BNWL-809

UC-25

2-

EVALUATION OF UNARCOBOARD-36
STRUCTURAL INSULATING PANELS

N. C. Davis

MAY 1968

AEC RESEARCH &
DEVELOPMENT REPORT

ROUTE TO	DATE	BY	FILED	DATE
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BNWL-809
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Metals, Ceramics
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EVALUATION OF UNARCOBOARD-36
STRUCTURAL INSULATING PANELS

By

H. C. Davis
Materials Process Development
Materials Department

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JUL 25 '68

May, 1968

Battelle Memorial Institute
Pacific Northwest Laboratory
Richland, Washington

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EVALUATION OF UNARCOBOARD-36
STRUCTURAL INSULATING PANELS

ABSTRACT

A program was conducted by Battelle Northwest to evaluate Unarcoboard-36, a Unarco Industries insulating precast structural material. This program concentrated on determining the physical integrity of the material by use of compressive strength tests made after the material had been subjected to various environmental conditions. These conditions simulated the proposed application of this material in a radioactive waste storage tank installation.

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EVALUATION OF UNARCOBOARD-36
STRUCTURAL INSULATING PANELS

INTRODUCTION

The Materials Process Development Unit of Battelle Northwest was requested by the Facilities Engineering Unit of the Atlantic Richfield Hanford Company (ARHCO) to provide technical assistance in evaluating Unarcoboard-36. This material has been proposed by a contractor for use in an application in the construction of waste storage tanks.

The compressive strength and physical integrity of this material, subjected to various environmental conditions typical to this proposed application, is of major concern in this evaluation. All data collected are reported for the project engineering consideration of suitability in the proposed use. These are all laboratory scale experiments, attempting to simulate the known environmental conditions in the storage tank installation. Results should not be considered directly applicable to use of the material in the manner or service being considered. Comparison with other possible material for this use is not made and test results are not compared with the detailed criteria for this application. However, data presented will be beneficial in making these comparisons and final determinations.

SUMMARY

Unarcoboard-36 is precast asbestos fiber insulating material produced by the Chembest Division of the Unarco Industries. The manufacturer's data is provided as Appendix B in this report. A 2 feet x 2 feet square of their 1-7/8 inch thick board was supplied for these special evaluations.

Compressive test specimens were sawed from this sample to provide 1-7/8 inch cubes for the various tests. The environmental conditioning included; preheating the material, and soaking the samples in both water (including 20 psi water pressure) and substitution tank slurry. Compressive strengths results ranged from a low of 928 psi in a single test of a sample that had been pressurized 5 days at 20 psi water to a high of greater than 3000 psi. This extremely wide spread of results is apparently due to the many special environmental conditions.

The thermal insulating properties of this material were demonstrated in a test that applied a hot face to one side of the material with temperature readings obtained at various distances from the applied heat. With 1100 °F on one surface, the temperature was reduced to 174 °F approximately 4 inches through the material and further reduced to 92 °F on the extreme face 7-1/2 inches from the applied 1100 °F temperature.

One inch cubes were cut from this material and subjected to radiation to a total dose of 10^8 R. This irradiation did not have any apparent effect on the samples. Crushed test results indicated very similar physical integrity to the identical non-irradiated samples.

Figure 1. Typical Compressive Test Cubes 1-7/8 Inch

Approximately forty (40) 1-7/8 inch cubes were sawed from the Unarcoboard-36 sample as shown in Figure 1. This material is manufactured by laminating asbestos fibers in a high pressure process that results in a preferred orientation for compressive loading. Samples were tested by applying compressive load both parallel and perpendicular to the direction of forming. As would be expected, greater structural strength was noted as a result of loading perpendicular to the forming direction. The values shown in Table I are maximum loads recorded at the point of deflection of the material. After this initial load deflection, the sample would be slightly deformed (compressed) and then maximum load could be increased approximately 50% before total failure.

Environmental Test Conditions

- A. Room temperature compressive testing of samples as sawed.
- B. Room temperature compressive testing of samples after soaking in water thirty minutes.
- C. Samples heated to 350 °F and tested at temperature.
- D. Samples heated to 500 °F and tested at temperature.
- ^{1*}E. Samples heated to 500 °F, then to 1100 °F at a rate of 100° per hour and tested at 1100 °F.
- F. Samples heated to 350 °F, allowed to cool, and tested at room temperature.
- G. Samples heated to 500 °F, allowed to cool, and tested at room temperature.
- ^{1*}H. Samples heated to 1100 °F, allowed to cool, and tested at room temperature.
- I. Samples heated to 350 °F, allowed to cool, soaked in water, and tested wet.
- J. Samples heated to 500 °F, allowed to cool, soaked in water, and tested wet.
- K. Samples heated to 1100 °F, allowed to cool, soaked in water, and tested wet.
- L. Samples pressurized in water to 20 psi for five days and tested wet.
- ^{2*}M. Samples soaked in substitution tank slurry, Table I, for five (5) days.
- ^{2*}N. Samples soaked in substitution tank slurry, Table II, for five (5) days.

^{1*} Sample at temperature 1100 °F displayed microcracks which were not observed after cooling.

^{2*} Substitution tank slurry specification shown in Appendix C.

Table I
Compressive Test Results *
Unarcoboard 1-7/8 Inch Cubes

<u>Sample No.</u>	<u>Environmental Conditions</u>	<u>Loading Direction</u>	<u>Maximum Load</u>		<u>Lb. Per Sq. In.</u>
1	A	⊥	7500	-	2143
2	A	⊥	7600	-	2171
3	A		5750	-	1643
4	A	⊥	8550	-	2443
5	B		4700	-	1343
6	B		4950	-	1414
7	B		5100	-	1457
8	C		6750	-	1928
9	C		4750	-	1357
10	C		6250	-	1785
11	D		4900	-	1400
12	D		7600	-	2171
13	D		5300	-	1514
14	E	⊥	7650	-	2186
15	E		6350	-	1814
16	E	⊥	6025	-	1721
17	F	⊥	9850	-	2814
18	F	⊥	9600	-	2742
19	F	⊥	9150	-	2614
20	G		7250	-	2071
21	G	⊥	10750	-	3071
22	G	⊥	9450	-	2700
23	H	⊥	10400	-	2971
24	H		8550	-	2442
25	H	⊥	10400	-	2971
25A	H		6700	-	1914
26	I	⊥	6900	-	1971

*Test Data Sheets included in Appendix A.

Table I (Continued)

<u>Sample No.</u>	<u>Environmental Conditions</u>	<u>Loading Direction</u>	<u>Maximum Load</u>		<u>Lb. Per Sq. In.</u>
27	I	⊥	7150	-	2042
28	I	⊥	7200	-	2057
29	J	⊥	8775	-	2507
30	J		5250	-	1500
31	J	⊥	8650	-	2471
32	K	⊥	4600	-	1314
33	K		4200	-	1200
34	K	⊥	5200	-	1486
34A	K	⊥	4700	-	1343
35	L	⊥	5200	-	1486
36	L		3250	-	928
36A	L	⊥	6000	-	1714
37	M		3450	-	986
38	M	⊥	4750	-	1357
39	N		3950	-	1128
40	N	⊥	5250	-	1500

Figure 2. Comparison of Unarcoboard After Irradiation

Irradiation Testing

The four samples on the right, Figure 2, were irradiated in a Co^{60} gamma radiation facility. They received a total dose of 10^6 R and appeared identical after irradiation to the two samples on the left that were not irradiated. These one inch cubes were broken by compressive loading, and the integrity of the material after irradiation is very similar to the non-irradiated material.

Sample A	non-irradiated	2525 psi
Sample B	non-irradiated	2050 psi
Sample 1X	irradiated 10^3 R	2550 psi
Sample 2X	irradiated 10^6 R	1800 psi

Figure 3. Thermal Mock-Up Insulation Test

To simulate the 1100 °F stress relieve heat treatment planned for the proposed storage tank and to observe the insulating qualities as well as the effect this temperature would have on the Unarcoboard-36 material, a mock-up test was performed. The 1-7/8 inch board was cut into squares of 5 inches x 5 inches and stacked as shown in Figure 3. Heat was applied (1100 °F) through a 1/4 inch steel plate at the bottom of the stack and temperatures were recorded as noted (Figure 3). Visually no ill effects were noted during or as a result of this thermal gradient heating.

ACKNOWLEDGEMENT

The cooperation of the U.S. Testing Company, Richland, Washington, in the formal testing of this material is appreciated. The contribution of Mr. Harry Waltenbaugh and William Alexander are especially acknowledged by the inclusion of their test data sheets in Appendix A in this document. Recognition is also due Mr. R. E. Woodley of Battelle's Material Compatibility Unit for his scheduling the use of the Co⁶⁰ gamma facility.

APPENDIX A

UNITED STATES TESTING COMPANY
UNARCOBOARD TEST DATA SHEETS

ESTABLISHED 1880

United States Testing Company, Inc.

2800 GEORGE WASHINGTON WAY
 RICHLAND, WASHINGTON 99352
 509-946-5157

REPORT

DNWL-809

NUMBER

A-31293
 (Refer to this number)

May 28, 1968

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	1	2	3	4
Marking	A	A	A	A
Environmental Test Conditions	Tested as Received, Room Temperature	Tested as Received, Room Temperature	Tested As Received, room Temperature	Tested as Received, room Temperature
Loading Direction	<u>I</u>	<u>I</u>	<u>II</u>	<u>I</u>
Maximum Load	7,500	7,600	8,750	8,550
P.S.I. Lbs./sq. inch	2,143	2,171	1,643	2,443

Cube Size: 1.875" X 1.875"
 Area (sq. inches): 3.52
 Loading Direction,
 Perpendicular: I
 Parallel: II

Date Tested: May 20, 1968

Page 1 of

Supervised by

William A. Alexander
 William A. Alexander

United States Testing Company, Inc.

Harry L. Waltenbaugh
 Harry L. Waltenbaugh

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 RICHLAND, WASHINGTON 99352
 509-946-5157

REPORT

NUMBER

A-31293
 (Refer to this number)

May 28, 1963

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	5	6	7	
Marking	B	B	B	
Environmental Test Conditions	Tested as Received, soaked in H ₂ O 30 min.	Tested as Received, soaked in H ₂ O 30 min.	Tested as Received, soaked in H ₂ O 30 min.	
Loading Direction	II	II	II	
Maximum Load	4,700	4,950	5,100	
P.S.I. Lbs/sq.inch	1,343	1,414	1,457	

Cube Size: 1.875" X 1.875"

Area (sq.inches): 3.52

Loading Direction,

Perpendicular: $\frac{1}{11}$

Parallel: $\frac{1}{11}$

Date Tested: May 20, 1968

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REPORT

NUMBER

A-31293
(Refer to this number)

May 28, 1968

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	8	9	10	
Marking	C	C	C	
Environmental Test Conditions	Heated to 350°, Held 1 hr., Tested	Heated to 350° Held 1 hr., Tested	Heated to 350° Held 1 hr., Tested	
Loading Direction	II	II	II	
Maximum Load	6,750	4,750	6,250	
P.S.I. Lbs/sq.inch	1,928	1,357	1,785	

Cube Size: 1.875" X 1.875"
Area (sq.inches): 3.52
Loading Direction,
Perpendicular: I
Parallel: II

Date Tested: May 20, 1968

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NUMBER

A-31293

(Refer to this number)

May 28, 1968

REPORT

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	11	12	13	
Marking	D	D	D	
Environmental Test Conditions	Heated to 500° held 1 hr., Tested	Heated to 500° held 1 hr., Tested	Heated to 500° held 1 hr., Tested	
Loading Direction	11	11	11	
Maximum Load	4,900	7,600	5,300	
P.S.I. lbs/sq.inch	1,400	2,171	1,514	

Tube size: 1.875" x 1.875"
 Area (sq.inches): 3.52
 Loading Direction,
 Perpendicular: 1
 Parallel: 11

Date Tested: May 20, 1968

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BY Harry L. Waltenbaugh

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509-946-5157

REPORT

NUMBER

A-31293
(Refer to this number)

May 28, 1968

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	14	15	16	
Marking	E	E	E	
Environmental Test Conditions	Heated to 1100° @100°/hr, start at 500°, Tested	Heated to 1100° @100°/hr, start at 500°, Tested	Heated to 1100° @100°/hr, start at 500°, Tested	
Loading Direction	I	II	I	
Maximum Load	7,650	6,350	6,025	
P.S.I. Lbs/sq. inch	2,186	1,814	1,721	

Cube Size: 1.875" X 1.875"
Area (sq. inches): 3.52
Loading Direction,
Perpendicular: I
Parallel: II

Date Tested: May 20, 1968

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BY Harry L. Waltenbaugh
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REPORT

NUMBER

A-31293

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May 28, 1968

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	17	18	19	
Marking	F	F	F	
Environmental Test Conditions	Heated to 350° Cooled to room Temp., Tested	Heated to 350° Cooled to room Temp., Tested	Heated to 350° Cooled to room Temp., Tested	
Loading Direction	<u>1</u>	<u>1</u>	<u>1</u>	
Maximum Load	9,850	9,600	9,150	
P.S.I. Lbs/sq.inch	2,814	2,742	2,614	

Cube Size: 1.875" X 1.875"
 Area (sq.inches): 3.52
 Loading Direction,
 Perpendicular: 1
 Parallel: 11

Date Tested: May 20, 1968

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NUMBER

A-31293
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May 28, 1968

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	20	21	22	
Marking	G	G	G	
Environmental Test Conditions	Heated to 500° Cooled to Room Temp., Tested	Heated to 500° Cooled to Room Temp., Tested	Heated to 500° Cooled to Room Temp., Tested	
Loading Direction		⊥	⊥	
Maximum Load	7,250	10,750	9,450	
P.S.I. lbs/sq.inch	2,071	3,071	2,700	

Cube Size: 1.875" X 1.875"

Area (sq.inches): 3.52

Loading Direction,

Perpendicular: $\frac{1}{11}$

Parallel: 11

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May 28, 1968

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	23	24	25	25A
Marking	H	H	H	H
Environmental Test Conditions	Heated to 1100 Cooled, Tested	Heated to 1100 Cooled, Tested	Heated to 1100 Cooled, Tested	Heated to 1100 Cooled, Tested
Loading Direction	I	II	I	II
Maximum Load	10,400	8,550	10,400	6,700
P.S.I. Lbs./sq. inch	2,971	2,442	2,971	1,914

Cube Size: 1.875" X 1.875"
Area (sq. inches): 3.52
Loading Direction,
Perpendicular: I
Parallel: II

Date Tested: May 20, 1968

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Harry L. Waltenbaugh

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NUMBER

A-31293
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May 28, 1968

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	26	27	28	
Marking	I	I	I	
Environmental Test Conditions	Heated to 350° Cooled, Soaked H ₂ O 30 min, Tested	Heated to 350° Cooled, Soaked -----	Heated to 350° Cooled, Soaked -----	
Loading Direction	<u>I</u>	<u>I</u>	<u>I</u>	
Maximum Load	6,900	7,150	7,200	
P.S.I. Lbs/sq. inch	1,971	2,042	2,057	

Spec Size: 1.875" X 1.875"
 Area (sq. inches): 3.52
 Loading Direction,
 Perpendicular: I
 Parallel: II

Date Tested: May 20, 1968

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May 28, 1968

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	29	30	31	
Marking	J	J	J	
Environmental Test Conditions	Heated to 500° Cooled, Soaked Tested	Heated to 500° Cooled, Soaked Tested	Heated to 500° Cooled, Soaked Tested	
Loading Direction	I	II	I	
Maximum Load	8,775	5,250	8,650	
P.S.I. Lbs/sq.inch	2,507	1,500	2,471	

Cube Size: 1.875" X 1.875"
Area (sq.inches): 3.52
Loading Direction,
Perpendicular: I
Parallel: II

Date Tested: May 20, 1968

Page 1 of

Supervised by

William A. Alexander

United States Testing Company,

BY

Harry L. Waltenbaugh

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ESTABLISHED 1800

United States Testing Company, Inc.

2800 GEORGE WASHINGTON WAY
 RICHLAND, WASHINGTON 99352
 509-946-5157

REPORT

NUMBER

A-31293
 (Refer to this number)

May 28, 1968

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	32	33	34	34A
Marking	K	K	K	K
Environmental Test Conditions	Heated to 1100° Cooled, Soaked Tested	Heated to 1100° Cooled, Soaked Tested	Heated to 1100° Cooled, Soaked Tested	Heated to 1100° Cooled, Soaked Tested
Loading Direction	<u>I</u>	II	<u>I</u>	<u>I</u>
Maximum Load	4,600	4,200	5,200	4,700
P.S.I. lbs/sq. inch	1,300	1,200	1,486	1,343

Cube Size: 1.875" X 1.875"
 Area (sq. inches): 3.52
 Loading Direction,
 Perpendicular: I
 Parallel: II

Date Tested: May 20, 1968

Page 1 of

Supervised by

William A. Alexander
 William A. Alexander

United States Testing Company

BY *Harry L. Waltenbaugh*
 Harry L. Waltenbaugh

A-12

BNWL-809

ESTABLISHED 1900

United States Testing Company, Inc.

2300 GEORGE WASHINGTON WAY

RICHLAND, WASHINGTON 99352

509-946-5157

REPORT

NUMBER

A-31293

(Refer to this number)

May 28, 1963

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	35	36	36A	
Marking	L	L	L	
Environmental Test Conditions	20 PSI water pressure - 5 days, Tested	20 PSI water pressure - 5 days, Tested	20 PSI water pressure - 5 days, Tested	
Loading Direction	<u>⊥</u>		<u>⊥</u>	
Maximum Load	5,200	3,250	6,000	
P.S.I. Lbs/sq.inch	1,486	928	1,714	

Cube Size: 1.875" x 1.875"
Area (sq.inches): 3.52
Loading Direction,
Perpendicular: ⊥
Parallel: ||

Date Tested: May 20, 1968

Page 1 of

Supervised by

William A. Alexander

United States Testing Company, Inc.

BY

Harry L. Waltenbaugh

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THE SAMPLE TESTED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF ANY PRESENTLY IDENTICAL OR SIMILAR PRODUCTS. SAMPLES NOT DES
TESTING. RETAINED A MAXIMUM OF THIRTY DAYS. THE QUALITY AND THE NAME OF THE UNITED STATES TESTING COMPANY, INC.

A-13

BNWL-809

ESTABLISHED 1880

United States Testing Company, Inc.

2800 GEORGE WASHINGTON WAY

RICHLAND, WASHINGTON 99352

509-946-5157

REPORT

NUMBER

A-31293

(Refer to this number)

May 28, 1968

Client: Battelle - Northwest
Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	37	38		
Marking	M	M		
Environmental Test Conditions	Soaked 5 days Slurry Table II Tested	Soaked 5 days Slurry Table I Tested		
Loading Direction	II	I		
Maximum Load	3,450	4,750		
P.S.I. Lbs/sq.inch	986	1,357		

Cube Size: 1.875" X 1.875"

Area (sq.inches): 3.52

Loading Direction,
Perpendicular: I
Parallel: II

Date Tested: May 20, 1968

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Harry L. Waltenbaugh

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ESTABLISHED 1939

United States Testing Company, Inc.

2800 GEORGE WASHINGTON WAY

RICHLAND, WASHINGTON 99352

509-946-5157

REPORT

NUMBER

A-31293

(Refer to this number)

May 28, 1968

Client: Battelle - Northwest
 Attention: Mr. N. C. Davis

Subject: Compression Test Analysis of Unarcoboard Specimens

Specimen No.	39	40		
Marking	N	N		
Environmental Test Conditions	Soaked 5 days Slurry Table 1 Tested	Soaked 5 days Slurry Table 1 Tested		
Loading Direction		⊥		
Maximum Load	3,950	5,250		
P.S.I. Lbs/sq.inch	1,128	1,500		

Cube Size: 1.875" X 1.875"
 Area (sq.inches): 3.52
 Loading Direction,
 Perpendicular: ⊥
 Parallel: ||

Date Tested: May 20, 1968

Page 1 of 1

Supervised by

William A. Alexander
 William A. Alexander

United States Testing Company, Inc.

BY

Harry L. Waltenbaugh
 Harry L. Waltenbaugh

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 THE USE OF THE NAME OF UNITED STATES TESTING COMPANY, INC., MUST RECEIVE OUR PRIOR WRITTEN APPROVAL. OUR LETTERS AND REPORTS APPLY TO
 THE SAMPLE TESTED AND ARE NOT NECESSARILY INDICATIVE OF THE QUALITIES OF APPARENTLY IDENTICAL OR SIMILAR PRODUCTS. SAMPLES NOT DE
 IN TESTING OBTAINED A MAXIMUM OF THIRTY DAYS FROM THE DATE OF TESTING AND THE NAME OF THE UNITED STATES

APPENDIX B

CHEMBEST DIVISION OF UNARCO INC.
PHYSICAL PROPERTIES DATA

UNARCOBOARD

Structural Insulating Panels Resistant to 1200°F

Additional Properties of Amosite Asbestos Provide Greater Strength and Higher Insulation Quality

WHY UNARCOBOARD? . . . There are two important advantages inherent in Unarcoboard. First, being made with Amosite Asbestos, its longer, stronger fibers produce a board that is structurally stronger than many competitive products. Next, because of the intrinsic characteristics of Amosite Asbestos fiber, in combination with other materials and an inorganic binder, Unarcoboard is resistant to temperatures up to 1200° F. These are only the two principal advantages. The others which follow make Unarcoboard worthy of your consideration.

OTHER ADVANTAGES . . . Because of high strength and insulating efficiency Unarcoboard eliminates need for metal sheathing for containment or protection. Unarcoboard also offers the following advantages. **Extremely Hard Surface** . . . an important feature that cuts costs by reducing surface scratching and abrasion wear. **Easily Shaped and Handled** . . . can be sawed, planed, sanded, drilled, screwed, nailed and painted as easily as wood. Can also be laminated to almost any material. **No Maintenance** . . . immune to swelling, cracking, warping, burning, rotting and vermin. **Resistant to Chemicals** . . . most chemicals and their fumes or gases have no effect on Unarcoboard.

MANY APPLICATIONS

The basic advantages described make Unarcoboard particularly applicable to a wide range of uses, the following are just a few:

- Marine Bulkheads
- Ovens, Dryers
- Breechings
- Insulated Housings and Heat Screens
- Fabricated Assemblies of Many Types
- Core Material For Fire-proof Doors, Partitions and Other Forms of Construction

Underwriters' Laboratories, Inc. has assigned Retardant No. 4353 for the following rating: Flame spread—0; Smoke developed—0; Fuel Contributed—Negligible. This classification is listed under Label Service Guide #40 UB.13.

physical properties

	UNARCOBOARD 22	UNARCOBOARD 36
Density (Dry) lb/cu.ft.	22	36
Moisture Content (Normal at 50% RH) % of dry weight	5	3.5
Transverse Strength (Dry) psi (Modulus of Rupture)	500	1000
After 24-hr. soaking neat at indicated temperature	500 (1000° F)	1000 (1000° F)
Modulus of Elasticity (Dry) psi		
In Flexure	.20 x 10 ⁶	.30 x 10 ⁶
In Compression	.09 x 10 ⁶	.10 x 10 ⁶
Consolidation (Normal) in./in.		
Load, psi	500	.006
	2000	.050
	4000	.350
	8000	.520
Proportional Limit in compression, psi	1550	1750
Compressive Strength (Normal) psi	13500	8300
Charpy Impact Resistance (Normal) in.lb.		
ASTM D 256-54T, Method B-4" span.		
5" x 1/2" x 1/2" unnotched samples	1.3	1.4
Screw Holding Strength (Normal) lb/screw		
(Withdrawal load for Type A No. 6 Sheet Metal Screws)		
1/2" penetration	41	152
3/4" penetration	124	232
Shear Strength (From Screw Holding Test) psi	205	700
Brinell Hardness No. (Dry) (50 kg load, 10 mm ball, 10 sec)	—	4.32
Brinell Hardness No. (Dry) (10 kg load, 10 mm ball, 10 sec)	.53	—
Dimensional Change Due to Moisture in./in.		
Shrinkage — Normal to Dry	.0007	.00052
Expansion — Normal to 90% RH	.00012	.00016
Expansion — Dry to Saturated	.0012	.00170
Expansion — Dry to 90% RH	.0004	.00058
Thermal Expansion in./in./°F		
	2.0 x 10 ⁻⁶	1.0 x 10 ⁻⁶
	(212°, shrinkage thereafter)	(212°, shrinkage thereafter)
Maximum Service Temperature, (For Continuous Service)	1200° F	1200° F

The above values are supported by figures from an independent laboratory.
Additional information is available to relate these values to specific applications.

DIMENSIONAL TOLERANCES (Inches)**UNARCOBOARD (ALL TYPES)**

Length and Width	± 1/16
Thickness	± 1/32
Squareness, maximum deviation per linear yard	± 1/16

STANDARD THICKNESS AND SIZES

Type 22	Type 36	SHEET SIZES (ALL TYPES)
3/4"	1/2"	4' x 4'
7/8"	3/4"	4' x 6'
1"	7/8"	4' x 10'
1 1/4"	1"	5' x 10'
1 1/2"	1 1/4"	
2"	1 1/2"	
	2"	

Prices for especially fabricated pieces, non-standard sheet sizes and thicknesses available on request.

Chemibond Division of
1111 West Perry St., Bloomington, Illinois 61701

UNARCOBOARD 33

Unarcoboard 33 had been tested according to the U.S. Coast Guard Specification for Bulkhead Panels ---- Fire Endurance Test, Sub Part 164.008. The material was considered acceptable following the test at the National Bureau of Standards.

This fire test is conducted having a 3/4" thick Unarcoboard installed similar to the application aboard ship. The endurance of the fire test is for one hour during which time the temperature rises from room temperature to 1700 °F. At the end of one hour, the material must be intact and not allow any passage of flame or smoke. The allowable temperature rise on the cold face at the end of the first 15 minutes is 250°F. over room temperature.

U.S. Coast Guard Approval - August 13, 1964

Underwriters' Laboratories Approved 36 pound - March 9, 1961

Underwriters' Laboratories Approved 22 pound - October 10, 1965

HEAT LOSS AND SURFACE TEMPERATURE GRAPH EXPLANATION FOR FLAT VERTICAL SURFACES

I - HOT FACE TEMPERATURES

Example: Knowing the hot face temperature a line is projected vertically upward to intercept the desired thickness curve. From this intersection move horizontally to the left. Moving past the reference curve to the scale on the left read directly the BTU loss per square foot per hour. Stopping the horizontal projection at the reference curve and then moving vertically upward the surface temperature is read directly from the top scale.

With a selected hot face temperature of 600° F. expecting to use 3" of UNARCOBOARD we move vertically upward from the 600° F. point until the 3" thickness curve is reached. Then projecting all the way to the left we find 125 BTU's per square foot per hour would be lost. Stopping the horizontal leftward projection at the reference line and then moving upward we find a surface temperature of approximately 144° F.

II - MAXIMUM BTU LOSS

Example: In a "situation" where a maximum BTU loss is required, using the same set of circumstances, in this case 125 BTU's per square foot per hour, move from the 125 mark on the left scale horizontally to the right to the reference line and then vertically upward to determine the surface temperature. Continuing the horizontal movement to the right past the reference curve to the thickness curve indicates the hot face temperature. In this case the intercept is at the 3" curve for a 600° F. hot face temperature.

III - MAXIMUM SURFACE TEMPERATURE

Example: If a maximum surface temperature is required, in this case 144° F., starting at the top scale move vertically downward until intercepting the reference curve. From here a horizontal projection to the left will show the BTU loss per square foot per hour. Projecting horizontally to the right we note that a 3" thickness is required for a hot face temperature of 600° F.

UNARCOBOARD APPLICATIONS

Ceramic tile backing
Brick veneer backing
Roof decking
Interior wall panels
Curtain wall panels
Flooring
Ceilings
Shelving
Door cores
Duct work
Breachings
Subfloors in bowling alleys, ice skating rinks, etc.
Subfloors in any commercial building
Heat screens and deflectors
Structural steel protection
Valve and other housings
Base for decorative finishes
Lining dust collecting equipment
Fireproofing file cabinets
Ship bulkheads
Deck flooring
Structural members
Interior partitions and ceilings
Panels for drying and baking ovens
Heating panels
Pattern making applications
Foundry work - 1. Core plates
 2. Jackets
 3. Patterns
 4. Pattern boards
Vacuum forms in plastics
Tank insulation
Drying tower insulation
Aircraft fire walls
Pouring nozzles, troughs, etc. for non-ferrous metals industry
Floats for non-ferrous metals industry

FINISHING MATERIAL

Paints

Moisture Coatings

Water repellent silicone resin

Coumarone resins

Laxtex base paints of acrylic, polyvinyl acetate or styrene-butadiene types are self priming, usually two coats.

Chlorinated rubber base masonry paints are also self priming.

Where moisture and heat are encountered, a breathing type paint should be used.

TYPE A SHEET METAL

<u>Screw Size</u>	<u>Drill Size</u>
No. 6	0.138"
No. 8	0.165"
No. 10	0.191"
No. 12	0.218"
No. 36	0.106"
No. 29	0.136"
No. 20	0.161"
No. 13	0.185"

ISSUED TO UNARCO Industries, Inc. Chembest Division 1111 West Perry Street Bloomington, Illinois 61702	UNITED STATES COAST GUARD CERTIFICATE OF APPROVAL for Bulkhead Panel	EXPIRATION DATE August 27, 1969	APPROVAL NUMBER 164.008/46/0
--	---	------------------------------------	---------------------------------

DESCRIPTION

"UNARCOBOARD 33" bulkhead panel identical to that described in National Bureau of Standards Test Report No. TG10230-25: FR 3639 dated August 13, 1964; approved as meeting Class B-15 requirements in a 3/4 inch thickness, 33 pounds per cubic foot density.

ALARMED

None

IDENTIFYING DATA

National Bureau of Standards Test Report No. TG10230-25: FR 3639 dated August 13, 1964.

THIS IS TO CERTIFY THAT the above named manufacturer has submitted to the undersigned satisfactory evidence that the item specified herein complies with the applicable laws and regulations as outlined on the reverse side of this Certificate, and approved as such by the undersigned. This approval shall be in effect for a period of five years from the date hereof, provided or extended by proper authority.

BY *[Signature]* COMMANDANT

Given Under My Hand This 27th Day of
August 1964, at Washington, D. C.

Acting *[Signature]* S. H. RICE, CAPTAIN, USCG
Chief, Merchant Marine Technical Division, U. S. C. G.

CGN-10330 (Rev. 5-63)

TERMS: The approval of the item described on the face of the Certificate has been based upon the submission of satisfactory evidence that the item specified herein complies with the applicable provisions of the navigation and vessel inspection laws and the applicable regulations in Chapter I of Title 46 of the Code of Federal Regulations. The approval is subject to any conditions noted herein or in the applicable regulations governing the use thereof, for use on merchant vessels subject to Coast Guard inspection or on certain other vessels and motorboats as may be required by law or regulations.

Consideration will be given to an extension of this approval provided application is made 3 months prior to the expiration date of this Certificate.

When materials or devices covered by the approval set forth on the face hereof are to be in production, the Commander of the Coast Guard District in which the factory is located shall be notified in sufficient time to assign an inspector to the plant for the purpose of making any necessary inspections or tests.

The approval of the item covered by this certificate is valid only so long as said item is manufactured in conformance with the details of the approved drawings, specifications, or other data referred to. No modification in the approved design, construction, or materials is to be adopted until same has been presented for consideration through the Coast Guard District Commander and confirmation received that the proposed alteration is acceptable.

NOTICE: Where a manufacturer of safety-at-sea equipment is offering for sale to the maritime industry, directly or indirectly, equipment represented to be approved, which fails to conform with either the design details or material specifications, or both, as approved by the Coast Guard, immediate action may be taken to invoke the various penalties and sanctions provided by law including prosecution under 43 U.S.C., 481, which provides in part:

"Any person who willfully and knowingly manufactures or sells, or offers for sale, or has in his possession with intent to sell, any lifesaving, firefighting, or other equipment subject to the provisions of title 52 of the Revised Statutes, as amended, which is so defective as to be inefficient to accomplish the purpose for which it is intended, shall be fined not more than \$10,000 and may, in addition thereto, in the discretion of the Court, be imprisoned for a term not exceeding five years."

APPENDIX C

SUBSTITUTION TANK SLURRY

TABLE I

TABLE II

April 11, 1968

To: W. C. Armstrong
Facilities Engineering

From: W. C. Schmidt

Subject: CHEMICAL COMPOSITION OF B-PLANT
STORED BOILING WASTE

The compositions of current B-Plant stored boiling waste are listed in Table I. These compositions are based upon the present chemical flowsheets. These flowsheets will change as processing experience is gained but it is believed that they are sufficiently accurate for representing the slurry in the tank on a current basis.

Radiation decomposes the organics to sodium carbonate and a nitrogen-carbonaceous material which have not been identified. It also reduces the nitrate ion to a nitrite ion. Upon standing for a period of time the slurry in the tank will have the chemical composition shown in Table II.

It is recommended that the insulating concrete for the AY Tank Farm be evaluated in both slurries.

Attachment
WCS:jas

cc: P. Hatch
GC Oberg
PM Smith
File 354
LB

<u>Chemical</u>	Table I Current Boiling Waste Composition	Table II Stored Boiling Waste Composition
	<u>M</u>	<u>M</u>
Fe	0.10	0.10
Al	0.12	0.12
Na	1.2	2.0
Cr	0.005	0.005
Ni	0.002	0.002
Ca	0.001	0.001
Zr	0.02	0.02
SiO ₂	0.25	0.25
NO ₃	1.0	0.20
NO ₂		0.80
SO ₄	0.20	0.20
CO ₃	0.14	0.54
OH	0.05	0.05
F	0.02	0.02
Tartrate	0.013	
NTA	0.10	
Hydroxyacetate	0.18	
HEDTA	0.10	

Note from Standard Laboratory:

Foreign Ions: Table I
K⁺ 0.645 M

Table II
K⁺ 1.08 M
Cl⁻ 0.651 M

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