.44}{609}$
(Strength at Heat Treatment/ Density)	6.4	3.9	3.5	10.6
Price/Board Ft	\$2.48	\$5.32	\$6.00	\$3.69 \$7.38 (header grade)

G = Good

E = Excellent

EVALUATION LOCATIONS

MARINITE I - ATC

VERNON

WENATCHEE

LAFAYETTE

DAVENPORT

MASSENA

TENNESSEE

WARRICK

PYROTHERM B-2 - ATC

ROCKDALE

BADIN

DAVENPORT

WENATCHEE

MASSENA

WARRICK

TENNESSEE

COMPARATIVE DATA ON CHEMFIL GRC 125/S
& JOHNS-MANVILLE'S FLAT TRANSITE

<u>Technical Data</u>	<u>CHEMFIL GRC-125/S</u>	<u>JOHNS-MANVILLE FLAT TRANSITE</u>
Max. Service Temperature	320°C (600°F)	320°C (600°F)
Density, Kg/m ³	2000	1600
Pcf	125	100
Water Absorption % of Dry Weight	Max. 16%	Max. 22%
Modulus of Rupture, MPa	27.6	27.6
Psi	4000	4000
Compressive Strength, MPa	69.0	82.8
Psi	10,000	12,000
Shear Strength, MPa	2.4 Interlaminar	
	9.7 In-plane	24.1
Psi	350 Interlaminar	3500
	1400 In-plane	
Thermal Expansion cm/cm/K	7x10 ⁻⁶	5x10 ⁻⁶
in/in/F	12x10 ⁻⁶	8.6x10 ⁻⁶
Thermal Conductivity, W/m ^o K	1	.9
Btu in/hr Ft ²	5	4.5

R-680 PROGRAM

INTRODUCTION

PROPERTIES

LAB RESEARCH

- a) ALLOY CHANGES
- b) SHEET INGOT
- c) WENATCHEE-BADIN 6" & 7"
- d) PROPER INSTALLATION & USAGE
- e) CLAMPING PRESSURES
- f) THERMAL PROFILES

R-680 - IS A REFRACTORY COMPOSED PRIMARIALLY
OF FUSED SILICA AGGREGATE BONDED TOGETHER
BY A COMBINATION OF CEMENT PHASES
($\text{CaO} \cdot 2\text{Al}_2\text{O}_3$, $\text{CaO} \cdot \text{Al}_2\text{O}_3$) AND AN EXTREMELY
CORROSION RESISTANT GLASS COMPRISING OXIDES
OF Zn, B, Si, Ca, AND MINOR IMPURITIES.

PHYSICAL & CHEMICAL PROPERTIES OF R-680 CERAMICS

<u>CHEMICAL ANALYSES</u>	<u>WT%</u>
SiO ₂	68.4
Al ₂ O ₃	23.1
CaO	4.5
B ₂ O ₃	1.0
ZnO	2.9
Na ₂ O	.24

<u>PHYSICAL PROPERTIES</u>	<u>SI UNITS</u>	<u>BRITISH</u>
Specific Gravity	2480 Kg/m ³	
Bulk Density	1299 Kg/m ³	(120 pcf)
Apparent Porosity	23%	
Modulus of Rupture	14.5 MPa	(2100 psi)
Cold Crushing Strength	67.6 MPa	(9800 psi)
Coefficient of Linear Thermal Expansion (50°C/Hr) (20-860°C) in./in./°C (70-1700°F) in./in./°F	4.4 x 10 ⁻⁶ 2.4 x 10 ⁻⁶	
Thermal Conductivity C Room Temperature	0.88 $\frac{\text{Watts}}{\text{M-K}}$	6.1 $\frac{\text{Btu-W}}{\text{hr-ft}^2 \text{F}^\circ}$