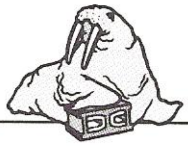
CBIS Korfil®

Protection is a concrete idea.



Technical Data Sheet No. 96-7

Urea Formaldehyde Foam Insulation (UFFI)

(Has the appearance and consistency of white shaving cream foam when pumped into the cells or cavities of masonry walls)

	Issue	Concern
1.)	**Toxicity**	Formaldehyde is a known health hazard and has been found in UFFIs. In 1982 the Consumer Product Safety Commission found sufficient evidence to ban materials containing this gas. Reference 1
2.)	**Shrinkage**	UFFIs have been tested and show shrinkage as a result of curing in the 3% - 6% range. They continue to shrink with age. This reduces Thermal R values significantly by as much as 30% - 40%. Reference 2, Pages 22 & 23; Reference 3, Page 3
3.)	**Disintegration Due to Moisture & Temperature**	Under temperature and humidity conditions found within Masonry Walls, UFFIs deteriorate with time. Reference 2, Page 23 Reference 3, Page 3
4.)	**Performance**	There can be a major reduction in the thermal efficiency of masonry walls when UFFI is replaced with grout and steel reinforcement. Reference 4, Table 1

Complete Copies of all References available upon request. **July 1996**

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Reference 1 - CBIS Technical
Data Sheet No. 96-7

C11011 1903225 K 0-01-02-030433

RATUIJAZ RUEVDFH0036 2251845-UUUU--RUGSGOF RHHMGSC
TLX W 09026521 DHUD AHG.
HUDA
R 131845Z AUG 82
FM DONALD K BAXTER HCC HUD WASH DC
TO RUGSGOF/REGIONAL ADMINISTRATOR HUD REGIONAL OFFICES
AREA OFFICE MANAGER HUD AREA OFFICES.
HOUSING DIVISION DIRECTOR HUD AREA OFFICES
SERVICE OFFICE SUPERVISOR HUD SERVICE OFFICES
SUPERVISOR HUD VALUATION AND ENDORSEMENT STATIONS
TO RHHMGSC/GSA PLS DLVR TO AREA OFFICE MANAGER HUD HONOLULU AO
HOUSING DIVISION DIRECTOR HUD HONOLULU AO
TO 09026521/AREA OFFICE MANAGER HUD ANCHORAGE AO
HOUSING DIVISION DIRECTOR HUD ANCHORAGE AO
BT
UNCLAS 8/13/82

ON APRIL 2, 1982 THE CONSUMER SAFETY PRODUCTS COMMISSION PUBLISHED A BAN ON UREA-FORMALDEHYDE FOAM INSULATION IN THE FEDERAL REGISTER, WHICH BECAME EFFECTIVE ON AUGUST 10, 1982. IN CONFORMANCE WITH THIS REQUIREMENT, THE DEPARTMENT INTENDS TO NOTIFY THE PUBLIC BY PUBLICATION IN THE FEDERAL REGISTER OF WITHDRAWAL OF USE OF MATERIALS (UM) BULLETIN NO. 74 THERMAL INSULATION, UREA BASED FOAMED IN PLACE AS A HUD PUBLICATION AND REMOVAL OF UM NO. 74 FROM ALL VOLUMES OF THE MINIMUM PROPERTY STANDARDS WHERE IT IS INCORPORATED BY REFERENCE.

/S/
DONALD K. BAXTER
DIRECTOR
CONSTRUCTION STANDARDS DIVISION
OFFICE OF MANUFACTURED HOUSING
AND CONSTRUCTION STANDARDS
BT
#0036

NNNN

030433 ACPT

Reference 2 - CBIS Technical
Data Sheet No. 96-7

ORNL-Sub-78/86993/1

ornl

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Performance Characteristics of Foamed-In-Place Urea Formaldehyde Insulation

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DYNATECH R/D COMPANY
Cambridge, Massachusetts

Part of
The National Program
for
Building Thermal Envelope Systems
and Insulating Materials

Prepared for the
U.S. Department of Energy
Conservation and Solar Energy
Office of Buildings and Community Systems
Buildings Division

OPERATED BY
UNION CARBIDE CORPORATION
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

Table 7. The Effect of Initial Thermal Resistance of Cavity Insulation and Wall Construction on the Reduction of Thermal Performance[a]

Reduction in Dimensions (%)	Reduction of Effective Thermal Resistance,[b] %	
	Initial R-14.7[c]	Initial R-18.55
1	6.7	8.4
2	12.8	15.4
3	18.0	21.8
4	22.9	27.2
5	27.2	31.8
7	34.5	39.9

[a] Calculated according to National Bureau of Standards model. Source: W. J. Rossiter, Jr., R. G. Mathey, D. M. Burch, and E. J. Pierce, "UreaFormaldehyde Based Foam Insulations: An Assessment of Their Properties and Performance," *NBS Tech. Note (U.S.)* 946, National Bureau of Standards, Washington, July 1977.

[b] As a function of thermal resistance of cavity fill (R_{wall} = 2.6).

[c] Equivalent to typical urea formaldehyde insulation.

ORNL-DWG 80-12186

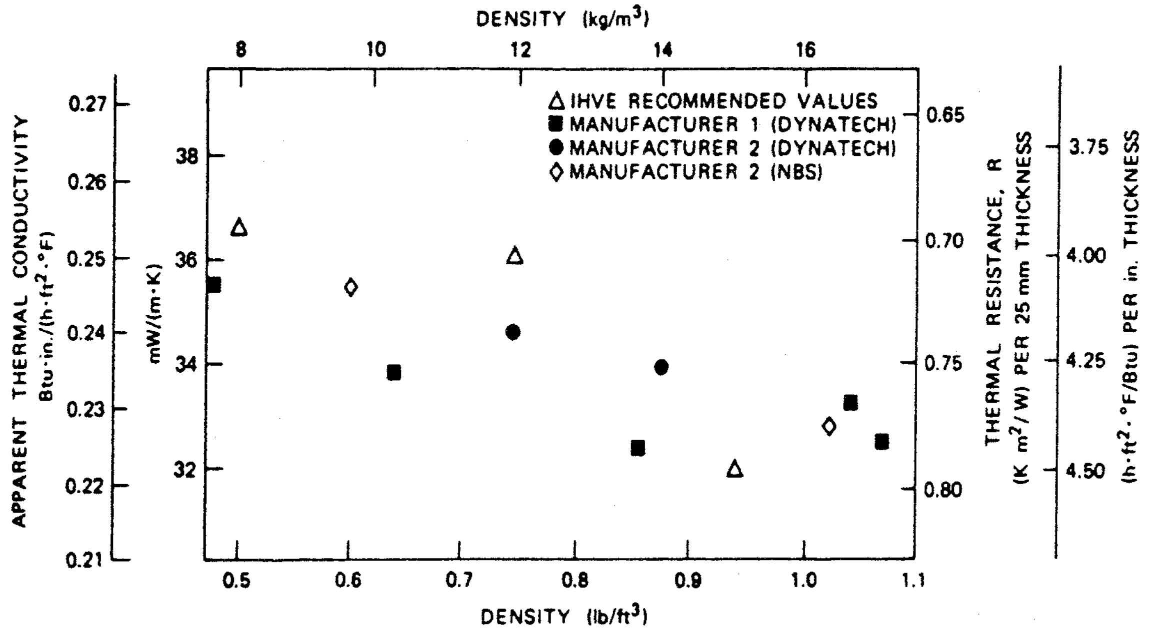

Fig. 3. Apparent Thermal Conductivity of Urea Formaldehyde Foam Insulation as a Function of Density.

5. SUMMARY AND RECOMMENDATIONS

The dimensional and mechanical properties of a urea formaldehyde product subjected to different temperature and humidity conditions for periods up to 8 months were measured. The thermal performance of a typical wall cavity containing thermal insulation and representing different sizes and positions of vertical air gaps were also measured. The air gap sizes were varied to cover a range equivalent to a 7% total reduction in cavity insulation dimensions. Various analytical techniques for the calculation of thermal performance were compared.

The conditioning study indicated that the installed 28-d urea formaldehyde density varied up to 25%. It had average linear shrinkage of 3.3% after curing and continued to shrink with time. After 8 months it had an average linear shrinkage of 5.4%. For all combinations of temperature and relative humidity the material showed reduced compressive strength with time. For high-temperature, high-humidity conditions the material had virtually no strength after 1 month. It had disintegrated after 8 months. Vapor appeared to influence the mechanical and dimensional properties more significantly than temperature alone.

The air gap study indicated a linear relationship between reduction in thermal performance and air gap size for reductions up to 7% in the linear dimensions of the insulation. The analysis of the results indicated that the parallel model can be used to derive representative thermal performance for cavity walls containing air gaps. The study did not include air gaps in the insulation or air infiltration effects. Thus the results provided *minimum* reductions when considering real life performance of insulated cavity walls.

Recommendations for further work to complement this study include the following:

1. study the changes of dimension and mechanical properties for low-temperature, high-humidity conditions and also for one cyclic condition that includes a higher humidity condition than the one of the present study;

2. repeat the conditioning program for one or more different urea formaldehyde foam insulation products now available with conditions outlined in 1;

3. use the present cavity wall system to measure thermal performance of the existing uninsulated wall and then install insulation containing simulated horizontal and diagonal air gaps representing 3, 5, and 7% reduced dimensions. Such air gaps are claimed by the urea formaldehyde manufacturers to be more representative of that material in a cavity wall;

4. measure the actual performance of the present wall system insulated separately with two different urea formaldehyde foam insulation products currently available to compare predicted and actual results.

Test Results

As indicated in the results tables, the samples exhibited some of the characteristics of previously available products. The dimensional stability tables show 9 of 14 samples had significant cracking after 13 days and 3 of 8 samples were broken and not measurable after 34 days. All of the samples were difficult to handle and easily compressed with finger pressure.

Linear shrinkage as a result of curing was calculated for one material by measuring the difference in the block cavity dimensions and those of the foam that was removed. This was measured in each of the two "Cossitt from block" cavities. This was found to be 5.2% in average dimension (15.6% volume). This compares well with previously measured values of 3-6% average per dimension. The following dimensional changes due to conditioning are in addition to the initial changes do to cure.

Linear shrinkage due to conditioning was calculated at approximately 1 week intervals. For the samples exposed full-time, average dimensional changes to date peaked in 2 weeks at +0.8% and was dropping to -0.6% in 5 weeks. Because the "Cossitt in block" samples are conditioning at 2 weeks behind the others, and 2 of the other 8 samples were not measurable at 5 weeks, the average values represent 11 samples at 1 week and 6 samples at 5 weeks. Limited data is available for dimensional stabilities over this short period of time. A study conducted for ORNL indicates a dimensional change of -0.9% after 4 weeks at the same condition.

The three samples being cycled showed dimensional changes of +1.0% wet at week 1, -3.1% dry at week 2, -0.2% wet at week 3, -3.5% dry at week 4 and -2.3%% wet at week 5. The cycling study previously described was conducted at generally more humid conditions (~70°F / 95% RH -> 50% RH) for longer cycle periods. The dimensional changes corresponding to the same period of time were -3.2% after the last dry condition and -0.6 after the last wet. At the first dry observation the density recovered to about 3% less than the received density. The shrinkage in volume was somewhat equal to the loss in mass.

One significant difference in the results is the mass <u>increase</u> that occurred. An increase has not been found in any of the previous studies of exposures to high humidities at this early stage of conditioning. Ignoring outliers, average mass increases of 76%, 112% and 26% for each specimen type was measured at the

Reference: CBL-2b 3 April 1996

Holometrix

Reference 3 - CBIS Technical
Data Sheet No. 96-7

Report on the

APPARENT THERMAL CONDUCTIVITY and DIMENSIONAL STABILITY of *FOAMED in PLACE* CELLULAR PLASTICS

Prepared for:

Concrete Block Insulating Systems
Freight House Road
West Brookfield, MA 01585-1000

Testing Services Division of Holometrix, Inc.

Report Number **CBL-2b**

Work Performed Under Purchase Order Number:
119

Submitted By: ______________________
Timothy J. Kunz
Project Manager
Testing Services Division

June 1996

Reference 4 - CBIS Technical
Data Sheet No. 96-7

NCMA TEK

National Concrete Masonry Association
an information series from the national authority on concrete masonry technology

R-VALUES FOR SINGLE WYTHE CONCRETE MASONRY WALLS

TEK 6-2A

Energy & IAQ (1996)

Keywords: insulation, reinforced concrete masonry, R-values, thermal insulation, thermal properties

INTRODUCTION

Concrete masonry walls are often constructed of hollow units with cores filled with loose fill material and/or grout. This construction method provides the minimum wall thickness, while allowing insulation and reinforcement to be included to increase thermal and structural performance, respectively.

Determining the thermal insulation values of these walls, however, can be time consuming, especially when the wall is composed of several materials. This TEK facilitates the determination of thermal resistance (R) and thermal transmittance (U) of these single wythe concrete masonry walls.

R-VALUE TABLES

Tables of calculated R-values for hollow block of 6, 8, 10 and 12 in. (152, 203, 254, and 305 mm) thicknesses, for concrete densities of 85 to 135 lb/ft³ (1362 to 2163 kg/m³) are included. In addition, Table 1 shows the approximate percentage of grouted and ungrouted wall area for different vertical and horizontal grout spacings, which can be used to determine R-values of partially grouted walls. Thermal properties used in compiling the tables are listed in Table 6.

In addition to the core insulations listed in Tables 2 through 5, polystyrene inserts are available which fit in the cores of concrete masonry units. Inserts are available in many shapes and sizes to provide a range of insulating values and accommodate various construction conditions. Specially designed concrete masonry units may incorporate reduced-height webs to accommodate inserts. Such webs also reduce thermal bridging through masonry, since the reduced web area provides a smaller cross-sectional area for heat flow through the wall. To further reduce thermal bridging, some manufacturers have developed units with two cross webs rather than three. In addition, some inserts have building code approval to be left in the grouted cores, thus improving the thermal performance of fully or partially grouted masonry walls.

Table 1—Percent Ungrouted Area/Percent Grouted Area For Partially Grouted Walls

Horizontal grout spacing, in. (mm)	Vertical grout spacing, in. (mm): no vert. grout	48 (1219)	40 (1016)	32 (813)	24 (610)	16 (406)
no horiz. grout	100/0	83/17	80/20	75/25	67/33	50/50
48 (1219)	83/17	69/31	67/33	63/37	56/44	42/58
40 (1016)	80/20	67/33	64/36	60/40	53/47	40/60
32 (813)	75/25	63/37	60/40	56/44	50/50	37/63
24 (610)	67/33	56/44	53/47	50/50	44/56	33/67
16 (406)	50/50	42/58	40/60	37/63	33/67	25/75

The ASHRAE series-parallel method (also called isothermal planes) (ref. 1) was used to calculate the base case values (i.e., the row *Exposed block, both sides*) in Tables 2 through 5. This method accounts for the thermal bridging through the webs of concrete masonry units. R-values of the various finish systems are added to these base values. To determine R-values for walls with 2 in. (51 mm) of rigid insulation (expanded polystyrene, extruded polystyrene, or polyisocyanurate) rather than the 1 in. (25 mm) shown in the tables, simply add the appropriate insulation thermal resistivity value from Table 6 to the R-values in Tables 2 through 5.

R-values of concrete masonry walls are correlated to concrete density, since thermal conductivity of concrete increases with increasing density. Tables 2 through 5 list a range of R-values for each density, as well as a single value, which represents a calculated middle of the range. The U-factor is determined by simply inverting the R-value (i.e., $U = 1/R$).

A range of thermal values is appropriate for concrete products because the thermal conductivity of concrete cannot always be accurately estimated from density alone. The thermal conductivity of concrete varies with aggregate type(s) used in the concrete mix, the mix design, moisture content, etc.

These published values reflect a compendium of historical data on thermal conductivity of concrete (refs. 1,3). Locally available products and local conditions may result in thermal values which fall outside of this range. The middle-of-the-range values are presented for use in cases where more accurate values are not available from local manufacturers.

(continued on back page)