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Use of Plastics in the Building Industry

Vienna, 20-24 September 1971

PLASTIC FOAMS FOR HOUSING[1/]

by

Werner T. Meyer

Chairman of the Board
U. F. Chemical Corporation
Woodside, New York
U.S.A.

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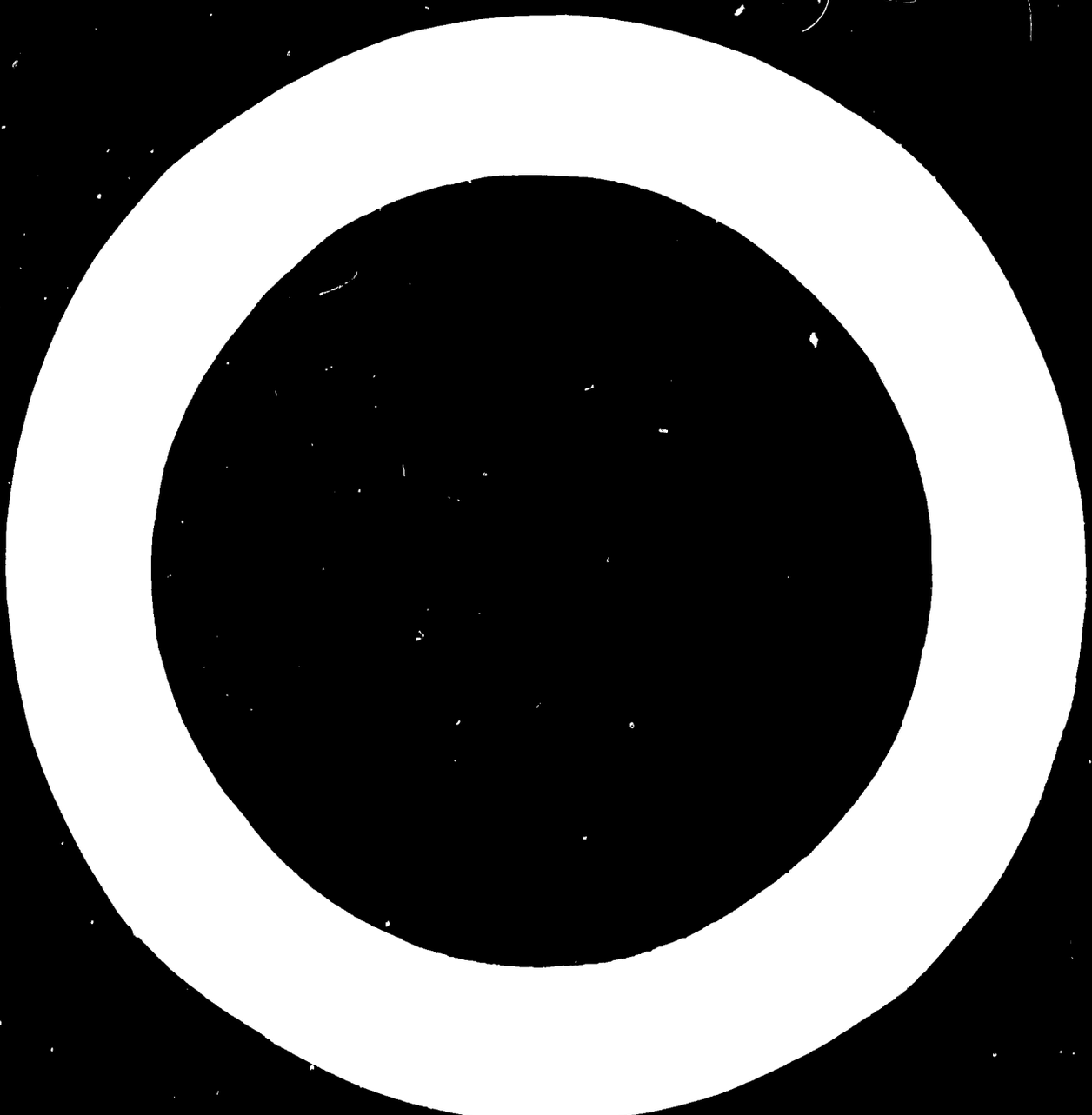

U. F. Chemical Corp.
CELLULAR PLASTICS TECHNOLOGY, MATERIALS, MACHINERY
WOODSIDE, N. Y. 11377 57-20 58TH STREET · TEL. 212-651-0837

U.F.C.® UREA-FORMALDEHYDE PLASTIC FOAMS FOR HOUSING

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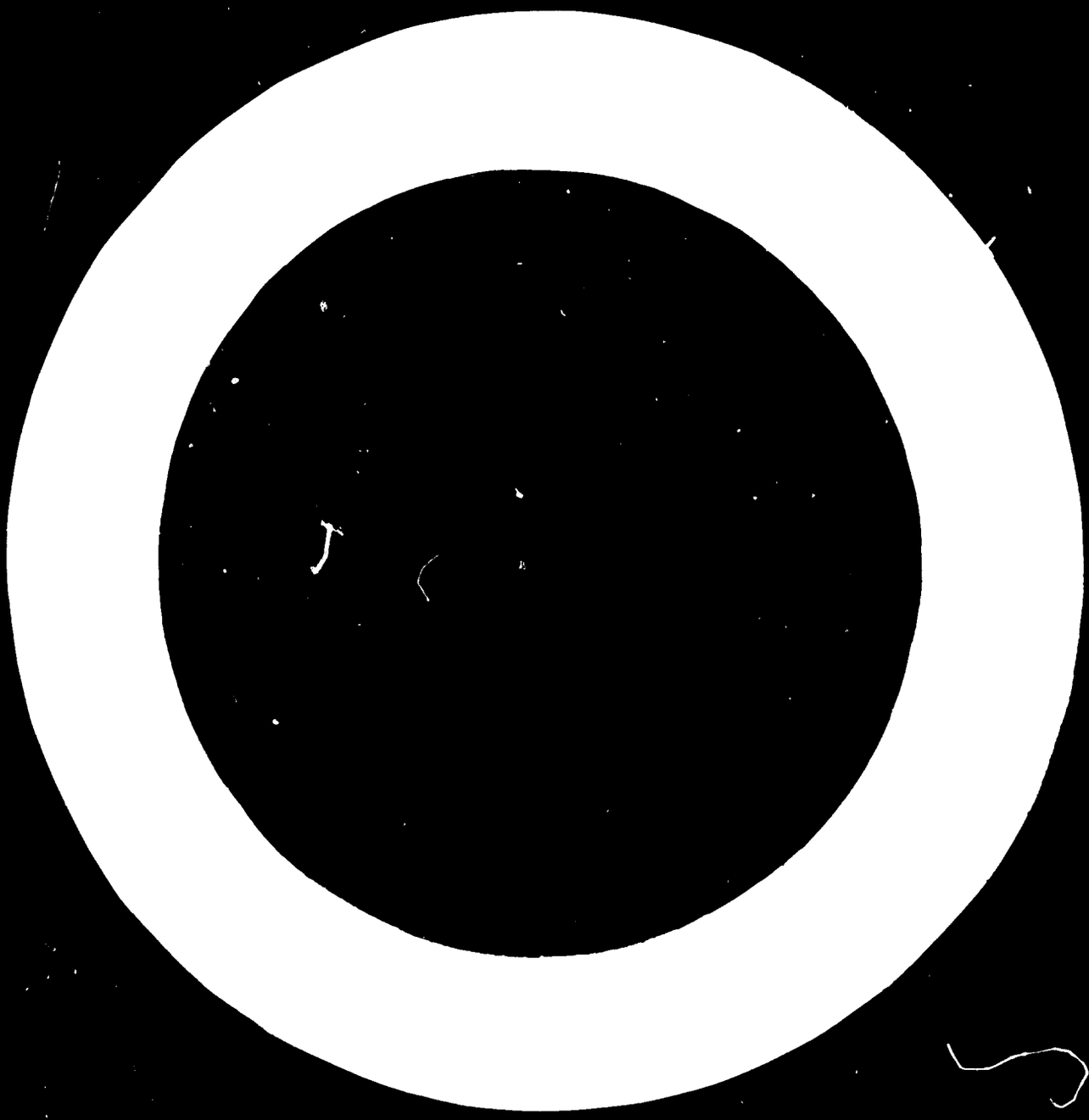

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1.0 INTRODUCTION

Urea-formaldehyde chemicals for foam generation are manufactured by U. F. C. CHEMISCHE FABRIK FRANKENTHAL, Zuckerfabrik Strasse #3, 671 Frankenthal/ Pfalz, Germany, and affiliates in the U. S. A. and Canada under a proprietary process (UFC® Foam).

UFC® Foam, an excellent thermal and acoustical insulation, is used in combination with UFC® Coating (a weather resistant paint) and with locally available construction materials to erect permanent, high quality housing. This can be achieved with local labor, and with significant savings in time and capital over normal construction methods.

The U. F. C. system can be licensed to interested parties for manufacture, use and sale; a total, proven system from raw materials through applications is available. We are willing and able to construct, on behalf of our clients, an integrated chemical manufacturing plant and train local staffs. In addition, usage for housing will be demonstrated, again through the training of local personnel.

2.0 DISCUSSION

Adequate shelter for people is a humanitarian, economic and political requirement. Unfortunately, today's standard construction methods require large capital investments in manufacturing plants supplying components for mass housing. This includes cement or brick factories, steel, lumber, roofing materials, etc. These plants are normally located far from where the need for housing exists. Further, for mass production, precise measurements for structural parts are a necessity, and skilled labor for construction is required. Frequently, locally available products are not usable due to the type of construction employed.

SHK, a division of UFC-Chemische Fabrik Frankenthal, has developed a commercial system for mass-housing using our products with local building materials.

After a license has been signed, our architectural staff will design or help to design the buildings to be constructed preferably using locally available construction materials (be they wood or steel) and conforming to local taste or tradition.

UFC Foam's remarkably high thermal and acoustical properties coupled with its low weight (0.5 to 1.0 lbs. per cubic foot or 8-16 kg/cu.m.) allow lighter foundations, columns and beams. The foam is non-combustible, mold resistant, insect repellant, unfriendly towards rodents, water resistant and stable vis-a-vis most solvents. Walls and roofs are designed so as to form 2" to 3" (5.0 - 7.5cm) cavities between inner and outer skins. These cavities are filled with foam. Inner and outer skins again maximize local products; these may be wood, wallboard, metal, jute or even cardboard. These walls are then painted with UFC Coating which is weather-proof, has high abrasion resistance and adheres strongly to any clean surface. Maintenance is minimal, and repairs, if any, can be made easily and inexpensively.

It should be noted that precise dimensions for the component parts are less critical with this system than for standard construction methods, because UFC Foam will fill any cavity irrespective of shape. Further, the load-bearing parts can be cut on site or shipped efficiently in bundled form.

Erection takes place rapidly using semi-skilled labor with unskilled helpers. Foaming is accomplished with simple, precalibrated equipment requiring only UFC's patented gun, two air driven pumps, an air compressor, hoses and the two-component liquid system (non-toxic, non-flammable water solutions). UFC Coating is supplied pre-mixed and may be brushed, sprayed or rolled on both inner and outer walls as well as the roof.

The resultant building, when compared to standard construction practice, is lighter, earthquake and storm resistant, better insulated against temperature extremes (30% to 50% more insulation against heat and cold) and approximately 35% less expensive.

Both UFC Foam and UFC Coating are highly stable compounds; tests performed after over 12 years showed no significant deterioration of properties.

SHK has erected over 1000 dwellings ranging from Red Cross emergency housing at 8000 feet (1,800m) elevation and -20°F (-30°C) temperature, and vacation colonies in the subtropics to luxury villas. All were completed in 3 to 4 months. We have kept some of these structures under observation, and found the product to perform on specification after more than 10 years.

Attached are summary data sheets on UFC Foam and UFC Coating giving the major properties of these products.

3.0 TECHNICAL DESCRIPTION

3.1 UFC Foam

This foam is generated from two water solutions. One solution is the urea-formaldehyde resin, the other the foaming agent. One volume of liquid yields over 30 volumes of foam.

U. F. CHEMICAL CORP. supplies the entire system to generate foam. The two solutions are normally supplied in 55 gallon steel drums. One air-driven pump per drum feeds the product into the patented foaming gun. Pumps, gun, hoses, connectors, etc. sell for about $3,600.00 in the U. S. A. including training. The only additional equipment required is a portable air compressor costing about $550.00.

The foaming gun is a sturdy, simple design weighing about 11 lbs. (5kg) and is handled by one man. It is pre-calibrated at the factory leaving the user to set 2 clearly marked dials, plus an air valve when ready to foam. Maintenance requirements are minor, assuming that this equipment will be kept clean and not excessively abused. The cleaning medium is water, and a special tool kit, plus spare parts are normally supplied with each gun.

The resin itself is polymerized at atmospheric pressure in a specially designed reactor using a proprietary process. Water, electricity, thermal energy and cooling water are required for the reaction.

The basic raw materials for UFC Foam are urea and formaldehyde. Additional chemicals required are mostly standard or commodity products readily available in almost all parts of the world. That small portion possibly not available locally can easily be imported.

The foaming agent requires a separate reactor and the same utilities. Part of the raw materials may have to be imported.

Resin and foaming agent manufacture are of the batch type and require 2 - 3 operators per shift. One of these men needs to be trained for 2 to 3 weeks and should be able to monitor a simple reaction involving time, temperature and flow-rate controls.

The finished liquid products are stored in bulk (after simple quality control checks) or in drums. The shelf-life of the resin solution is limited, and depending on climatic conditions, varies from 2 to 6 months. The foaming agent has an unlimited shelf-life.

Approximately 10,000 square feet (1,000m^2) of manufacturing and storage space are required to produce the chemicals capable of generating 100,000,000 square feet (10,000,000m^2) of foam one inch thick (2.5cm) per year. This is based on a three-shift operation (24 hours per day, 5 days per week).

U. F. C. Chemische Fabrik Frankenthal, and its affiliates have the skills required to design the plant taking local conditions into account, build the equipment, train operators, help erect and start up the plant and demonstrate the products' applications in practice. Follow-up technical service is also available.

3.2 UFC Coating

This product requires a special mixer easily run by 2 men per shift which can produce 15,000,000 square feet (1,500,000 sq.m.) per year per 3 shifts. This equipment will also fit into the above 10,000 square foot plant.

4.0 COMMERCIAL AND ECONOMIC DISCUSSION

The standard plant will be able to produce yearly the chemicals capable of generating 100,000,000 square feet of foam one inch thick when operating 24 hours per day and 5 days per week. Considering the 1:30 volume relationship between the liquid and foam, these chemicals amount yearly to 25,000 barrels (55 gallon) of resin and foaming agent each.

This same plant can be run one shift (8 hours) per day producing about one-third of the above quantities. Operating economics, except depreciation, are only slightly inferior to three-shift operation.

This plant with all manufacturing equipment plus foaming equipment and training is available from UFC Chemische Fabrik Frankenthal and affiliates. Total cost is $60,000-$100,000 excluding land, buildings, utilities, and of course sale of the license. Recognizing that local business customs, laws and conditions vary widely, there is no fixed, rigid approach for the licensing of this system.

The simplest is an outright sale to each interested party of the complete package (as described above) including a paid-up patents and know-how license. Smaller or bigger plants are also available. Specific terms can be negotiated, and inquiries are welcome.

Other business arrangements such as equity for know-how and patent license, running royalties, etc. can also be worked out, if mutually attractive.

In the U. S. A., the chemicals generating UFC Foam sell for $0.03 to $0.04 per square foot of foam one inch thick including a reasonable profit, but not including labor to install.

5.0 SUMMARY

Housing the world's increasing population requires, especially for the developing nations, that the best and most economical means be utilized to achieve this objective.

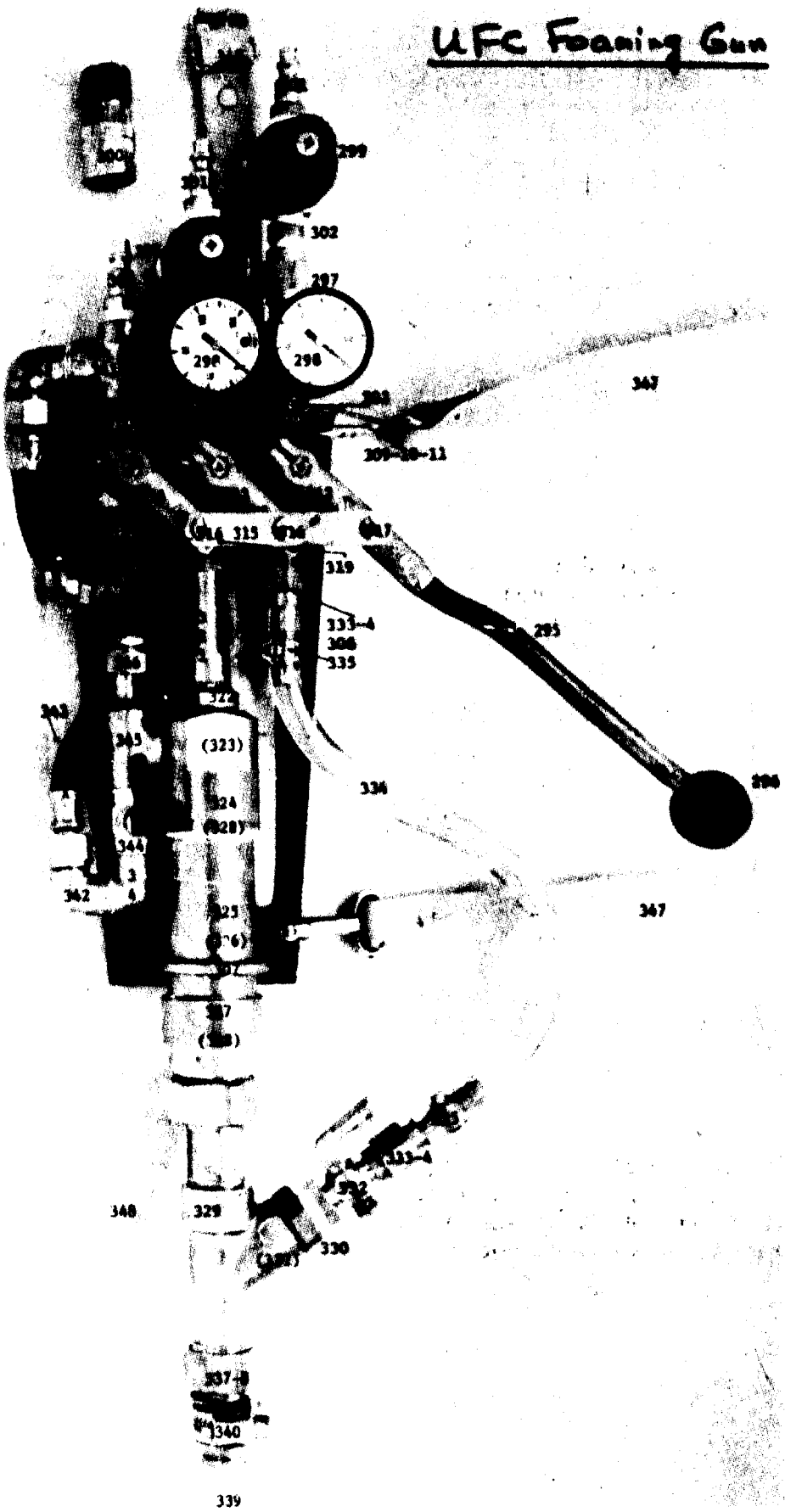
UFC Chemische Fabrik Frankenthal and its affiliates can supply a total, time-tested integrated system of chemical manufacture, application and use which will give permanent housing to those who require this fundamental human need.

The same system, slightly modified, may also be used for other purposes. Agriculture, (converting semi-arid regions to crop-production without irrigation), oil pollution, sewage disposal, packaging, paper, mine safety, and other applications are all outlets for UFC Foams.

Capital investments are very low; this is a major advantage to the developing nations.

Technical and descriptive data are attached to familiarize the reader with the UFC system.

Interested parties are requested to communicate with UFC Chemische Fabrik Frankenthal, Zuckerfabrik Strasse #3, 671 Frankenthal/ Pfalz, GERMANY, or with U. F. CHEMICAL CORP., 37-20 58th Street, Woodside, New York 11377.


UFC Foaming Gun
299
302
297
298
347
295
336
347
(323)
329
330
340
339

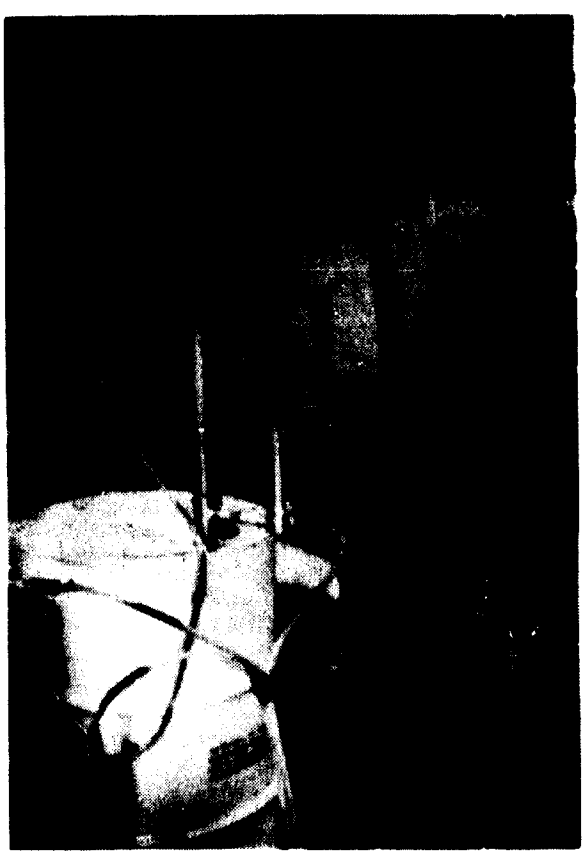
Portable Foaming Set-up
(with tool-box, manual of operation)

Not shown: air compressor or pressure bottle

Typical Foaming Set-up

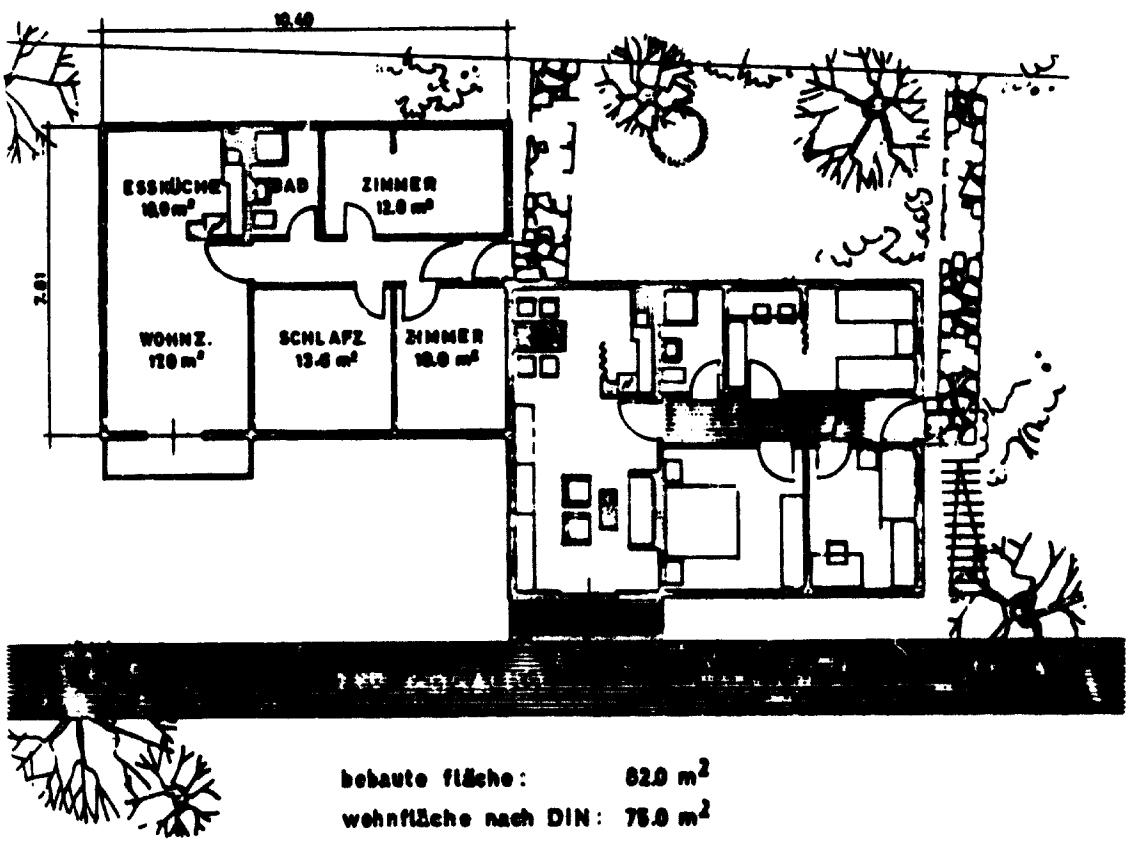
Showing resin drum with air-driven pump, and gun.

Not shown: Foaming agent drum with same pump.



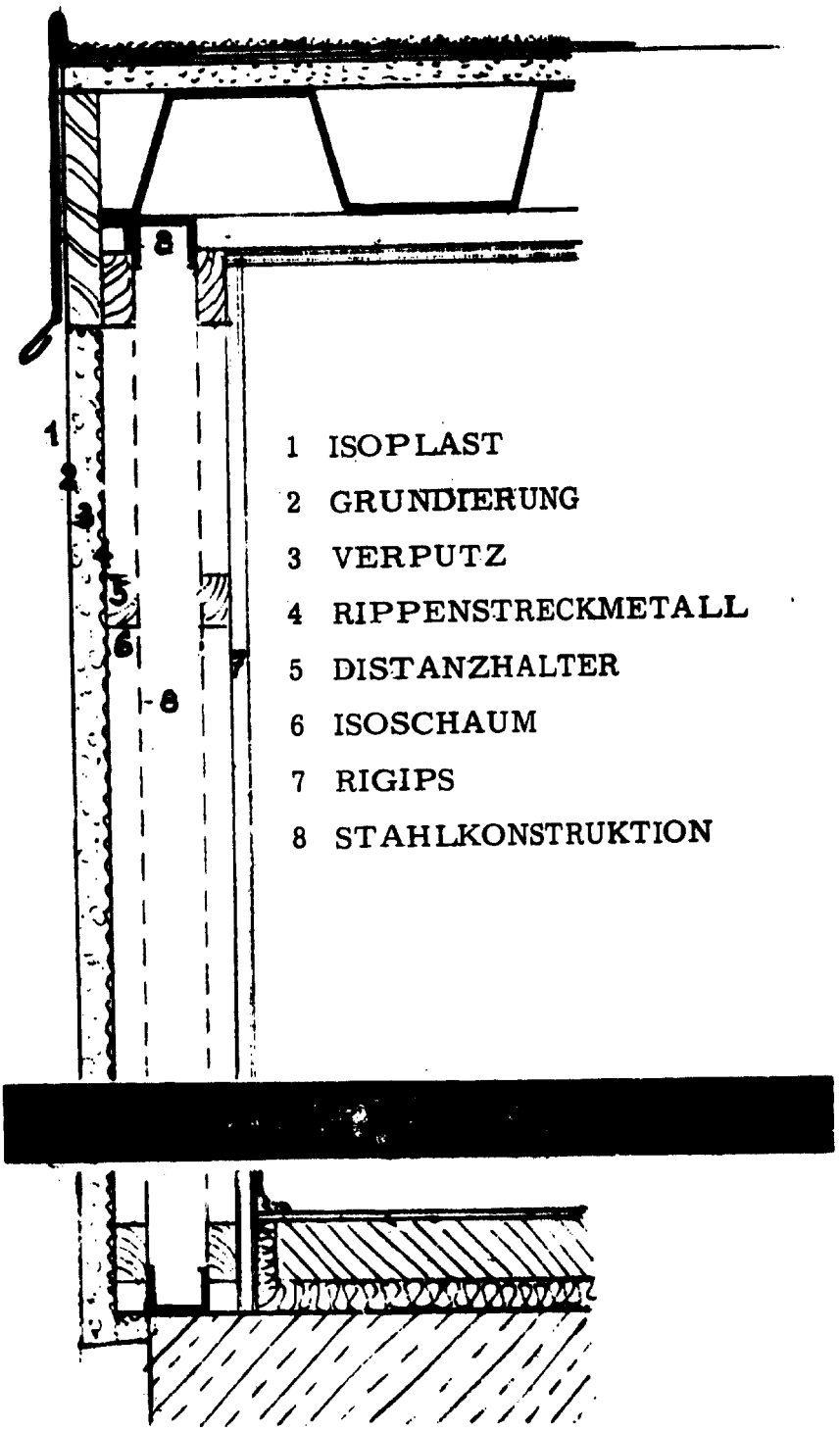
Portable Foaming Set-up (Packaging)

Typical SHK designs for individual homes

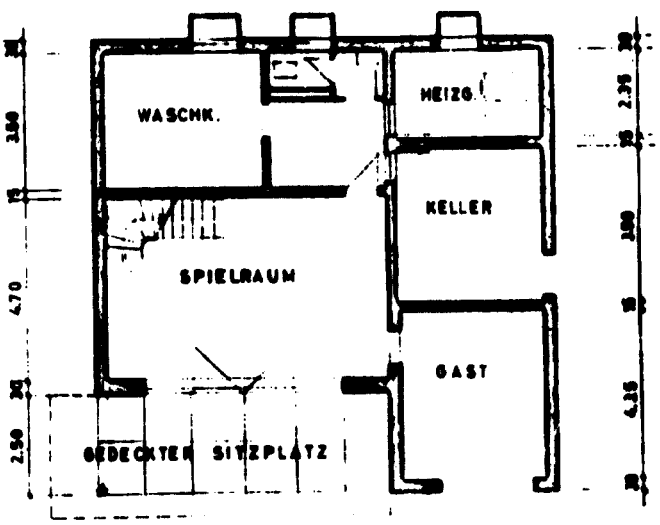


bebaute fläche:	82.0 m²
wohnfläche nach DIN:	75.0 m²
dachform:	giebeldach
konstruktion:	holz
preis ab ok. kellerdecke:	DM 49'000

SCHAUMHAUS – KONSTRUKTION ©mbH



1 ISOPLAST
2 GRUNDIERUNG
3 VERPUTZ
4 RIPPENSTRECKMETALL
5 DISTANZHALTER
6 ISOSCHAUM
7 RIGIPS
8 STAHLKONSTRUKTION


WASCHK.
HEIZG.
KELLER
SPIELRAUM
GAST
GEDECKTER SITZPLATZ
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350
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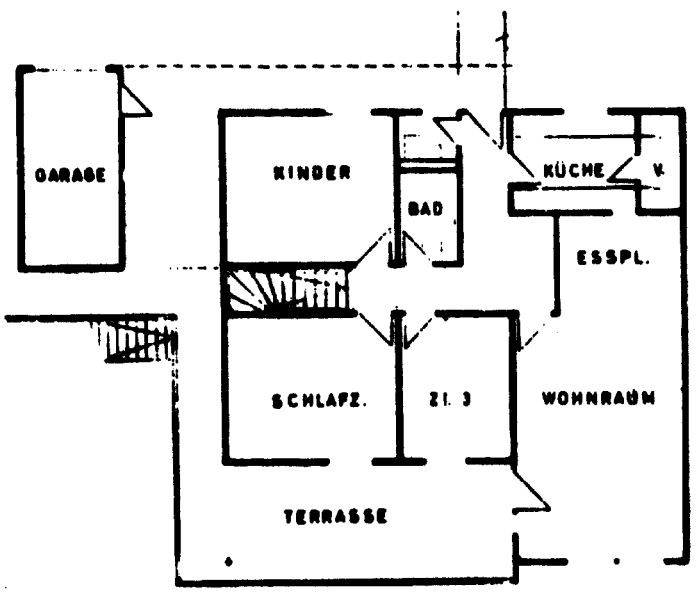
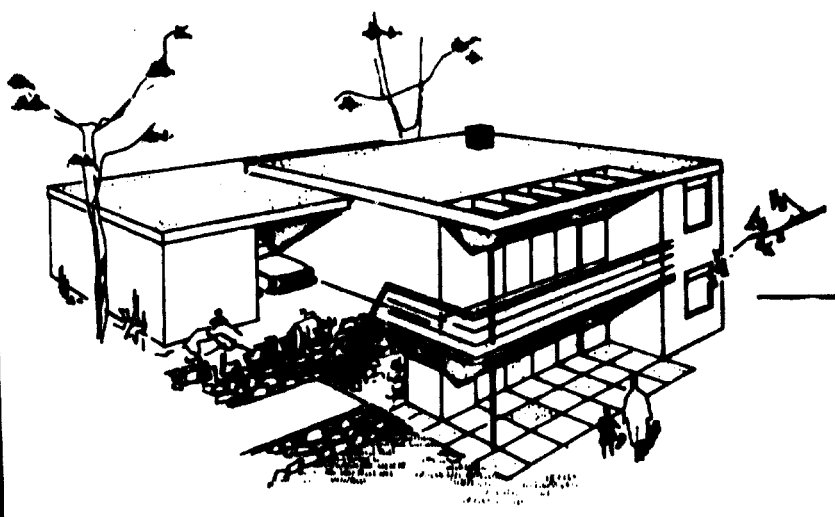
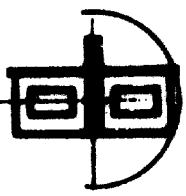
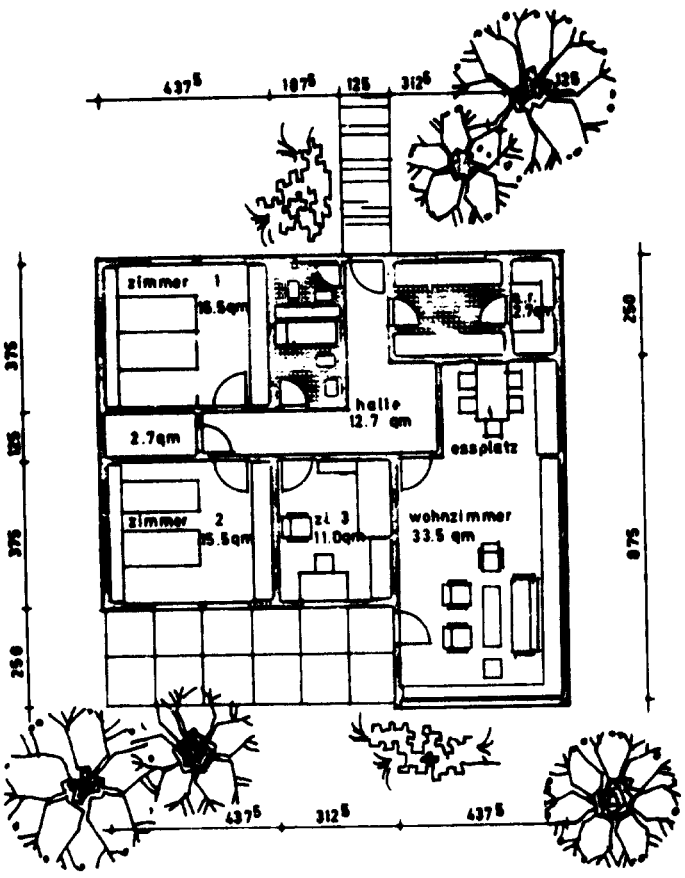

GARAGE
KINDER
BAD
KÜCHE
V.
ESSPL.
SCHLAFZ.
ZI. 3
WOHNRAUM
TERRASSE



TYP 13

SHK





TYP B

bebaute fläche : 118.8 m^2

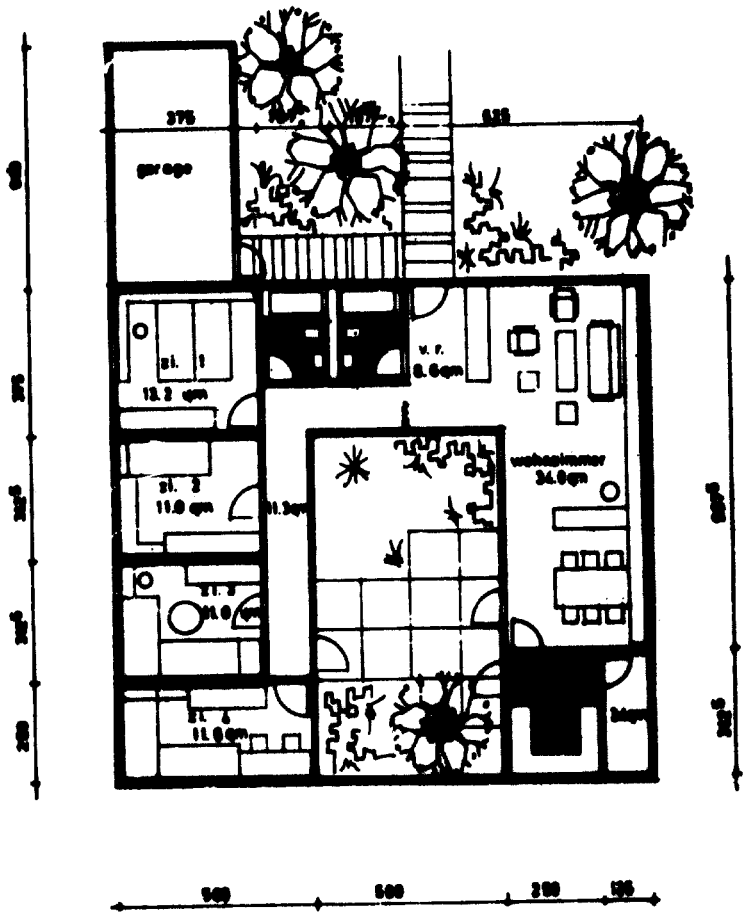
wohnfläche nach DIN : 106.4 m^2

dachform : flach-, giebel- u. walmdach

konstruktion : holz od. stahl

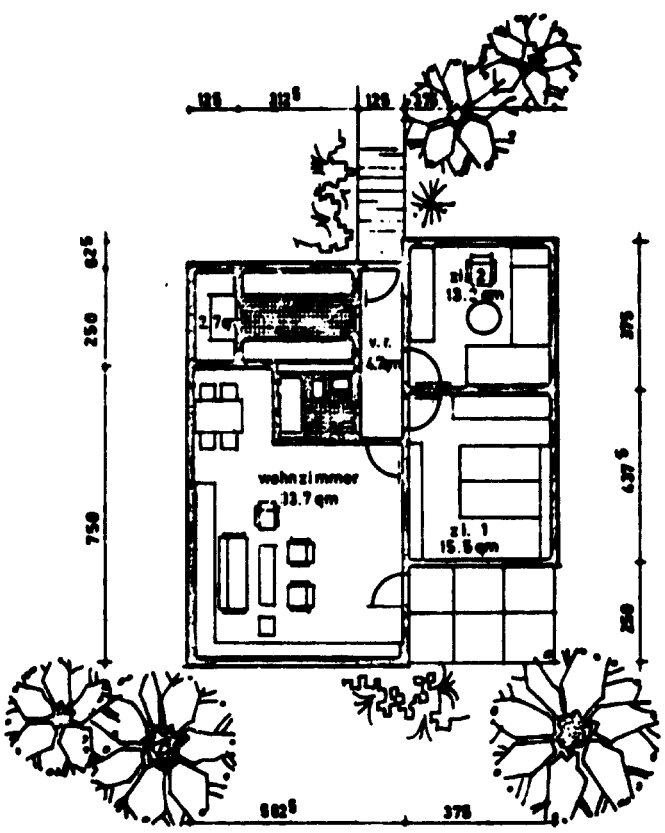
richtpreis :

SCHAUMHAUS - KONSTRUKTION GmbH



bebaute fläche : 133.8 m²
wohnfläche nach DIN : 118.8 m²
dachform : flachdach
konstruktion : holz od. stahl
richtpreis :

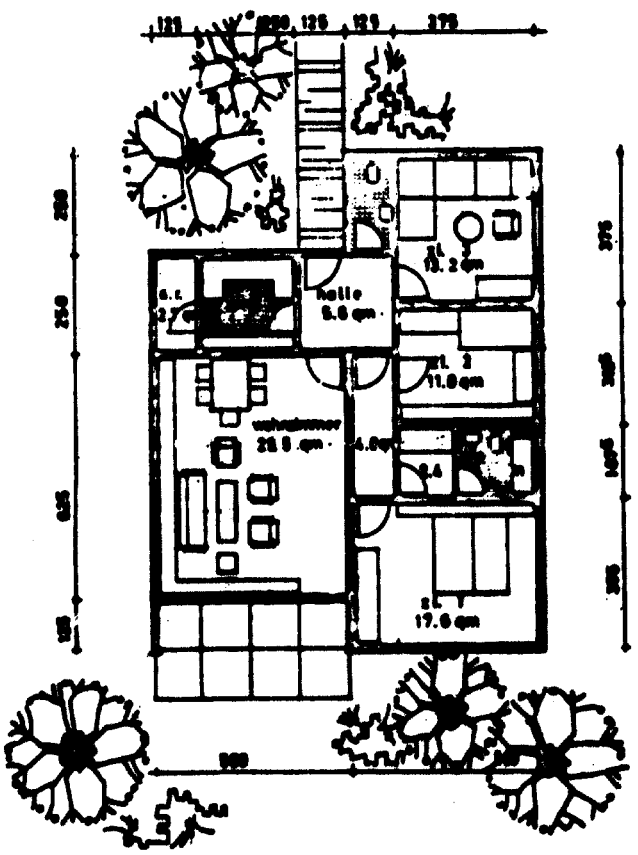
SCHAUMHAUS - KONSTRUKTION GmbH



D

bebaute fläche:	101.2 m²
wohnfläche nach DIN:	80.7 m²
dachform:	flach- u. giebeldach
konstruktion:	holz od. stahl
richtpreis:	

SCHAUMHAUS - KONSTRUKTION GmbH



[redacted]

bebaute fläche: 116.8 m²
wohnfläche nach DIN: 98.1 m²
dachform: flachdach
konstruktion: holz/od. stahl
richtpreis:

SCHAUMHAUS - KONSTRUKTION GmbH

foamed-in-place insulation

thermal and acoustical

what UFC foam is

UFC FOAM is a superior insulation which on an installed-cost-per-unit effectiveness basis is less expensive than poured or matted insulation material.

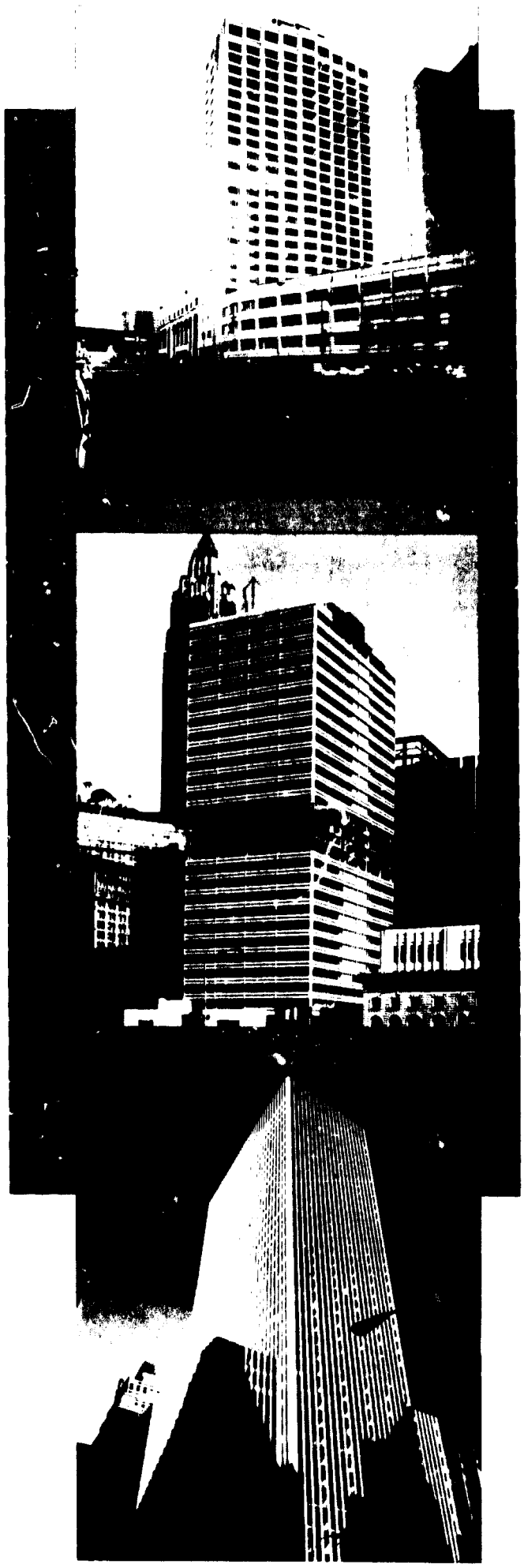
its many attributes:

- **thermal insulation**
- **sound absorption**
- **low cost**
- **application ease**
- **dimensional stability**
- **moisture resistance**
- **pest control**
- **non-flammability**

how UFC foam is applied

UFC-Foam is applied from a patented gun within which the foaming action takes place. There is no further expansion after the foam leaves the gun. Voids can be completely filled without fear of subsequent pressure build-up. It can be applied in any temperature as easily as spreading shaving cream.

UFC-Foam can be used to fill existing voids through holes as small as one inch, can be applied between open frames--floor, wall or ceiling—or can be foamed through metal lath. Once in place it can be smoothed with a trowel and sheathed over immediately. A typical between-studs void is completely insulated in less than 2 minutes.



Where U.F.C. foam has been used

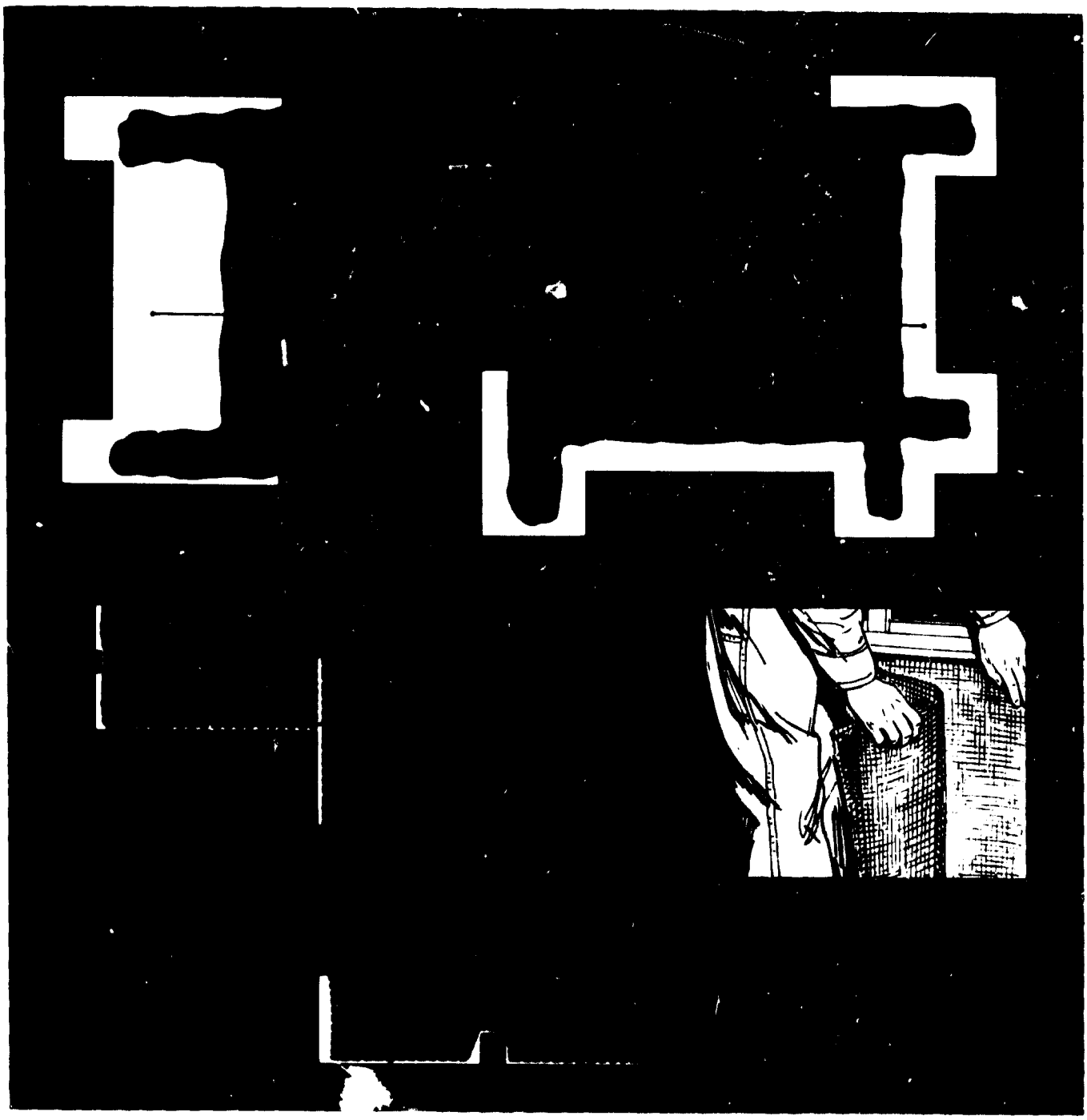
Columbia University
St. Clair Place, N.Y.C., N.Y.
Architect: Brown, Guenther, Battaglia, Galvin

Walston Building
77 Water Street, N.Y.C., N.Y.
Architect: Emery Roth & Sons
Gen'l contractor: Diesel Construction Co., Inc.

Chanin Building
1411 Broadway, N.Y.C., N.Y.
Architect: Irwin S. Chanin
Gen'l contractor: Chanin Construction Corp.

typical installations

ufc FOAM 7.14/Uf



air and sound insulation

The unique thermal and acoustical properties of UFC foam, and its ability to completely fill odd-shaped crevices containing pipes, wires, ducts and fixtures, make it an ideal insulating material for pipe chase areas and other cavities adjoining lightweight walls or partitions.

Preventing the transmission of annoying or embarrassing sounds is effectively accomplished with UFC foam while providing efficient insulation for hot and cold conduits.

U. F. CHEMICAL CORP.

ufc FOAM

properties

thermal conductivity: K factor 0.20 at 70°F mean temperature and 0.18 at 35°F mean temperature

thermal resistance: (R factor per inch of thickness): 5.5 @ 35°F mean (winter) 5.0 @ 75°F mean (summer)

sound absorption: 83 to 92% @ 2" nominal thickness

C.P.S.	400	800	1600	3200
%	83	92	95	92

sound resistance: UFC-Foam in walls improves sound transmission ratings 5-7 Decibels

dimensional stability: Unaffected by heat, cold or moisture

water resistance: Its permeability to vapors precludes accumulations of moisture, making moisture barriers unnecessary.

non-toxic: No protective masks are worn by applicators. Not toxic when ingested.

fire behavior: ASTM D1692—Self Extinguishing

ASTM E136—Non Combustible

ASTM E84—Flame Spread

Non Combustible	25
Smoke Density	0-5
Fuel Contributed	10

chemical stability: It is resistant to most solvents. Time does not change its chemical structure.

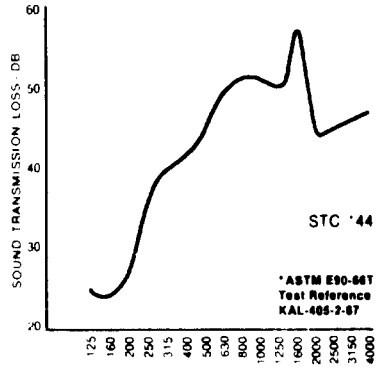
sound transmission curve

construction details

1⅜" P.S.S. 16" O.C.
3.4=D.M. Lath
Uree Formaldehyde Fill
Send Plaster (1:2)
Lime Putty Finish
Plaater Thickness ⅝"
Total Partition Thickness 3⅛"

frequency c.p.s.

Nota tha unusually high rasults for this thicknaas of lath and plaster partition in the range 500 to 4000 C.P.S. Despite the 44 STC rating this partition may be very effective against transmission



suggested specifications

(a.) Submit price for a Foam-In-Place Urea-Formaldehyde insulation for

_____
specific location

(b.) The Urea-Formaldehyde Foam Insulation shall be manufactured by U. F. Chemical Corporation, Woodside, New York and shall have the following properties:

1. Thermal conductivity K-0.20 @ 75 F
2. Fire Behavior ASTM D 1692 Self-Extinguishing; ASTM E136 Non Combustible
3. Flame Spread ASTM E84

Non Combustible	25
Smoke Density	0-5
Fuel Contributed	10

4. Water Repellant, Non Corrosive, Mold Resistant
5. Density: 0.6 Lbs. Cu. Ft.
6. Shrinkage: Linear 1.8% Normal 3% Max.
7. Sound Absorption Range: 83-92% @ 400-3200 CPS @ 2" Thickness
8. FHA Materials Release #551A, April 14, 1969
9. Perm Rating: 32-38 Perms/In., @ 60% Closed Cells
10. Toxicity: Non-Toxic per Federal Hazardous Substances Act and complies with N.Y.C. Building Law.

(c.) Install Insulation by means of Licensed Applicators.

Use equipment specially designed for this particular Foam Application.

SPEC-DATA

This Spec-Data Sheet conforms to editorial style prescribed by The Construction Specifications Institute. The manufacturer is responsible for technical accuracy.

1. PRODUCT NAME

Foamed-in-place insulation
U.F.C.®-Foam
(Formulated in accordance with the patented Isoschaum process.)

2. MANUFACTURER

U. F. Chemical Corp.
37-20 58th Street
Woodside, N.Y. 11377
Phone: (212) 651-0837

3. PRODUCT DESCRIPTION

Basic Uses: Thermal and acoustic insulation. For application into floors, walls, partitions, pipe chases and other building cavities.

For use in houses, apartments, office buildings, manufacturing and commercial facilities, laboratories, sound studios, ships and other construction. Can be used for remedial work in occupied buildings as well as in new construction.

Limitations: The material should not be used where it will be subject to temperatures in excess of 210°F for prolonged periods. In exposed applications it requires a protective surface to prevent mechanical damage.

Composition & Material: U.F.C.-Foam is a modified urea-formaldehyde resin. It is cold-setting and forms a low-density, non-combustible resilient plastic foam. The material has the ability to flow into odd-shaped spaces, around wires, piping, etc. Setting takes place 10 to 60 seconds after it leaves the applicator gun. The material can be trowelled before setting.

There is no further expansion of the material after it leaves the applicator gun. Voids can be completely filled without danger of subsequent pressure build-up.

4. TECHNICAL DATA

Thermal Conductivity: k-factor (ASTM C-177) nominally 0.2 at 70°F and 0.18 at 35°F mean temperature.

Sound Absorption: In a 1⅝ inch metal stud and plaster wall it improves the sound transmission class (STC) from 37 to 44. In dry wall construction it reduces sound transmission from 5 to 7 decibels.

Structure & Density: The structure is a microscopic sized cell agglomeration interspersed with microscopic capillaries which are irregular and discontinuous.

The standard density of U.F.C.-Foam is 0.6 lbs./cu. ft., although the density can be varied from 0.6 to 1.0 lbs./cu. ft. When fresh it weighs 2.5 lbs./cu. ft. at the standard density. It has 60% closed and 40% open cells.

Volumetric Stability: Temperature or humidity variations will not cause U.F.C.-Foam to change volume or exert pressure.

Normal shrinkage during the drying-out period is 1.8% to 3% linear. Rapid or forced drying may cause shrinkage in excess of 3%; slow drying will hold the shrinkage to 1.8% or less. No shrinkage will occur if the material is foamed into an air-tight cavity and then sealed in.

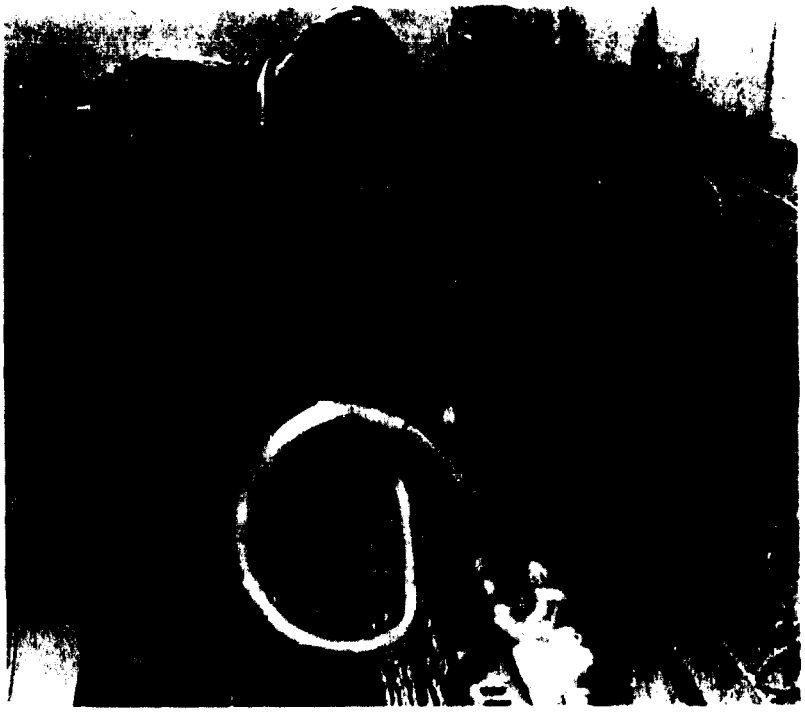
Resilience: U.F.C.-Foam is a resilient material with a very high vibration resistance. The foam will not support a load.

Moisture Effect: U.F.C.-Foam will not hydrolyze. Moisture absorption in wet cavity wall over 24 hour period, 2% by weight (U.S. Testing Co. report No. 43336). Water transmission, 32-38 perms (ASTM E 96-B) (American Standards Testing Bureau Inc. Report No. 13982.)

Fire Behaviour: Non-combustible per ASTM E136-65. Will not ignite up to 1,202°F. (U.L. File MH 8952). Factory Mutual approval for sandwich construction ½ inch sheet rock, 2½ inch U.F.C.-Foam. No sprinkler system required.

Approved by the Board of Standards and Appeals for use in New York City under Calendar Number 487-70-SM.

Tunnel test (American Standards Testing Bureau) ASTM E-84-61 with



foam exposed, flamespread 25. Smoke density 0-5, fuel contributed 10.

Gas Evolution: When subjected to a flame or radiant heat of 1,300°F the material decomposes releasing water vapors, 18% oxygen, 2% carbon dioxide, 2% carbon monoxide and amines. No toxic vapors are produced.

Toxicity: The material is nontoxic per Federal Hazardous Substances Act and complies with NYC Building Law.

Pest Resistance: The de-oiling effect of U.F.C.-Foam makes it a hostile environment for rodents, and insects.

The material is completely resistant to the common Mucor, Aspergilli and Alternaria types of mold. In addition, the foam is mildly bactericidal.

Approvals: FHA Materials Release #551A, April 14, 1969.

5. INSTALLATION

Preparatory Work: No preparatory work required. In existing structures the foam can be applied through an opening as small as one inch in diameter.

Methods: U.F.C.-Foam is applied from a patented gun, within which the foaming takes place. There is no further expansion after the foam leaves the gun. Working pressure of the gun is 65 to 85 lbs./sq. in.

Application can be made at any temperature, provided the components can be brought to the foaming apparatus at 50-70°F. The foam can be applied through open frames or through metal lath. Once in place it can be smoothed over with a trowel and sheathed over immediately. A typical between-studs void is completely insulated in less than two minutes. The cured foam can be removed and replaced by hand.

Cure Stages: Initial *setting* takes place 10-60 seconds after the foam leaves the applicator gun. Additional curing takes place in 2-4 hours, during which the foam acquires resilience. *Drying* takes 1-2 days; longer if in closed cavities or in very cold weather.

6. AVAILABILITY AND COSTS

Availability: U.F.C.-Foam is installed by approved insulation contractors. Contact U. F. Chemical Corp., 37-20 58th Street, Woodside, N.Y. 11377, phone (212) 651-0837 for the name of the nearest approved installer.

Costs: Individual job costs will be quoted by the contractor.

7. GUARANTEE

The stability of the material is guaranteed for ten years.

8. MAINTENANCE

No maintenance is required after application.

9. TECHNICAL SERVICES

Information or assistance on special or unusual applications is available from the manufacturer, U. F. Chemical Corp.

10. FILING SYSTEMS

Sweet's Architectural Catalog File Sweet's Industrial Catalog File. Additional product information available on request.

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TECHNICAL PAPER 1

RESOLVING MOISTURE PROBLEMS WITH ISOCHARM

Condensation has been a problem for the designer and builder because most of the insulation materials either accumulate condensation due to their inorganic nature, or because they form barriers where accumulations of water are possible.

ISOSCHAUM has some very interesting characteristics when reacting with moisture. These will be presented here to help the designer and user obtain optimum results.

ISOSCHAUM is a porous urea-formaldehyde resin with 60% closed cells, interspersed with microscopic capillaries into which no water in the liquid form can penetrate. To obtain a clear picture of its behaviour, 2 " thick specimens were prepared and stored in air at a constant moisture content. The moisture absorption was determined at intervals of 24 hours. Density was 0.82 and 0.44 lbs./cu. ft. respectively. As can be seen from fig. 1 to 3 , the absorption is minimal. It reaches its equilibrium after 1 - 4 days. This process is reversible, i.e., the foam will give off its moisture at the same rate at which it has absorbed it when the relative humidity of the surrounding air is restored to normal.

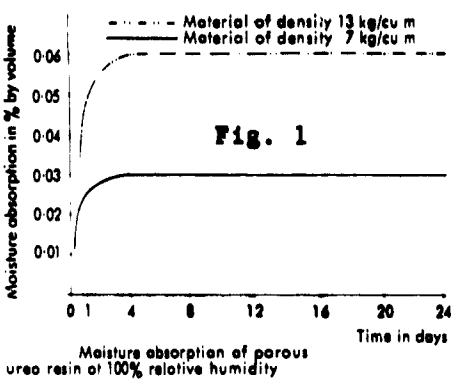


Fig. 1

Moisture absorption of porous urea resin at 100% relative humidity

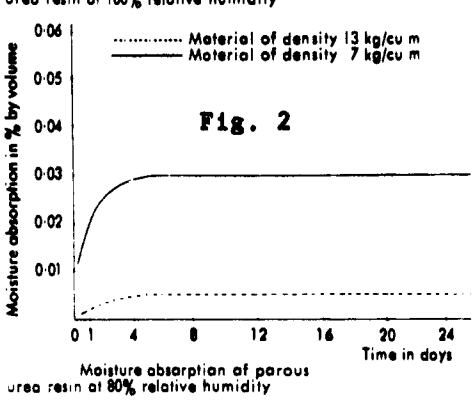


Fig. 2

Moisture absorption of porous urea resin at 80% relative humidity

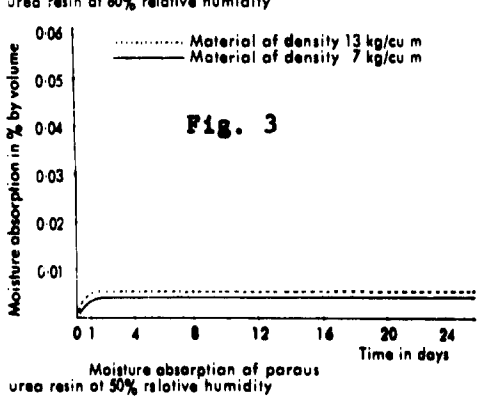


Fig. 3

Moisture absorption of porous urea resin at 50% relative humidity

Fig. 4 shows the results of tests where complete submersion was initiated. As can be seen the penetration is very slow. The higher density material submerged in color coded water showed a penetration of 1/8 " after 24 hours where the head of the water was 2 ".

It can be seen from this that should ISOSCHAUM accidentally come in contact with water in the liquid state it becomes saturated very slowly. Furthermore, the foam contains small amounts of phosphoric acid which passivates metallic surfaces by forming a protective coating of iron sulphate.

Fig. 5 shows the moisture absorption of ISOSCHAUM when in contact with wet sand. The specimens were 0.8 ", and here again the absorption is minimal thus precluding any danger in a cavity wall installation.

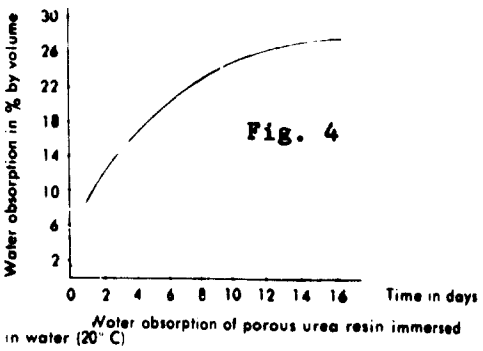


Fig. 4

Water absorption of porous urea resin immersed in water (20° C)

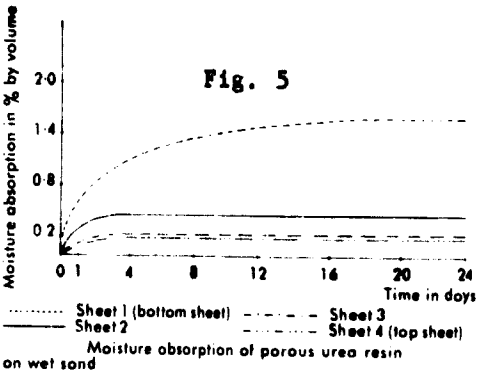


Fig. 5

Moisture absorption of porous urea resin on wet sand

With the knowledge from these tests and our formula for computation of the thickness of ISOSCHAUM for prevention of condensation as shown in our specification booklet " Properties of Isoschaum " , one can design appropriate combinations that will not allow condensation without resorting to moisture barriers which are subject to mechanical failure.

Figures 6 and 7 show the pantry of a sea-going vessel during the various stages of insulation. Figure 6 clearly shows the gridwork of furring strips fastened to the bulkhead and burlap stretched over it. The foam was "shot" through the burlap with a special nozzle, thus filling all cracks and irregular voids. Figure 7 shows the decorative panels being installed. No moisture barriers are being employed, and for that matter neither have they been used on any of the 400 other ship insulations done with ISOSCHAUM.

Fig. 6

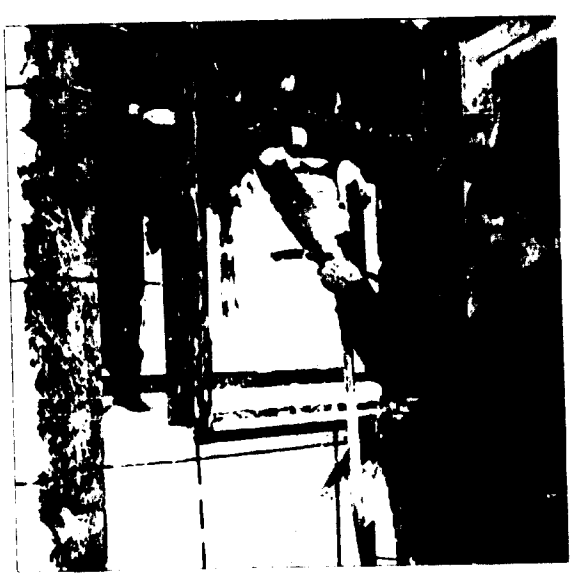
Fig. 7

Figure 8 shows another installation of ISOSCHAUM in severe moisture conditions, again without moisture barrier. This is a tile roof placed on a wooden gridwork of studs. Burlap was stapled to the lower edge of the studs and the resulting cavity filled with ISOSCHAUM. This is a common type of roof in central Europe and this method of insulation has shown to be cheap and effective. No accumulations of moisture have been reported during the past ten years. This method of insulation has certain advantages, such as protecting the roof structure from stresses created by thermal expansion and contraction. It also permits storage in the attic, which would not be possible if the insulation were between the joists.

Fig. 8

Another very advantageous application is in pipe chases, where hot and cold water as well as chilled water for central air conditioning systems are together. There the pipes need not be insulated one by one, rather the whole cavity is filled in one shot through one or two openings under the moulding. Here again tests have shown that no moisture barriers are required. Figure 9 shows a typical pipe chase insulation with a fire hydrant opening on every floor.

Fig. 9



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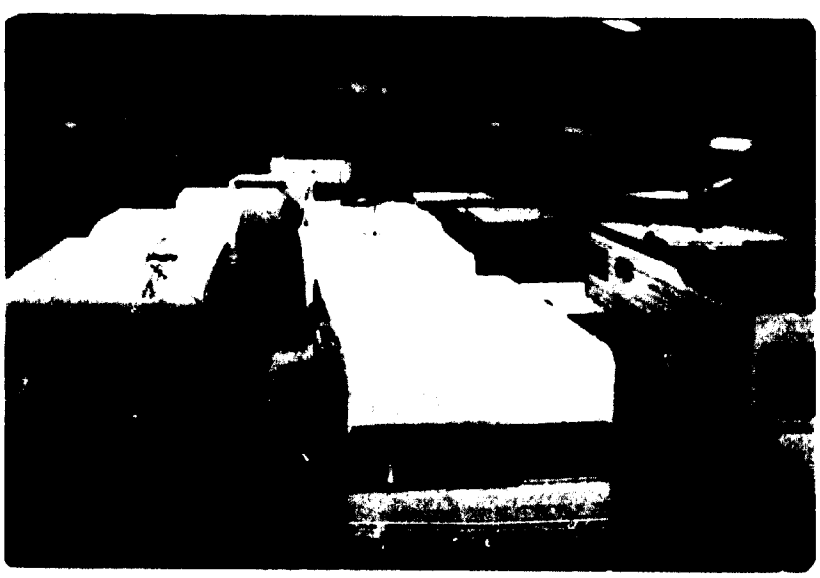
TECHNICAL PAPER # 2

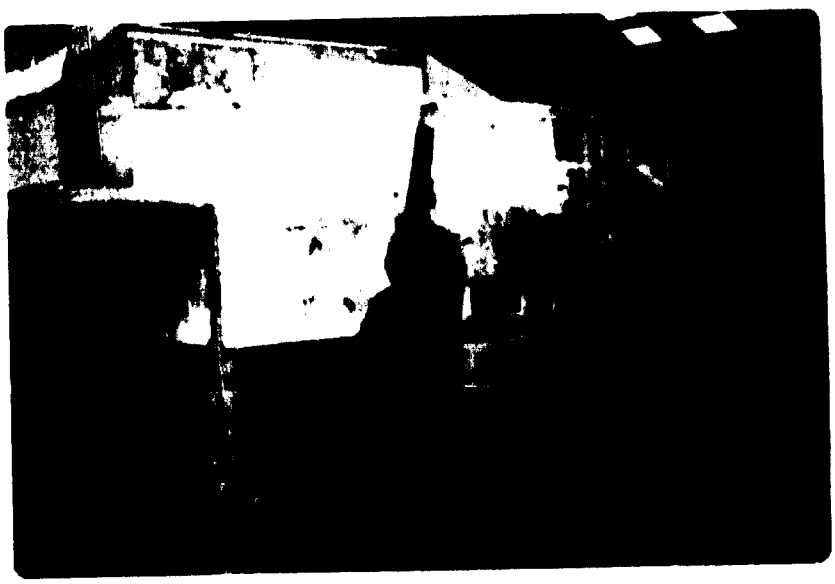
MOBILE HOME TRAILER ACOUSTIC AND THERMAL INSULATION



Mobile home trailers can be easily and economically insulated against noise, heat and cold with ISOSCHAUM. This offers the mobile home owner maximum comfort.

A two inch thick layer of ISOSCHAUM absorbs 83 to 92 % of airborne sound in the 400 to 3200 cps range. This same thickness also has an insulation value of R-10, which means that the heating and air conditioning bills will be much lower.

All cables and wires are enclosed in this foam, therefore there will not be any rattles and short circuits. Condensation and moisture problems are also eliminated because of ISOSCHAUM's water repellent nature.



The above illustrations show the FLEETCRAFT MOBILE HOME production line in Seattle, Wash. The procedure not only looks, but is indeed simple: One man sprays the foam, another one trowels it smooth and a second crew fastens the outside skin. There is no further expansion of the foam, therefore no waiting time between operations. A very important saving is the storage space: ISOSCHAUM comes in two liquids that are expanded when needed.

The FLEETCRAFT MOBILE HOME MANUFACTURING COMPANY has not only improved their product, but done so in an invisible way: The customer can not see, but he surely can feel the difference in comfort, quietness and reduced fuel bills. And when he wants to trade or sell his mobile home he can be sure that there won't be any dry rot, vermin in the insulation or insulation that has sagged to the bottom.

Technical data:

Density: 0.6 lbs./cu.ft.

Closed cells: 60%

Melting point: 428°F

Max. shrinkage: 1.8%

Expansion: 0%

Toxicity: none

Moisture absorption @ 100% RH : 0.03% by vol. in 4 days

Vibration resistance: no deformation after 35,000 automobile miles.

Structurel strenght: week, resilient material suiteble only for cevity filling.

Setting time: 40 to 60 seconds

Drying time: 2 to 14 days

Fire reting: Self extinguishing ASTM 1692 D

K-Factor: 0.20 @ 75 meen

Sound abeorption: 2" thickness 83 - 92% 400 - 3,200 cps.

PLASTIC FOAM INSULATES, 'RAT PROOFS' BUILDINGS

specially-formulated resin injected in wall cavities creates a hostile environment denying rats a habitat

ONE OF the nagging problems plaguing contractors engaged in renovation and new construction of slum areas is the pesky rat—a rodent man has tried to exterminate for centuries.

Past methods, which tried to eradicate rats hidden in buildings have had little success. Even if rats are temporarily eliminated from buildings to be renovated, they return after the job is done. Keeping the rodents out of newly-constructed buildings has also met with little success. The dual attraction of large quantities of food remnants and a warm, secure habitat attracts rats en masse.

The only solution is to create a hostile environment which will permanently deny rats a habitat. A new material "Isoschaum-R," from Isoschaum Corp. is designed to create this hostile setting.

The product, a specially-formulated resin is a variation of the company's commercial cold-setting plastic foam, used as insulation for

MECHANIC FILLS cinder block cores through one inch openings. Foam denies rodents habitat and is bacterial static snd insecticidal. Roaches and ants avoid it. Equipment consists of compressor, which supplies propellant and pressurizes the two material tanks. Specially-formulated foaming agent, "isoschaum-R", consists of resin and air combined in a patented mixing device (hanging on side of operator). Agent sxits from hose as liquid insulation and acoustic foam—which hardens in sbout one minute. Gun can be activated by pushing lever down for on, and up for off. Intermittent use is possible since no plugging of gun will occur. There is only one regulating device which is an air needle va ve. This regulates the density of the foam by admitting more air for a lighter foam; less air for a denser foam.

heat and cold, acouatical insulation and fire retardation.

'Rat-proofing' a building

Fritz Kramer, Iaoachaum Corporation'a president tells how a building is "rat-proofed" using "Isoschaum-R."

"Our liquid foam," Kramer aays, "ia injected into wall cavities through one-inch openings. Fluid pressure fills the wall cavity. The foam flows into all cracks and crevices—setting in 40-60 seconds without further expansion."

Krame· adds that when the foam hardens, it envelops and entraps rodents. It also makes the habitat inaccessible to other rodents.

What tests show

Dr. Ross M. Grey of Columbia University backs up Kramer's claims for "Isoschaum-R." Grey is chairman of the Institute of Comparative Medicine, Columbia College of Physiciana and Surgeons. He says: "In testa where compressed air is replaced with nitrogen gas, 'Isoschaum-R' kills the animals within 90 seconds."

He adda, "The foam presents a hostile environment to rats for two reasons: 1) The formaldehyde gas entrained in the closed cells of "Isoschaum-R" is in high concentration and rats will not attempt to burrow through it; 2) the substitution of nitrogen causes quick asphyxlation of the animals."

Grey says he set up a test to see whether a rat would burrow through the foam to get at food encased in it. "The rat," he saya, "knew that food was behind the foam but did not attempt to reach it for four days—although he did not get any food during this time."

'Has great possibilities'

Dr. Grey concluded his report on "Isoschaum-R" and ita possible uae in construction saying:

"In my opinion, the use of this foam as a tool for rodent control has great possibilitiea.

"Ita possible use in the area of rat control is evidenced by the fact that the foam will: 1) Quickly asphyxiate rats caught in the foam; 2) eliminate living and nesting space; 3) provide a barrier through which rats will not attempt to penetrate. Such a barrier system, if further teated might be of great value in new construction."

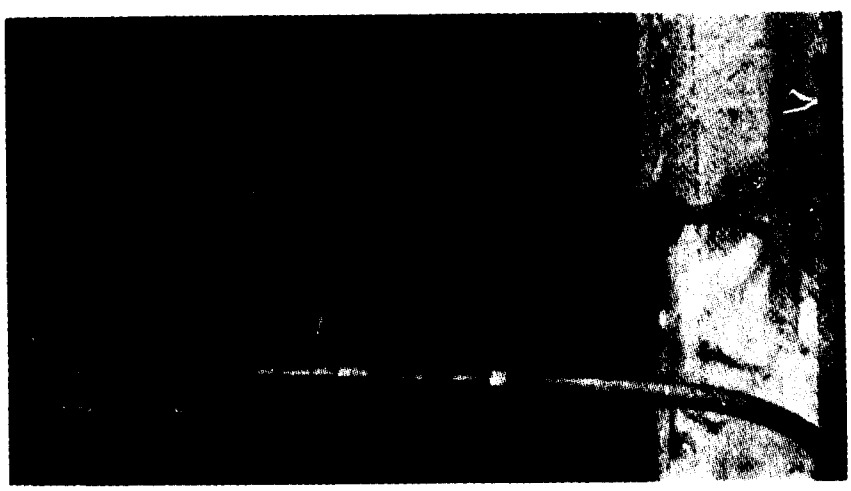
Acoustical, thermal insulator

Kramer predlcts that "Isoschaum-R" will find wide acceptance once contractora are exposed to the product.

"This is because," Kramer says, "contractors not only get a ratproofing material but an excellent acouatlcal and thermal insulator as well."

Kramer saya that aa an acoustical insulator the product absorba 83-92% of airborne sound in the frequency range of 400-3200 cps—at a thickness of less than two inches. Aa a thermal insulator, it has a K-factor of 0.2. ■■■■

INSULATION foam is injected into pipe chase (below) showing close-up of easily operated apparatus. The "Isoschaum" foam flows into and around all odd-shaped crevices filled with pipe wires, fixtures. It seals air and sound infiltration, cracks and voids. Right: Close-up of foam as it fills pipe chase.



Isoschaum
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TECHNICAL PAPER # 3

PRESENTING A NEW OIL-ABSORBING SYNTHETIC FOAM FOR OIL POLLUTION CONTROL

The Torrey Canyon disaster again underlined the need for new methods and materials to control oil pollution. The huge quantities discharged by the Torrey Canyon made the use of detergents impractical as well as undesirable, since the emulsification of oils worsens the situation, rather than improve it. According to authoritative opinion the best way to clean up oil slicks is to soak it up with straw. This binds the oil rendering it harmless.

While this method is in its effects excellent, it is obvious that where large quantities of oil are spilled it becomes a problem of logistics and availability. It also can become quite costly, because usually straw is not a commodity readily obtainable at the beaches or on board ship, or for that matter in a harbor.

Chemische Fabrik Frankenthal, Germany, our affiliate, under the direction of Dipl. Ing. Heins Baumann, its director of R & D, has been able to develop a low cost synthetic foam that absorbs and holds more oil than straw and costsconsiderably less.

The main characteristics of this foam are that it can absorb selectively oil from 30 to 50 times its own weight without taking up any water.

The foam can be manufactured in-situ (on board ship or in the harbor) when it is needed from two aqueous solutions with a very simple and inexpensive apparatus. A short time after the foam has been produced it can do its intended job.

Its remarkable ability to absorb oil is based partly on its cellular structure which is shown on the front page in a 1:40 photomicrogram. The synthetic resin takes only 1% of the volume, the remainder being air bubbles which are interconnected with a network of microcapillaries. These are so small and offer such resistance to water that considerable pressure is required to introduce water into the foam. However, oil having a much lower surface tension can easily penetrate into the capillaries and cells.

Another very important charactaristic of the foam is that it is resilient and will release the oil under pressure, i.e. oil in the foam can be expressed for recovery. One can foresee some very interesting possibilities in the shipping of oily substances.

Oil slicks can be surrounded with this foam and since a large part of it protrudes from the water, used as a wick for burning off the oil. It can also be left drifting - it will not harm aquatic life. Bacterial action will eventually decompose it. The foam itself is stable and biologically harmless to living tissue.

Our new method and material for absorbing oily substances (patents pending) offers low cost oil pollution control, great versatility, ease of application and complete safety.

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Fine Fluff To Soak Up Oil Tested

...The Germans have dis-...vered that a building in-...lation material used in the ...rm of a fine, white fluff will ...so completely soak up oil ...ills from water, and the ...oduct is being promoted for ...ch use for the first time in ...s country.

The State Water Control ...oard staff, with last year's ...ills from ships on the York ...ver fresh in mind, got word ...out the use of the product ...d obtained a sample of it ...cently from a distributor ...re. The staff reported keen ...erest in the possibilities.

Tests Encouraging

...Tests in its laboratory ...owed the fluff soaked up ...ery drop of oil rapidly from ...water surface, and none of ...e water. The blackened fluff, ...ich still floated, could then ...scooped off, leaving the ...ter clean as a whistle. The ...aterial burns. It is a type of ...ea formaldehyde plastic, ...urted into walls as a spray. ...t hasn't been tried on a real ...ill in this country, C. E. ...oley, director of the board's

Richmond Times-Dispatch

Oil Spill 'Fluff' Tested

Continued From First Page

pollution abatement division, was told.

But no easy way has been developed previously to clean up a big spill satisfactorily. Detergents are used to break up an oil mass.

The American Oil Co., at whose Yorktown refinery the spills from suppliers' unloading ships were reported, has resorted to the use of a floating boom system to encircle a ship. It then uses a dispersant on the oil.

This sinks it, Cooley said.

A beauty of the insulating product, which is inert, is that it would avoid any harmful effect on marine life, such as detergents could have, said Earl R. Sutherland, the board's Richmond area representative.

There is no chemical action involved, but only the physical action of absorption through the countless small capillaries of the fluff, they said. The difference in the surace tensions of oil and water accounts for the complete separation of the two, they added.

The oil can be squeezed out of the product afterwards.

The Germans came upon the behavior of the material, after the Torrey Canyon disaster, which sent tons of oil onto Britain's beaches when that tanker broke up off the coast, Cooley said. The incident came about the time of last year's first spills on the York.

The insulating material could be used to clean up oil spills on the highways to avoid hazards, Cooley said. He saw no reason why some petroleum products couldn't be reclaimed completely by pressing out the fluff if they are costly enough to justify the cost of that step.

CAPILLARDIAMIN.

TECHNICAL DATA:

Color: white
Density: 0.5 lbs./cu.ft. ± 15%
Consistency when dry: resilient
Air cells per 1000 cc: 5,000,000
Structure: Lamellae with microscopic capillaries
pH value: 6.5 ± .5
Combustibility: non burning
Ash: 5%
Melting point: 428°F
Oil absorption as a powder 1 - 3 micron: 12.32 ml/gm

Water absorption: Immersion in water 20°C for 48 hrs. - 10% vol.
Moisture absorption: By volume at RH 80 - 0.05%
Oil absorption: 85 - 90% volume.
Oil recovery by pressing: 90% plus.
Setting time: 15 - 120 min. from foaming
Oil penetration: Directly proportional to oil viscosity.

CLEAN SWEEP ON OIL SPILLS!

CAPILLARDIAMIN®

acts like a blotter . . .
absorbs up to 40 lbs. of oil per cubic foot

It's a patented plastic foam with only 1% of the volume made up by the tough synthetic resin. The rest is air, in bubbles connected by fine capillaries that attract and absorb oil [illegible] water.

It can be made conveniently at the site of the oil spill — on ship or on shore [illegible] the applicator [illegible] to-handle [illegible] and kept for use as needed.

Capillardiamin® [illegible] oil slicks and [illegible] areas [illegible]

Where there [illegible]

Capillardiamin® [illegible] bacteria [illegible] animal or plant life.

If desired [illegible] by pressing.

Capillardiamin® [illegible] much more efficient. It presents no transportation problems [illegible] more readily available [illegible] easier to dispose of after use.

For complete information on the clean sweep material, write to

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37-20 [illegible] Street
Woodside, N.Y. 11377
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TECHNICAL PAPER # 4

CALCULATION OF INSTALLED INSULATION RESISTANCE

To facilitate the calculation of installed insulation resistance for heating and cooling load determination, the table below gives the values of most commonly used building materials (ASHRAE guide 1966): Where the manufacturers give resistance values, these should be used.

DESCRIPTION OF MATERIAL	Nominal Inch Thickness	Direction of Heat Flow	Resistance "R"
SURFACES: (FILMS)			
Outside (15 MPH wind)	——	Horz.	.17
Inside	——	Horz. & up	.61
Inside	——	Down	.92
Inside (reflective foil)	——	Up	1.32
Inside (reflective foil)	——	Horz.	1.78
Inside (reflective foil)	——	Down	4.55
BOARD-PANELS-SHEATHING:			
Wood siding—beveled and lapped	½	Horz.	.81
Asbestos Siding	——	Horz.	.17
Woods—fir, pine, soft woods	25/32	All	.90
Plywoods	½	All	.63
Sheathing (impreg. or coated)	25/32	All	2.06
	½	All	1.32
Drywall	½	Horz. & up	.45
Plaster board and plaster	¾	Horz.	.90
Composition wallboard	——	Horz. & up	1.83
Carpet and rubber pad	——	Down	1.23
Tile—vinyl, asphalt, etc.	——	Down	.05
MASONRY MATERIALS:			
Concrete	1	Horz.	.08
Concrete block—3 core	4	Horz.	.71
Concrete block—3 core	8	Horz.	1.11
Concrete block—lightweight	8	Horz.	2.00
Filling cores of concrete block add		Horz.	.76
Face brick	4	Horz.	.11
Stone, sand	1	Horz.	.08
Built-up roofing	⅜	Up	.33
INSULATION:			
Wood Pulp Cellulose	1	All	3.57 to 4.17
Cotton blanket	1	All	3.85
Mineral Wool blanket or batt	1	All	3.12 to 3.70
Mineral Wool loose fill	1	All	2.50 to 3.33
Vermiculite	1	Horz. & up	2.08
Polystyrene	1	All	3.57
Polyutrehane	1	All	5.88
Pre-formed roof insulation	1	Up	2.78
Roof dack slabs	1	Up	1.82 to 2.25

ISOSCHAUM R-value per inch = 5.5 @ 35°F mean (winter resistance)
ISOSCHAUM R-value per inch = 5.0 @ 75°F mean (summer resistance)

The sum of R-values of a given, completed structural section, divided into 1 , gives the U-factor, i.e., the heat flow in BTU/hr., through one square foot per 1°F temperature differential.

When ISOSCHAUM is used for insulation, no moisture barriers are required, provided the materials on the warm side of ISOSCHAUM are less permeable than the ones on the cold side, and no constant freezing conditions exist, such as in cold storage.

SPECIFICATION FOR SOUND AND THERMAL INSULATION

_____ insulation shall be _____ inches thick
specify structure

ISOSCHAUM urea-formaldehyde, pour-in-place, resilient, sound and thermal insulation foam as manufactured by _____

and installed by licensed applicator:

_____
name

_____
address

with the following characteristics:

Density: 0.6 lbs.cu.ft.
Non burning (ASTM D 1692 - 59T), non melting, non toxic,
Perm Rating: 50 - 100 perms/in., @ 60% closed cells,
K-factor: 0.18 @ 35°F mean, o.20 @ 75°F mean,
Shrinkage: linear 1-1.8% normal, 3% maximum,
Sound absorption range: 83-92% @ 400 - 3,200 cps @ 2" thickness,
Water repellent, non corrosive, mold resistant
FHA materials release # 551, May 17, 1967 .

Project:_____

_____
Architect and/or engineer

_____
Remarks and additional instructions

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TECHNICAL PAPER #5

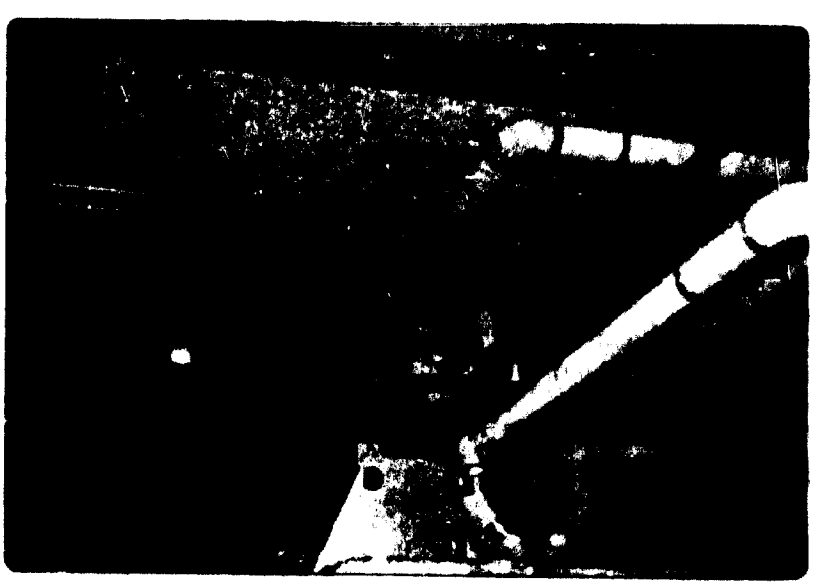
A HEAT AND NOISE BARRIER IN A BOILER ROOM

ISOSCHAUM is an excellent heat and noise barrier. It can solve a combination of heat and noise problems as shown in the illustration.

Noise and heat were penetrating into the apartment located above the boiler room. In order to shut out both ISOSCHAUM was foamed into a cavity created between the concrete surface and metal lath suspended from 3" stick-clips.

In order to allow proper bonding, the stick-clips were fastened the day before. The distance between the stick-clips is 2 - 3 feet. The metal lath was covered with ISOSCHAUM approximately 1/4" by spraying. No further treatment was required.

The foam was applied directly with a special trowel-nozzle. As the foam came out it penetrated through the metal lath and was trowelled smooth in one operation.



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TECHNICAL PAPER #6

CAVITY WALL INSULATION : BRICK VENEER/CINDER BLOCK

Cavity wall construction has become a popular building method in commercial construction.

One of the big problems of this type of construction is the problem of insulation and water penetration. Inorganic insulation materials have the tendency to absorb and retain moisture.

ISOSCHAUM pour-in-place insulation foam solves both problems as well as others.

The foam is poured, without exerting pressure, into the cavity before it is closed up. The foaming hose is dropped to the bottom of the cavity and withdrawn as the foam rises. As soon as the cavity is filled it can be closed. There is no need for moisture barriers as can be seen from the data published in our technical paper #1. Furthermore, the foam seals all cracks and crevices, thus creating an effective seal against air invasion.

An experienced two man crew can install up to 20,000 board feet per day. This high rate of application as well as the comparatively low cost of the material itself, make it very attractive from the cost point of view.

ISOSCHAUM'S high R - value (11 for 2 inches in the winter and 10 in summer), as well as its absolute water resistance offer the builder a superior product at low cost.

Isoschaum
THERMAL & ACOUSTIC
INSULATION

U. F. Chemical Corp.
CELLULAR PLASTICS TECHNOLOGY, MATERIALS, MACHINERY

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TEL. 212 - 651-0837

TECHNICAL PAPER #7

SOUND TRANSMISSION TEST OF PLASTER WALL FILLED WITH ISOSCHAUM. (*)

(*) With the permission of the Metal Lath Association.

Plaster—Plastic Study

Ideal partitions are made with materials that have light weight, structural strength, moisture and thermal resistance, that serve as sound and fire barriers, and, of course, have a reasonable price tag.

To date, no single material with all these qualities has been developed. The trend appears to be toward the use of combinations of materials—each of which is inherently strong in one or more of these ideal wall properties.

Positive steps have been taken by the Metal Lath Association to develop a compatible group of materials which, as a total assembly, will give desirable results at reasonable cost. Steel studs, metal lath and gypsum plaster have long been known for their strength-to-weight ratio and their unequaled record for performance in actual building fires. For exterior work, substitution of portland cement for gypsum plaster can fulfill the moisture resistance requirement.

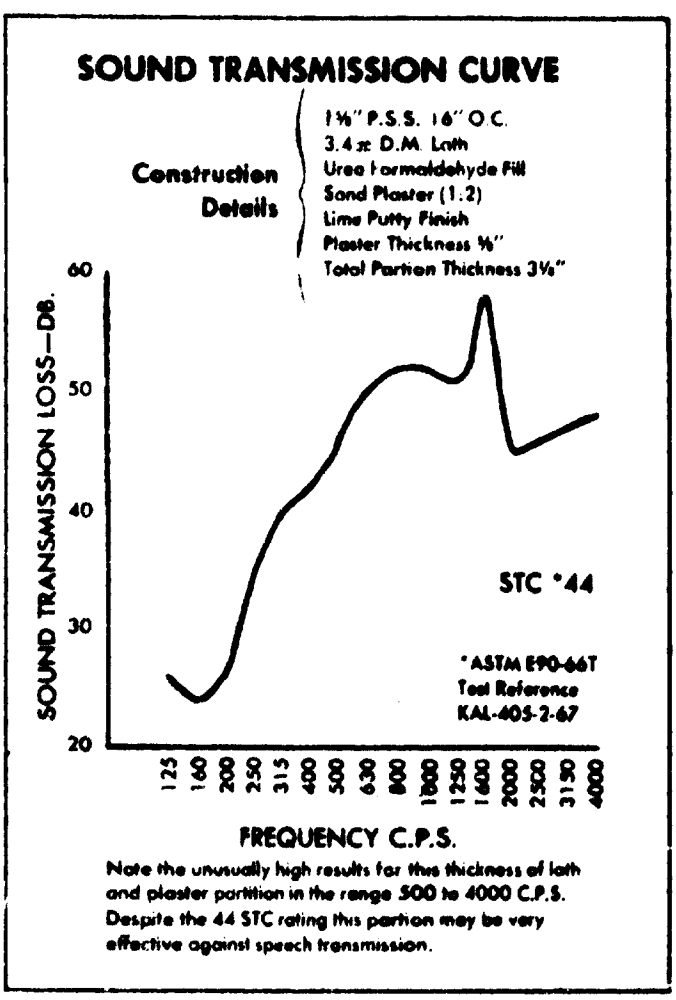
In the area of air-borne sound transmission control, the monolithic nature of metal lath and plaster has given adequate results in both field and laboratory. However, modern noise producing conveniences (garbage disposals, electric shavers, air conditioners, mass media) coupled with the increasing population density, results in a situation where upgrading of partitions and walls as sound barriers has become a prime necessity. The most practical and effective solution developed by the lathing and plastering industry is the use of resilient attachments between the steel studs and one or both metal lath and plaster membranes. With proper installation of resilient clips, a sound transmission class gain of seven to ten decibels may be obtained.

Another approach, although not entirely new, is to completely fill the partition cavity with a soft sound-absorbent material, the theory being that the sound wave passing through will be absorbed and converted to harmless heat energy. Testing of various lightweight filler materials proved the absorption theory to be correct. A urea formaldehyde fill material has been tested, with results that are favorable and especially compatible with lath assemblies.

Urea formaldehyde is a cold setting foam which is foamed in-place with a portable mechanical unit. Erection of steel studs and attachment of metal lath is done in the normal manner. The foam is then "shot through" the lath, filling the stud cavity completely. Construction of a test panel showed the feasibility of using the double-back plaster method on this foam-metal lath base. The foam is resilient enough to let plaster keys form, but also stable enough to allow the double back coat to be applied without affecting the scratch coat or keys. (Results of the sound transmission test are illustrated in the accompanying graph.)

Moisture content of freshly foamed urea formaldehyde is 1.8 lbs./cu. ft.—a factor which has some effect on the setting property of gypsum plaster. The use of the material in curtain wall construction* may have good possibilities. Because of this moisture condition, a slow cure is induced on the portland cement stucco face, thereby virtually eliminating the problem of shrinkage cracks. Other advantages in exterior work are: a thermal insulation-K-factor of .20, a moisture barrier, and fire resistance—since the foam does not support combustion—its melting point is 428 degrees F.

*Refer to METAL LATH NEWS, Vol. 30, No. 3, Fall, 1966 Metalath Studwall, pages 6 and 7.



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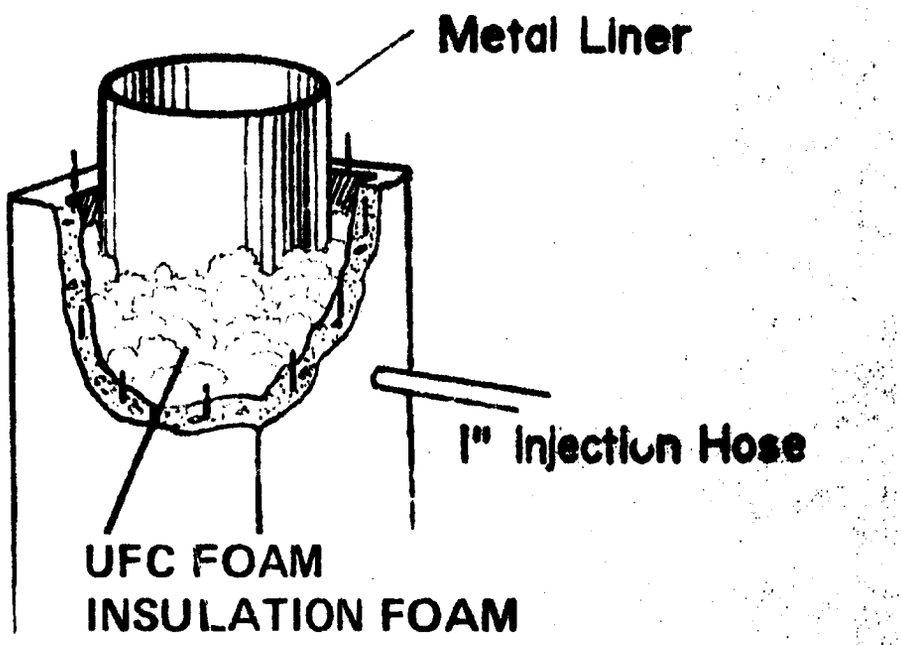
TECHNICAL PAPER #8

SOUNDPROOFING OF GARBAGE SHAFTS

Garbage shafts are usually metal-lined vertical ducts where high noise levels from falling garbage are generated. This situation can become (and usually is) a nuisance to tenants in rooms adjoining the garbage shaft. An effective noise barrier can be easily and inexpensively installed with the U. F. C. FOAM SYSTEM. This system lends itself to new construction as well as for remedial work in already occupied buildings.



U. F. C. FOAM is pumped into the hollow space between the lining and the wall of the incinerator shaft through one-inch holes. It does not require bracing since the foam does not expand once it leaves the applicator hose. Pumping pressure is below 35 psi. It sets within one minute after foaming. U. F. C. FOAM is an excellent thermal insulator (K-factor is 0.2) and an effective sound barrier (sound absorption coefficient: 83% @ 400 cps; 93% @ 1600 cps at a thickness of 2 inches). Continuous service temperature 210°F.

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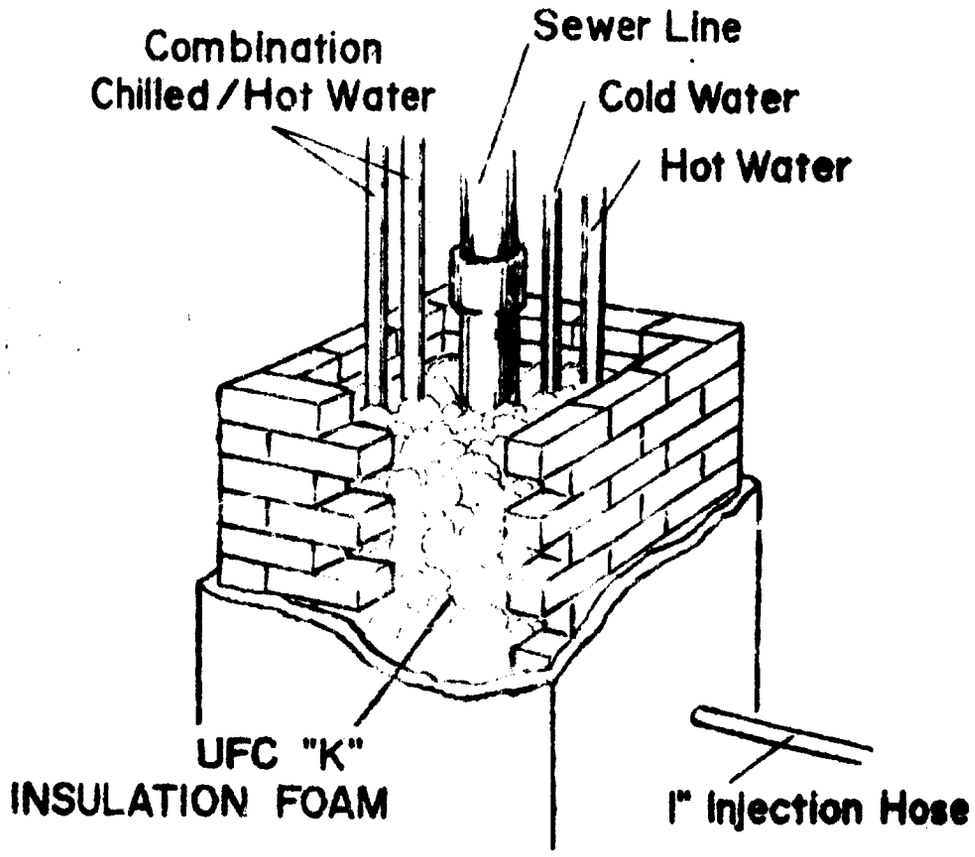
TECHNICAL PAPER #9 (REVISED)

PIPE CHASE INSULATION MADE EASY WITH UFC-FOAM

Insulating pipes in a pipe chase is expensive, time consuming and inconvenient.

The UFC "K" FOAM insulation system offers several advantages to the architect, the builder, the home owner, and the tenant.



UFC "K" is a liquid foam which can be injected from a hose into cavities through one-inch holes. It does not expand once it leaves the hose; therefore, no bracing is required. After one minute, the foam sets and hardens. It is highly resistant to pests, molds, chemicals, heat, and cold. No moisture barriers are required where temperatures do not go below 32°F. The maximum constant high-temperature exposure for UFC "K" is 210°F.

Continued

UFC-FOAM can be applied in winter and summer because it is a cold-setting process--independent of ambient temperature. The applicator gun discharges the foam at a rate of 2.5 cfm, which means that a chase 8" high, 6" deep, and 12" wide can be insulated in less than 2 minutes' foaming time, irrespective of the number of pipes in it or their configuration.

Repairs are easy to effect because the foam can be removed by hand and replaced afterwards.

It has very good insulation value (K-factor is 0.2 @ 75°F. mean temperature) as well as a high sound absorption coefficient. UFC prevents sound traveling from one bathroom to another by effectively preventing sound transmission through vertical pipe chases.

UFC-FOAM can do an excellent soundproofing job on drainage pipes, where high noise levels are often generated from down-rushing water. This can be eliminated in the design stage by placing the sewer lines in a pipe chase and foaming it with UFC-FOAM or as a remedial job by encasing the offending pipe in sheet rock or similar rigid enclosure and then foaming it. (Sound absorption coefficient is 83% @ 400 cps; 93% @ 1600 cps at a thickness of 2 inches).

U. F. Chemical Corp.
CELLULAR PLASTICS TECHNOLOGY, MATERIALS, MACHINERY
WOODSIDE, N. Y. 11377 37-20 58TH STREET · TEL. 212-651-0837

TECHNICAL PAPER #11

F L E X I C O R E S

To mathematically arrive at the potential thermal resistance value for an 8" thick Flexicore section covered with typical asphalt built-up roofing and Cores foamed with U. F. C. Foam we submit the following for your consideration.

Taking a section of Flexicore 6" long x normal width of 24" being 1 sq. ft. (144 sq. in.) 108 sq. in. (6 x 6 x 3 = 108) are over voids varying in height from 0 to 6". The balance of the surface area (36 sq. in.) (144 - 108 = 36) being 8' of concrete and roof coating only.

The average thickness of U. F. C. Foam in a 6" circle would be 4.7". Computed by: 28.27 (area of 6" circle) x 6" (length of single core in 1 sq. ft. section = 170 cubic inches. 170 : 36 (sq. surface measure of core = 4.7" x 5 = R of 23.5.

REFERENCE	ITEM	DESIGNATION	R VALUES
Manufacturer	(a)	4.7" U.F.C. Foam (R=5. per in.)	= 23.5
FHA	(b)	2" Concrete	= .32
FHA	(c)	Built-up roof	= .33
FHA	(d)	Inside air film	= .68
FHA	(e)	Outside air film	= .17
Manufacturer	(f)	Flexicore with built-up roof	= 2.00
Manufacturer	(g)	1.2" roof board (Urethane)	= 8.33
Manufacturer	(h)	2" Roof board (Styrene)	= 8.33
FHA	(i)	8" concrete	= 1.72

Then:

In one sq. ft. of surface (144 sq. in.)

c + d + e + 1 = 2.90	36 parts - 2.9 =	104.4
a + b + c + d + e = 25.	108 parts - 25. =	2700.0
		2804.4

2804 ÷ 144 = 19.46 average R value

Recognizing that mathematical and actual results are not always parallel, it is suggested we take a 20 per cent adjustment factor. 80% of 19.46 = 15.57.

By adding Urethane ("item g") or Styrene ("item h") under built-up roof, we have 13.57 + 8.33 = 23.90 R value which is a U of .0418.

The result of extremely high insulation value with roof boards of a practical thickness make this seem to be a most desirable system. Performance and economics are both attractive.

FACTORY MUTUAL RESEARCH CORPORATION

1151 BOSTON-PROVIDENCE TURNPIKE, NORWOOD, MASS. 02062

19357 February 25, 1970

U.F.C. FOAM, TYPE K

CORE INSULATION

from

U.F. CHEMICAL CORPORATION

33-69 55TH STREET

WOODSIDE, NEW YORK 11377

I INTRODUCTION

1.1 U.F. Chemical Corporation submitted their U.F.C. Foam, Type K, core insulation (2 1/2 in. thickness) faced on both sides with 1/2 in. thick paper-faced standard gypsum wallboard for possible Factory Mutual approval as a wall assembly of low fire hazard, not requiring automatic sprinkler protection of itself.

1.2 Fire tests in the FM Construction Materials Calorimeter and an additional fire test to evaluate the possibility of a vertical spreading fire within the core show that the construction meets the Factory Mutual Approval Standards for Class I Building Materials.

1.3 The tests also served to qualify for approval constructions in which the foam is enclosed on both sides with paper or vinyl faced standard gypsum wallboard of thickness greater than 1/2 in., or enclosed on both sides by concrete or masonry.

II DESCRIPTION

2.1 The U.F.C. Foam, Type K, core material is a foam-in-place urea-formaldehyde base plastic. The foaming agent is an aqueous detergent mixture expanded by air.

III CALORIMETER TEST APPARATUS AND PANEL

3.1 The first fire hazard test was conducted using the FM Construction Materials Calorimeter. See attached re-print for description.

19.12.73

2 OF 2

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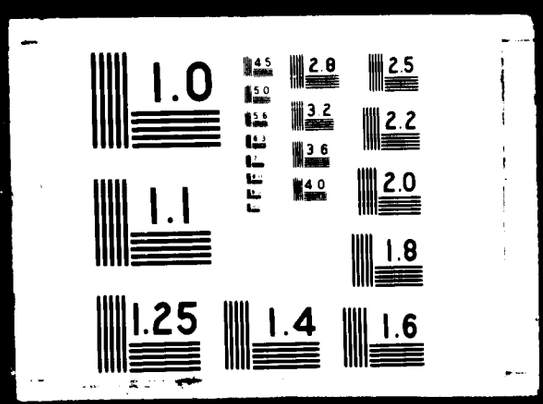

3.2 The submitted test panel (4 1/2 ft. x 5 ft.) consisted of a 2 1/2 in. thickness of U.F.C. Foam, Type K, sandwiched between 1/2 in. thick paper-faced standard type gypsum wallboard. (Metal studs, 16 in. o.c., were contained in the core parallel to the 4 1/2 ft. dimension.) The exposure side of the test panel contained a wallboard joint which was covered with a gypsum joint compound. The joint was parallel to the 5 ft. dimenaion, and 12 in. from the exposure edge. When in place, a 4 ft. x 4 ft. area of the test panel was subjected to the direct action of the fire exposure.

IV TEST

4.1 The preheat air was adjusted to 100°F.

4.2 With the refractory cover in place, the exposure fire was turned on and maintained at a fixed rate until thermocouples imbedded in the brick lining of the calorimeter reached 300°F. At that time, the exposure fire was cut off and the calorimeter allowed to cool until the imbedded thermocouples reached 175°F.

4.3 During the calorimeter cooling, the test panel was placed in position and the edges sealed with asbestos cement to prevent the escape of gases from the calorimeter chamber. This is the standard preheat procedure.

4.4 The exposure fire was then turned on and maintained at a fixed rate throughout the test. From the flue, a time-temperature curve was obtained representing the combined heat contribution of the sample and the exposure.

V. EVALUATION

5.1 The noncombustible refractory cover was placed on top of the furnace and sealed.

5.2 Again, following the standard preheat procedure for the calorimeter, the standard exposure fire was turned on. At the temperature recorder, the time-temperature chart was pre-plotted with the curve for the test panel to be evaluated. Then by adding metered fuel from a separate source through auxiliary burners, the curve obtained with the test panel was duplicated.

5.3 The various auxiliary fuel rates used were recorded and plotted. With this data and the heat value of the evaluating fuel, heat contribution rates of the test panel were computed to arrive at a Fire Hazard Classification.

5.4 The maximum one minute Fuel Contribution Rate FCR was recorded as 116 Btu/sq. ft./min. The total fuel contributed by the assembly during the 10 minute test was 300 Btu/sq. ft. These values are converted to a Fire Hazard Classification in accordance with the FM Standard for Class I Building Materials as shown on Page 3.

VI VERTICAL WALL TEST

6.1 A 4 ft. x 8 ft. panel of the same construction as the Calorimeter panel was supported on the floor on its 4 ft. edge. A 6 in. x 8 in. opening was cut into the center face of the wallboard 6 in. from the floor level. Three thermocouples were placed at 12 in., 36 in., and 60 in. distances from the top of the opening. (The top of the panel was unsealed.)

6.2 An acetylene torch was inserted into the opening and this exposure was maintained for one hour in an attempt to induce vertical fire spread.

VII RESULTS

7.1 Calorimeter Tests

The Fire Hazard Classification indices of the test panel and those of the maximum allowable by the Factory Mutual Approval Standard are shown below:

FIRE HAZARD CLASSIFICATION

	Flame Spread Index	Fuel Contributed Index
2 1/2 in. U.F.C. Foam, Type K, faced on both sides with 1/2 in. paper-faced standard gypsum wallboard	15	15
Factory Mutual Approval Standard	25	100

7.2 Vertical Wall Test

Only minor flame spread was observed in the immediate area of the exposure. No vertical flame spread resulted. Major damage (decomposition) to the core insulation was limited to an approximate 2 ft. distance above the exposure. Maximum thermocouple readings recorded were:

Thermocouple 1	12 in. above opening	1700°F
Thermocouple 2	36 in. above opening	100°F
Thermocouple 3	60 in. above opening	90°F

VIII CONCLUSIONS

Fire tests show that the U.F. Chemical Corporation's U.F.C. Foam, Type K, faced on both sides with minimum 1/2 in. thick paper-faced standard gypsum wallboard is a construction assembly of low fire hazard. The assembly conforms to the Factory Mutual Standard for Class I Building Materials and is not expected to contribute significantly to an interior fire. The assembly does not, of itself, require automatic sprinkler protection. Approval is also extended to

constructions in which the foam is enclosed on both sides with paper or vinyl faced standard gypsum wallboard of thickness greater than 1/2 in., or enclosed on both sides by concrete and masonry.

The manufacturer shall periodically furnish samples of the product for purposes of re-examination to insure continuation of product acceptability.

Approval is effective when the Manufacturer's Agreement is signed and returned to Factory Mutual.

BJC/brs

Notebook No. : 280

Tests and Report By:

B. J. Callahan

B. J. Callahan,
Project Engineer

Report Approved By:

W. Maroni

W. F. Maroni
Chief Materials Engineer

U. S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL HOUSING ADMINISTRATION

TO: INSURING OFFICE DIRECTORS

Series and Series No.

MATERIALS RELEASE
NO. 551a
Supersedes No. 551

Date
April 14, 1969

SUBJECT: 1. Product * U.F.C.-FOAM INSULATION

2. Name and Address of Manufacturer: U. F. Chemical Corporation
33-69 - 55th Street
Woodside, New York 11377

Data on the nonstandard product described herein have been reviewed by FHA and determination has been made that it is considered suitable from a technical standpoint for the use indicated herein. This Release does not purport to establish a comparative quality or value rating for this product as compared to standard products normally used in the same manner.

This Materials Release cannot be used as an indication of endorsement, approval or acceptance by the Federal Housing Administration of the described product, and any statement or representation, however made, indicating such approval, endorsement or acceptance by the Federal Housing Administration is unauthorized. See Code 18, U.S.C. 709.

Any reproduction of this Release must be in its entirety.

USE: Thermal Insulation for Buildings.

DESCRIPTION: * U.F.C.-Foam insulation is a light weight cellular plastic produced by the interaction in aqueous solution principally of urea and formaldehyde in the presence of a catalyst and foaming agent. It is a non-toxic self-extinguishing, white foam material with a density of 0.6 lbs. per cu. ft. and a thermal conductivity (k) factor of 0.24. Foam reaches near maximum insulating value in 14 days, maximum in 90 days. Shrinkage of foam shall not exceed 1.8% of length of joist or stud space.

APPLICATION: The insulation is foamed at the site by using a portable applicator equipped with flexible hose for delivering expanded wet foam to areas to be insulated. Drying time depends on thickness, temperature, humidity and the amount of ventilation. Under average summer conditions with normal attic ventilation, a 4" thick application will dry within 14 days. Winter temperatures do not affect foaming process provided solution temperatures are kept above 50°F during application.

A. **Attics**

Foam is pumped between the joists. If a vapor barrier is used, foam is pumped directly on it. A vapor barrier must be used between the foam and any material on which it may be applied if such material or its finish is adversely affected by moisture released by the foam in drying.

B. **Uncovered Exterior Walls**

1. Pump foam between studs with the exterior sheathing as backing.
2. Ventilate area while foam is being applied by leaving doors and windows open.
3. Apply vapor barrier as soon as possible after foaming.
4. Apply interior finish material in the usual manner.

C. **Covered Exterior Walls**

1. Drill a 1" hole in cavity between studs, including areas above and below window openings, above doors, and elsewhere to assure filling entire space between studs.
2. Drill one 1/2" hole, or two 1/4" holes, at the top of each opening or space.
3. Pump foam through the 1" hole until it comes out of the top hole or holes.

D. **Cavity Walls**

1. Pump foam into the cavity as wall reaches successive 8 ft. to 10 ft. heights. Drop application hose into cavity and pull back slowly as foam fills cavity. Repeat at intervals of 3 ft. to 5 ft. horizontally as necessary around the perimeter.

INSTALLATION: Foamed in place by authorized agent of the producer using their recommended materials and applicators.

* *

* Revised

487-70-SM

APPLICANT—U. F. Chemical Corporation, owner.

APPEARANCES—

For Applicant: H. M. Cole, V. Morfopoulos and C. H. Stillman.

ACTION OF BOARD—Material approved in accordance with the report and recommendation of Committee on Test.

THE VOTE—

Affirmative: Chairman Galvin, Vice Chairman Becker, Commissioner Klein, Commissioner Madigan and Commissioner Nolan 5
Negative: 0

THE RESOLUTION—

WHEREAS, the report of a Committee on Test reads:

487-70-SM—H. M. Cole for U. F. Chemical Corporation, New York, filed for approval of the material known as U. F. C. Foam Insulation under the provisions of C26-106.2 Building Code of the City of New York.

PROPOSED USE: Noncombustible insulation.

DESCRIPTION: The material is basically urea formaldehyde that is spray applied to the surface that is to be insulated.

The exact formulation is of a proprietary nature and therefore, the Board has placed the formula in a sealed envelope and deposited it in the Board's safe.

INSPECTION AND TEST: The applicant has submitted a report of test conducted by American Standards Testing Bureau, Inc. showing that the material is non-combustible when tested in accordance with ASTM E136, and that it has a thermal conductivity of .201 Btu-in./hr.-°F.-ft.² (ASTM C177), within ASTM limits.

RECOMMENDATION: On the basis of the test, the Committee on Test recommends the approval of the material known as U. F. C. Foam Insulation for use in New York City under the provisions of C26-106.2 Building Code of the City of New York, as a noncombustible insulation, on condition that this material shall not be considered and shall not be used in lieu of required fireproofing and that the insulation be adequately protected to the satisfaction of the Commissioner. Each container in which the material is marketed shall be labeled "Approved by the Board of Standards and Appeals for use in New York City under Calendar Number 487-70-SM".

A sworn affidavit by a responsible officer of the manufacturer, familiar with the materials, processes and controls of the product manufactured, shall be filed annually with this Board, certifying that such materials, processes and controls are being maintained as were in effect at the time of this approval. Failure to notify the Board of change of ownership, change of address or to submit the annual affidavit will be cause for revocation of approval.

(Sgd.) SOLOMON SHERB, P.E.,
Director,

STUART LOWENTHAL,
Asst. Engr.,
Committee on Test.

Resolved, that the Board of Standards and Appeals does hereby *approve* this *material* in accordance with the above report.

A true copy of resolution adpoted by the Board of Standards and Appeals December 8, 1970.
Printed in Bulletin No. 51, Vol. LV.

Copies Sent
To Applicant
Fire Comm.
Borough Supt.

Thomas F. Galvin

American Standards Testing Bureau, Inc.
44 TRINITY PLACE, NEW YORK, N. Y. 10006 ● PHONES: (212) WH 3-3157, 8 ● CABLES: AMSTATESBUR

P. #6071
R. #14158
December 7, 1970

U.F.C. FOAM INSULATION - FIRE ENDURANCE TESTS
(RE: U.S. STEEL BUILDING FIREPROOFED COLUMNS; N.B. 67/67)

INTRODUCTION:

Pursuant to ASTB Proposal QPR No. 6095670 dated June 29, 1970, and the reply thereto communicated by The Commissioner, NYC Department of Buildings, 100 Gold Street, New York, N. Y. 10038 on July 16, 1970, Mr. Fritz Kramer of U.F. Chemical Corporation, 37-20 58th Street, Woodside, N. Y. 11377 requested that a fire endurance testing program be carried out "to show that the fire resistive rating of the [subject fireproofed] column[s] will not be adversely affected" by the application of U.F.C. foam thermal insulation thereon (Ref. JTO:IEM:ap - 7/16/70). For that purpose, a set of steel column samples were prepared in accordance with ASTM E119-61. On September 23, 1970, Universal Fire Bar, Inc., 607 South Bell Street, Arlington, Va. 22202 sprayed four (4) 10WF49 and two (2) 14WF228 columns with fireproofing insulation previously approved by the NYC Department of Buildings as per UL File #R6183, 69CH8549 tests. On October 22, 1970, U.F.C. foam insulation was applied between steel cladding and the cured fireproofing layer on a 10WF49 column. After a six week total curing period and on November 3, 1970, a fire endurance test was conducted as per ASTM E119-61. The results of this test was elaborated in our Report No. 14141 dated November 11, 1970.

A standard 14WF228 column was foamed o November 3, 1970, as per the schematic drawing attached to this report. After a three week curing period and on November 23, 1970, a fire endurance test was conducted as per ASTM E119-61. The tests were witnessed by the following parties:

H. M. Cole, R.A.	Consulting Architect
R. J. Friedheim	National Gypsum Company
M. Kopp, R.A.	Skidmore, Owens & Merrill
F. Kramer	U.F. Chemical Corporation
I. Minkin, P.E.	NYC Department of Buildings
V. Morfopoulos, Eng.Sc.D.	American Standards Testing Bureau, Inc.

DESCRIPTION OF THE EXPERIMENTAL SAMPLE:

The standard 14WF228 column used was uniformly covered with a 1 5/8" layer of Universal Fire Bar fireproofing. The material was spray applied and had an average

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wet density of 30.0 lb/ft^3. The average oven-dried density of the fireproofing was determined to be 21.3 lb/ft^3. The U.F.C. foam was applied between a u-shaped metal cladding and the fireproofing, as per the attached schematic drawing of the sample. The average thickness of the foam was 1 7/8" and fireproofing was applied in the back sealing the foam and cladding extremities. The cladding was attached to the column base and cap by means of metal angles.

Two levels of four (4) thermocouples were used to continuously record the steel temperature at locations 1' and 2' - 6" distant from the concrete cap. The base of the clad specimen was incorporated to the furnace floor. The sample was photographed before and during the four hour fire endurance test. After the completion of the experiment, the column was examined and photographed. The test results described below were recorded under no-load conditions on a 5 ft. column.

TEST RESULTS:

The furnace time temperature curve was well within the limits allowed by ASTM E119-61. Two levels of four thermocouples were provided to measure the column temperatures during this study. The "top level" recording thermocouples were designated as Nos. 2, 10, 12, and 16. The "lower level" thermocouples were Nos. 4, 6, 8, and 14. The locations of these thermocouples and the recording of the temperatures obtained during the test are shown on the chart appended to this report. The following table summarizes the data obtained and compares them with previous ASTB and UL results:

	Average Thermocouple Temp., °F						Single High Temp., °F					
	ASTB R#14158		ASTB R#14141		UL R#6183-1		ASTB R#14158		ASTB R#14141		UL R#6183-1	
TIME	L-L	U-L	L-L	U-L	L-L	U-L	L-L	U-L	L-L	U-L	L-L	U-L
30 min	129	137	102	125	-	-	140	150	140	150	-	-
60	179	215	190	210	-	-	200	245	205	210	-	-
90	263	295	217	267	-	-	340	360	215	260	-	-
120	368	415	267	286	-	-	410	450	285	360	-	-
180	590	660	388	524	---	-	620	680	510	630	-	-
210	478	537	282	368	-	-	510	560	395	500	-	-
240	703	778	522	682	-	-	730	800	630	780	-	-
240	806	980	670	840	925	995	830	1140	770	930	985	1010

L-L denotes "lower level" and U-L denotes "upper level" thermocouples.

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According to ASTM E119-61 requirements, failure occurs when the average thermocouple temperature, at any level, reaches 1000°F or when a single thermocouple temperature reaches 1200°F. Consequently, the sample tested was found to comply with the cited specifications. The temperature measurements recorded in this experiment were used to calculate the expected column failure time which was determined by the "top level" thermocouple readings to be 4.1 hrs. The limited temperature was reached by No. 2 thermocouple which began to record abnormally high temperatures after 3.6 hrs. of exposure to the furnace environment. Visual observations compiled during the test have as follows:

TEST TIME	REMARKS
6 Minutes	Flaming started through cladding joints.
10 Minutes	Cladding buckled severely at the edges, some burning of foam continued.
35 Minutes	Last visible remnants of foam disintegrate.

After the metal cladding was removed, there was no sign of massive foam detected. The fireproofing was discolored behind the metal cladding, however, indicating that some carbon residue has been preserved under the metal shield. The fireproofing material was soft and showed no visible signs of cracking with the exception of the area near thermocouple No. 2.

On the basis of our testing program results, we submit that there is no indication whatsoever that the foam interferes in any detrimental way with the rated performance of the fireproofed columns in question. In fact, there are indications that U.F.C. foam has a beneficial influence on the fire resistance of the fireproofed columns before the insulation is consumed.

Respectfully submitted,

AMERICAN STANDARDS TESTING BUREAU, INC.

V. Mortopoulos, Eng.Sc.D.
Technical Director

VM:awc

American Standards Testing Bureau, Inc.
44 TRINITY PLACE, NEW YORK, N. Y. 10006 • PHONE: (212) WH 3-6187 • CABLES: AMSTATBUR

P. #6071
R. #14053
August 10, 1970

U.F.C. FOAM INSULATION TOXICITY TESTS

(RE: U.S. STEEL BUILDING FIREPROOFED COLUMNS; N.B. 67/67)

INTRODUCTION:

On July 2, 1970, Mr. Fritz Kramer of U.F. Chemical Corp., 37-20 58th Street, Woodside, N. Y. 11377 requested that inhalation toxicity tests be conducted to ascertain the rating of U.F.C. Foam Insulation as per NYC Building Law BC26-504.10 and the Federal Hazardous Substances Act §191(f)(2). Comparison tests with plywood material were also conducted.

LABORATORY PROCEDURE AND RESULTS:

To determine the degree of hazard in rats as per applicable specifications, the test materials were burned and the combustion products therefrom were administered to animals. Ten normal, healthy, albino rats of the Carworth CFE strain, weighing 200 to 300 grams and equally divided as to sex, were used in this experiment. Samples of the respective test materials yielding 300 PPM of fumes were burned over direct, high-intensity flame in a glass receptacle. The rats were placed into the inhalation chamber and exposed to these fumes for six hours. At the end of the exposure period, the animals were returned to their individual cages and observed for fourteen (14) days for any untoward effects. Throughout the observation period, the animals were maintained on their regular diet of Lab Blox and water ad libitum.

Twenty-four (24) hours following exposure to test materials, in the manner described, two (2) of the experimental rats died due to U.F.C. Foam exposure and four (4) of the animals exposed to plywood fumes likewise died. The remaining animals survived the fourteen-day observation period, ate well, showed a normal increase in body weight and behaved as normal laboratory acclimated animals. The following table summarizes the experimental data recorded in this study:

TEST MATERIAL	NUMBER OF RATS EXPOSED	DEAD
U.F.C. Foam Insulation	10	2
Plywood	10	4

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DISCUSSION AND CONCLUSIONS:

On the basis of our laboratory findings regarding inhalation toxicity tests, we submit that U.F.C. Foam Insulation is non-toxic according to the specifications of the Federal Substances Act, Section 191(f)(2), 1961. Furthermore, the U.F.C. Foam Insulation appears to be comparatively less toxic than plywood and thereby fully compiles with the requirements of the NYC Building Law and Section C26-504.10 therein.

Respectfully submitted,

AMERICAN STANDARDS TESTING BUREAU, INC.

R. A. Turner, Ph.D.
Consulting Toxicologist

Approved by

V. Morfopoulos, Eng.Sc.D.
Technical Director

RAT:ma

American Standards Testing Bureau, Inc.

41 TRINITY PLACE, NEW YORK, N. Y. 10006 • PHONES: (212) WH 3-3157, 8 • CABLES: AMSTATEBUR

PROJECT No. 6071
Report No. 14157

Date December 4, 1970

From U. F. Chemical Corporation

Address 37-20 58th Street
Woodside, N. Y. 11377

Order Numbers

Material
U.F.C. Foam Insulation

Applicable Specifications ASTM C-177

On November 24, 1970, Mr. Fritz Kramer of U.F. Chemical Corporation requested thermal conductivity determinations (K-Factor) on a sample of U.F.C. Foam. Test specimens, measuring 12" x 12" x 1" and corresponding to a density of 0.7 lbs/ft^3, were delivered to ASTB on the same date.

The sample was prepared for test by cutting it into a circular disc of about 8" in diameter. The spacing was maintained by three spacer blocks set at angles of 120° about the sample. The K-Factor determinations were made in a circular, flat, guarded hot-plate apparatus as per captioned specifications. When a steady state was established, the following observations and results were obtained:

TEMPERATURE, F°				
HOT SIDE	COLD SIDE	MEAN	K, BTU-in/hr °F ft^2	R, °F hr ft^2/BTU
106.2	55.8	81.0	0.201	4.99

Upon removing the sample from the test apparatus, there was not discernible color change, shrinkage or other physical change.

Analyses by:
Tested by: JF
Witnessed by: VM

Copies Reported to:
Subscribed and sworn to on

We hereby certify that the above is a true report of the results of analyses and tests as made on the samples indicated.

AMERICAN STANDARDS TESTING BUREAU, INC.

By:
V. Vorfopoulos, Engr. Sc. D.

Form 6-65

American Standards Testing Bureau, Inc.
41 TRINITY PLACE, NEW YORK, N. Y. 10006 • PHONES: (212) WH 3-3157, 8 • CABLES: AMSTATBUR

PROJECT No. 6071
Report No. 13982

Date June 3, 1970

From U. F. Chemical Corp.

Address 37-20 58th Street
Woodside, N. Y. 11377

Order Numbers P. O. #FK:ANS - 5/8/70

Material U. F. C. Foam

Applicable Specifications ASTM E96

On May 8, 1970, Mr. Fritz Kramer, President, U. F. Chemical Corp., requested Water Vapor Transmission (WVT) determinations on certain plastic foam samples submitted to this laboratory. Said specimens were designated as U.F.C. Foam and measured 15" X 13" X 1-1/2"

The required laboratory measurements were conducted as per captioned specifications and according to Procedure B therein at 73.4°F. The humidity conditions employed were 50% RH outside the cup and 100% RH inside the cup. Recorded data in WVT units were then converte to Permeance units (perms) by means of established computation methods recommended by ASHRAE. The following table summarizes our findings over an 18-day period obtained on four (4) specimens:

DETERMINATION	WVT (g/m^2/24-hr)	PERMS
After 24 hrs - Average	262.8	37.7
After 72 hrs - Average	258.1	37.2
- Low	236.1	34.0
- High	261.0	37.6
After 144 hrs - Average	254.5	36.7
- Low	230.6	33.2
- High	261.7	37.7
After 432 hrs - Average	245.2	35.3
- Low	220.3	32.1
- High	259.0	37.3

Several permeance values for insulating materials are tabulated below for comparison purp

MATERIAL	PERMS (ASTM E96-B)
U.F.C. Foam	32-38
Mineral Wool (Unprotected)	116
Gypsum Wall Board, Plain 3/8"	50
Hardboard, 1/8"	11
Concrete (1:2:4 Mix)	3.2

Analyses by: LK
Tested by:
Witnessed by: VM

Copies Report to:
Subscribed and sworn to on

We hereby certify that the above is a true report of the results of analyses and tests as made on the samples indicated.

AMERICAN STANDARDS TESTING BUREAU, INC.

By: V. Morfopoulos, Eng.Sc.D.

VM:ma

American Standards Testing Bureau, Inc.
44 TRINITY PLACE, NEW YORK, N. Y. 10006 • PHONES: (212) WH 3-3167, 8 • CABLES: AMSTATBUR

PROJECT No. 6071
Report No. 14059A

Date August 25, 1970

om U. F. Chemical Corporation

Address 37-20 58th Street
Woodside, N. Y. 11377

rder Numbers

Material
U.F.C. Foam Insulation

pplicable Specifications ASTM E84-61

On July 20, 1970, Mr. Fritz Kramer of U. F. Chemical Corporation requested that fire hazard tests be conducted to ascertain the fire hazard rating of U.F.C. foam insulation as per captioned specifications. Foam samples 2" in thickness and 0.7 lbs/cu ft density were supplied by the manufacturer. After a seven (7) day conditioning period at 70°F and 35-40% RH, standard tests were performed and witnessed by NYC Department of Buildings' representatives, architectural and engineering independent consultants as well as industry representatives.

Fire hazard tests were performed on a U.F.C. foam specimen supported by a wire mesh. The effective burning period for this test was 1.5 minutes. The results reported below are calculated on the basis of the attached recorded data, laboratory observations and calibrations as per the applicable standard:

FLAME SPREAD	FUEL CONTRIBUTION	SMOKE RELEASE
25	10	0 - 5

The material was found to be self-extinguishing.

Analyses by:
Tested by: RN, JK
Witnessed by: VM

Copies Report to:
Subscribed and sworn to on

We hereby certify that the above is a true report of the results of analyses and tests as made on the samples indicated.

AMERICAN STANDARDS TESTING BUREAU, INC.

By: V. Mertzpoulos, Eng.Sc.D.

M:awc

m 8-66

American Standards Testing Bureau, Inc.

44 TRINITY PLACE, NEW YORK, N. Y. 10006 • PHONES: (212) WH 3-8357, 8 • CABLES: AMSTATE, NY

PROJECT No. 6071
Report No. 14000

Date June 23, 1970

From U. F. Chemical Corp.

Address 37-20 58th Street
Woodside, N. Y. 11377

Order Numbers P. O. FK-Verbal 6/18/70

Material U. F. C. Foam

Applicable Specifications ASTM E 136

On June 18, 1970, Mr. Fritz Kramer, President, U. F. Chemical Corp., requested non-combustibility determinations on captioned plastic foam samples as per ASTM E136-65. Four (4) standard test specimens (1.5" X 1.5" X 2") were prepared from the samples previously supplied (REF. ASTB R. #13982). The required laboratory measurements as per referenced standard were recorded under a constant furnace temperature of 1382° ± 2°F. The following table summarizes data thus obtained.

SAMPLE	TEMP. RISE, °F	FLAMING PERIOD, SEC.	WEIGHT LOSS, %
1049A	26	14	89.7
1049B	23	12	89.6
1049C	31	17	90.0
1049D	20	12	89.5

On the basis of the above results, we submit that the plastic foam in question is noncombustible and in compliance with ASTM E136.

Analyses by:
Tested by: CS
Witnessed by: VM

Copies Report to:
Subscribed and sworn to on

V^M:mb

We hereby certify that the above is a true report of the results of analyses and tests as made on the samples indicated.

AMERICAN STANDARDS TESTING BUREAU, INC.

By: V. Martorana
V. Martorana, Engineer

2M 6-69

ISO-KOTE LTD.
BOX R
WEEDSPORT, NEW YORK 11316

TELEPHONE: 315-834-9718

U. F. C.® COATING

(COARSE OR FINE GRAULATION)

U. F. C.® COATING is a one coat finish for inside and outside surfaces. The coating is waterproof, flexible, opaque, breathes, has long life.

COLOR: White (other colors on request and additional coat)

CHARACTERISTICS

U. F. C.® COATING is a mixture of plastic co-polymers in aqueous suspension with exceptional weather resistance and adhesion. Its flexibility and covering power will withstand cracks in walls up to 3/64". (1mm) Excellent resistance against U. V. light. Excellent abrasion resistance. Adheres well. Resistant to shock and erosion. Non-toxic. Prevents rusting. Odorless, when cured. Generally applicable on porous or non-porous material. Especially useful for the following:

CEMENT	STONE	CONCRETE	ACRYLIC	NYLON
WOOD	PLASTER	BRICKS	PVC	ALUMINUM
GLASS	POLYURETHANE	POLYSTYRENE	POLYETHYLENE	STEEL

U. F. C.® COATING may be applied by brush, spreader or low pressure spray gun.

Will not run or drip.

PRINCIPAL USES

Outside walls.

Inside Walls.

Decorative Surfaces.

Bathrooms, stairs, swimming pools, docks, ceilings, cold storage room

PROPERTIES

Easily washed and touched up.

Waterproof.

Coating permits the wall to breathe while substrate dries.

Elastic, absorbs expansion and contractions up to 3/64".

Coating is permeable to vapor. This prevents condensation and blistering of coating due to accumulation of moisture.

Will not affect plastics such as polystyrene, polyurethane, etc.

APPLICATION

PREPARATION OF U. F. C.® COATING

1. Stir well before use.
2. Add 10% water to first coating where two coatings required or for spray gun application.

PREPARATION OF SUBSTRATE

1. Clean surface from oil, grease, old paint.
2. Spackle and fill cracks and joints.
3. Base coat porous surfaces (Base coat: dilute UFC® Coating 1:10 with water and spray or brush on).

DRYING

1. 15 minutes after basecoat.
2. 1-2 hours after first coat.
3. Completely dry and cured in 18-24 hours.

APPLYING

a. Brush on: 3/64" (1.0mm)
b. Trowel on: 3/64" (1.0mm)
c. Spray on: 1/32" (0.6mm) Thin out with approx. 10% water.

Use 5/8" orifice spray gun -- low pressure (75 lbs./sq. in., 20 cfm compressor)

WORKABILITY: 5 - 15 minutes.

STORAGE: 6 months in closed container. PROTECT FROM FROST
On partially used containers, cover surface with water and/or close.

CLEANING: Can be washed off rugs and tools, before it is dry

ADDITIVES: Pigments, glass fibers, colored glass dust or sand can be added prior to application or sprinkled on while coating still tacky.

COVERAGE: Spray on: 1/32" - 1.5 lbs./sq. yd.

Brush on
Trowel on 3/64" - 2.25 lbs./sq. yd.
Roll on

DISTRIBUTED BY:

UFC Foam ... the superior foamed in-place thermal and acoustical insulation

Use UFC Foam anywhere. It's equally practical for large area or spot applications. It can be applied through one-inch openings in floors, ceilings, walls, partitions, pipe chases and other building cavities.

houses	laboratories
apartments	sound studios
offices	stores
factories	ships

benefits

NON-COMBUSTIBLE	Certified under ASTM E-136. Rated at 25 for flame spread, 10 for fuel contribution, 0-5 for smoke release under ASTM E-84 and ASTM E-119. Factory Mutual approved for sandwich construction without sprinkler system
LOW THERMAL CONDUCTIVITY	K factor of 0.20 at 75°F and 0.18 at 35°F — resistance factor of 5.0 at 75°F and 5.5 at 35°F
REDUCED SOUND TRANSMISSION	83% to 92% at a nominal thickness of two inches — lessens sound transmission through dry walls by 5 to 7 decibels
LOW COST	less expensive on an installed price/performance basis than poured or matted insulation
EASY TO APPLY	no preparatory work required—patented gun "shoots" foam into wall cavities as easily as applying shaving lather—typical between-studs void can be filled in less than two minutes
NON-TOXIC	no toxic vapors produced, even when subjected to heat and flame — no protective masks required for applicators
DIMENSIONALLY STABLE	unaffected by heat or cold — no pressure build-up or settling
CHEMICALLY STABLE	modified urea formaldehyde resin formulated in accordance with the patented isoschaum process — guaranteed for 10 years
WATER REPELLENT	moisture absorption in wet cavity wall over 24-hour period measured at 2%
PEST PROOF	foam is hostile environment for most rodents and insects
NO MAINTENANCE	stable under all normal environmental conditions

For additional information on UFC Foam, call or write:

ufc

U. F. Chemical Corp.
37-20 58th Street
Woodside, N.Y. 11377
Phone: (212) 651-0837

west of the Rockies
Brekke Enterprises, Inc.
1320 Tidehaven Road E.
Tacoma, Wash. 98424
Phone: (206) 922-5511

UFC Foam Insulation passes trial by fire

UFC Foam thermal and acoustical Insulation is non-combustible. This unique product has been certified as non-combustible when tested in accordance with ASTM E-136, and New York City's Board of Standards and Appeals has approved it under Calendar Number 487-70SM.

In other tests under ASTM E-84 and ASTM E-119, UFC Foam had ratings of 25 for flame spread, 10 for fuel contribution, and 0-5 for smoke release. These tests concluded, "the material is self-extinguishing after removal of the ignition flame and quite inactive over a surface burning test period extended to 30 minutes." UFC Foam enhances the fire rating of the structure tested, and Factory Mutual has approved UFC Foam for sandwich construction with ½-inch wall board and 2½-inch of UFC Foam without requiring a sprinkler system.

Specify UFC Foam Insulation on your next building project! It's non-combustible and has numerous exclusive benefits that will improve thermal and acoustical performance, make your job easier and increase customer satisfaction.

blanketing a building in insulating foam

insulating contractor for New York office building shows expanding uses for insulating foam

APPLICATOR INSULATES pipe chase area by injecting foam into all odd-shaped crevices filled with pipe, wire and fixtures. The foam sealed air and sound infiltration, as well as cracks and voids. Thermal Consultants was the insulation contractor. Diesel Construction Company was the general.

LITTLE DID Thermal Consultant's Don Toy know that when he got the insulation contracts for exterior spandrel panels of a 27-story office building that he'd end up blanketing almost the entire structure in foam.

Thermal Consultants is an insulation contractor specializing in urethane and other foam systems. It also provides engineering consulting services. The contract was on Walston Company's new headquarters building in New York City.

Thermal chose a hot new insulating and soundproofing product for the job called UFC foam. Manufactured by U.F. Chemical Corp., this foam product is designed to resist both heat and sound. It contains three elements—urea formaldehyde, foaming agent and air. The three components are fed through a hose into a gun, where they are pressurized, then formulated. It is applied at any temperature as easily as spreading shaving cream.

Only one contract. At the outset, Thermal had only one contract for the Walston building. It called for insulation of 150,000 board feet of exterior spandrel panels. Armed with 40-55 gallon drum sets, UFC's patented foam gun, Gray Company's specially adapted vertical piston pumps, a gasoline air compressor, hoses and a "bag of tricks", Toy's four-man crew tackled the job in earnest.

Thermal developed a white, non-burning netting which was used extensively on the job. Called "Cavnet", this netting is used to create a cavity to contain the foam (unlike urethane, UFC foam has weak adherence). It also acts as reinforcement.

By this method, Thermal sealed all leaks on each floor and provided a thermal barrier with a total U factor of .08 maximum. The foam insulated and prevented moisture from entering through the exterior wall.

Was just the beginning. "The job should have ended there, but it didn't," Toy says. "The general contractor on the job, Diesel Construction Company, saw what foam could do on the exterior wall. He was impressed by our rapid installation, so he found other places to use it. And since we also provide engineering services, we were able to advise him an the feasibility of other installations.

"Diesel first asked us if we could install a thermal barrier in the machine room. Since the uneven contours of the wall lent itself to foam installation, we were eager."

Toy says his men sealed 10,000 square feet of space in the machine room using 25,000 board feet of foam. They used the special net on this job also while monolithically insulating the wall with foam.

As a side effect, the foam in the machine room will dampen the noise of the machinery and thus let less noise escape into the street.

"The next problem Diesel called our attention to was the high hat lighting in the ceiling. Diesel correctly assumed that the high hats would be a

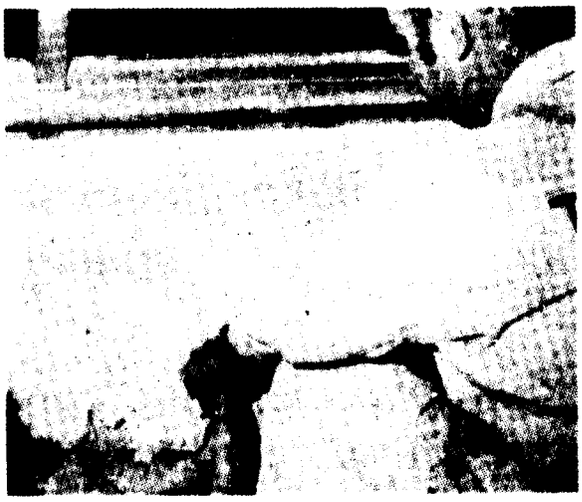


PHOTO ON LEFT shows a specially-developed white, non-burning netting which was used extensively on Walston & Company's headquarters building. On the right, UFC foam is injected into the cavity created by the netting. The "Cavnat" netting contains foam and acts as a reinforcement.

source of thermal leakage.

"To solve this problem, we did something that, as far as I know, has never been done before. We spiraled the foam around the fixtures in a turban manner. This method was developed by our foreman, Robert Brady."

Changed specifications. "Solving that problem led to something else," Toy says. "Next was the ceiling, which is hung over a vast outdoor open mall. Air conditioning duct work and piping as well as domestic hot and cold water and sanitary lines in the ceiling had to be separated from outdoor temperatures. Fiber glass was specified. But Diesel was wary of the multiple number of open joints that were impossible to seal.

"Diesel gave us the green light to use foam. We layed it down monolithically, totally blanketing the ceiling area leaving a very efficient thermal barrier.

Ready to leave. Toy says he was "ready to pack up" after insulating the high hats. But Diesel told him to "hold his horses". The general needed insulation in the mezzanine area. The architect's specifications called for thermal insulation to be placed vertically to separate an exterior hung ceiling area from an interior hung ceiling area. But the specs didn't pinpoint the type of insulation.

Diesel opted for foam and Toy got another job. He created a cavity of about two inches with the netting material hung in a vertical position between the underside of the above floor and the hung ceiling line. The foam was then injected into the created cavity space; it formed an absolutely monolithic thermal partition.

Toilet room noise. The owner, Mel Kaufman of Kaufman Realty, was responsible for Thermal's final UFC foam job on the building. He was concerned about the toilet rooms that were adjacent to tenant areas. They didn't want tenants to be annoyed by toilet room noises.

The solution agreed upon was insulation of the pipe chase area. Thermal injected the foam into all odd-shaped crevices filled with pipe, wires and fixtures. It sealed air and sound infiltration, cracks and voids.

Blanketing the upper structure of the building in foam did not entirely solve the problems. The ground floor slab which is almost entirely exposed to the weather also had to be protected.

Thermal did this by applying a ⅜" thick spray coat of polyurethane (manufactured by Diamond Shamrock) to the underside of the Q decking concrete floor form. This provided a monolithic thermal and vapor barrier. It also sealed the slab from water leakage.

Toy says the Walston job is "just the beginning". He says that for 1970-71 his firm is under contract to do work on many of the major office buildings under construction in New York City.

■■■■

A Thermal Consultants mechanic checks on urea formaldehyde set-up prior to foaming walls of new high riser apartment building. The drums consist of urea formaldehyde.

JOB OF THE MONTH

Foamed-In Place Insulation—New Sound Stopper

A large new New York apartment building got the silent treatment via foamed-in-place insulation (urea formaldehyde). The product proved to be an economical way to soundproof a thin-wall designed building

☐ A large new New York apartment building got the silent treatment via foamed-in-place insulation (urea formaldehyde). The product proved to be an economical way to soundproof a thin-wall designed building.

By utilizing a special foam-type material, an insulation contractor was able to efficiently and economically soundproof and insulate a high rise apartment building in New York City.

The 26-floor apartment ilding, St. Clair Place, designed to house .y members of Columbia University, required high-performance soundproofing. Thermal Consultants, Inc., New York, N.Y., which specializes in urethane and other foam systems, selected a new and fast-developing insulation and soundproofing product for the job—urea formaldehyde.

This foamed-in-place material with the strange sounding name is actually quite simple to work with.

Designed to resist moisture *and* sound, the system is made of three elements—urea formaldehyde, a foaming agent and air. The three components are fed through a hose into a gun, where they are pressurized, then formulated. The material is released from the gun, coming out like a foamy shaving cream. (For another similar application, see October '68 RSI).

President of Thermal Consultants Donald Toy, who had worked with UFM systems before, was confident that this process was ideal for such a project. "We first had to prove to the owner-architects that the foam would be effective, however," said Toy. "We foamed sample walls and pipe spaces, using the product in an on-the-job test. It worked. Upon inspecting the walls, the designers of the building noted that the walls were completely filled, without voids or pockets.

Based on lab tests now in existence, the architects, Brown, Gunther, Battiglia and Galvin, wanted to achieve a sound transmission factor of at least 54. The construction consisted of a 2½-inch metal stud place 16 inches on center, with approximately 2 ⅝-inch layers of sheet rock on each side.

The material, Toy explained, when pumped in via hose, flows around pipes, conduits, medicine cabinets and hampers that are built into the walls and, in some locations, even around ductwork.

By using the foam, Toy observes, the insulation and sound-proofing could be done with minimum interference between the working trades. "The wall installers, for example, can go ahead

The foam, under pressure, is released into the apartment wall partitions by another mechanic. Thermal generally employed just two mechanics to foam one apartment floor per day. The apartment floor was comprised of anywhere from one to four bedroom apartments per day.

Donald Toy, president of Thermal Consultants, specializes in foam jobs.

and install the partitions without waiting for the insulators. We only have to provide small holes to inject the gun. They are patched up by the wall operator when they are doing their finishing work —spackling, taping, etc."

Using U. F. C. Corp.'s foam, Thermal had the material—contained in drums—delivered to each floor. Basically, the job called for two sets of drums on each level. This provided a capability for each set-up of foaming 8000 to 10,000 board feet.

The material—the resin and agent—came in 55-gallon drums. The company used two mechanics per floor (although Toy claims it could be accomplished with just one man).

On a typical day, the mechanics would first set up the equipment, adjusting, cleaning and setting. They did about one floor per day.

The wall space in which the foam was released was 16 by 8 feet, 2½ inches deep. The process takes only a few minutes. Because it is pre-expanded, Toy explains, there is no risk of the walls being blown out.

The equipment used on the job consisted of vertical valve pumps (Grayco), a gasoline air compressor, hosing and a special foam gun (with mixer). Spare parts and tools and a bucket of water to rinse hands and parts (everything is water soluble) were the only tools needed on the job.

Specifically, Thermal Consultants foamed the following areas in the apartment complex:

Apartment wall partitions.

Pipe spaces.

Partitions dividing apartments from the public and incinerator rooms.

Masonry cavity walls of mechanical equipment openings.

Sealed openings of pipe penetrations through the floors.

Besides soundproofing, this also served as thermal protection among pipe and equipment areas.

Thermal Consultants, a unique contracting company which also provides engineering services, is doing other important work with urea formaldehyde in New York City. The process is being used, for example, in the Columbia Presbyterian hospital—three 35-story buildings. Declares Toy, who has been in the insulation business for over 10 years:

"There are fantastic and unlimited possibilities with this material. There are so many jobs calling for foam. Other products, because of the structural design, are not applicable. Architects and engineers are beginning to recognize that foams will be playing a key role for now and the coming years."

Toy is particularly enthusiastic about foam applications involving wall partitions. "I see a marriage of foam and metal partition. This material is ideal for filling tight spaces and fulfilling the soundproofing requirements," he said. □

CONTRIBUTORS—
Insulation Contractors:
Thermal Consultants, Inc.
New York, N.Y.
Material Supplier
U. F. C. Corp.
Woodside, New York, N.Y.

PROBLEM

Installation and Insulation For a New Heating-Cooling System in Existing Building

SOLUTION

Foamed-in-Place Insulation

• RISERS AND ducts in place, ready to receive insulation and plastering

To install a new heating and cooling system in an existing 5-story building (Public Works Building—State of California, Sacramento) it was necessary to provide insulation to protect the "poke throughs" involved.

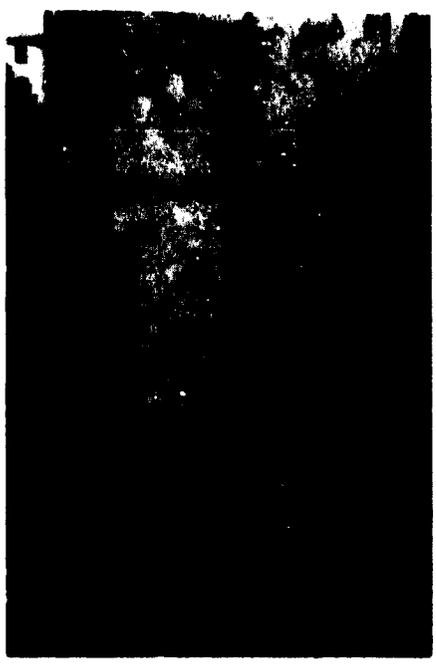
Approximately 32 riser locations on each floor went from the basement to the 5th floor. The concrete floor was cored out and the pipe and ducts were installed and tested.

Lathing and plastering contractors Thomas F. Scollan Company then framed a channel and metal lath column from floor to ceiling around the riser.

Northern California Insulation, Inc., then gun-applied UFC Foam in-place insulation, foamed through the metal lath and into the risers to insulate the hot air ducts and chilled water pipes.

Since excess foam is easily removed by brushing, it was then possible to apply gypsum plaster over the metal lath in the normal manner.

• OPERATOR "GUNS" foamed-in-place insulation through metal lath to fill cavity completely



• INSULATION COMPLETE and metal lath ready for plastering

ADVANTAGES

The method greatly improves the insulation value making the system more economical to operate

Up-Drafts are avoided and permanent fire blocking is provided within the riser

Sound control is provided in the plumbing cavity

Openings and odd dimensions are easily filled

The backing provided by the foam improves plaster keying and hastens application (in event of portland cement plaster the curing process would be reduced, thus reducing shrinkage fracturing)

UFC-Foam is a franchised application process, attracting interest from many wall and ceiling contractors and is manufactured under the trade name "Isochaum". Information from U. F. Chemical Corporation, 37-20 58th Street, Woodside, New York 11377.

U. F. Chemical Corp.

CELLULAR PLASTICS TECHNOLOGY, MATERIALS, MACHINERY

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PLASTOPONICS: A NEW METHOD FOR IMPROVING ARID AND COMPACTED SOILS.

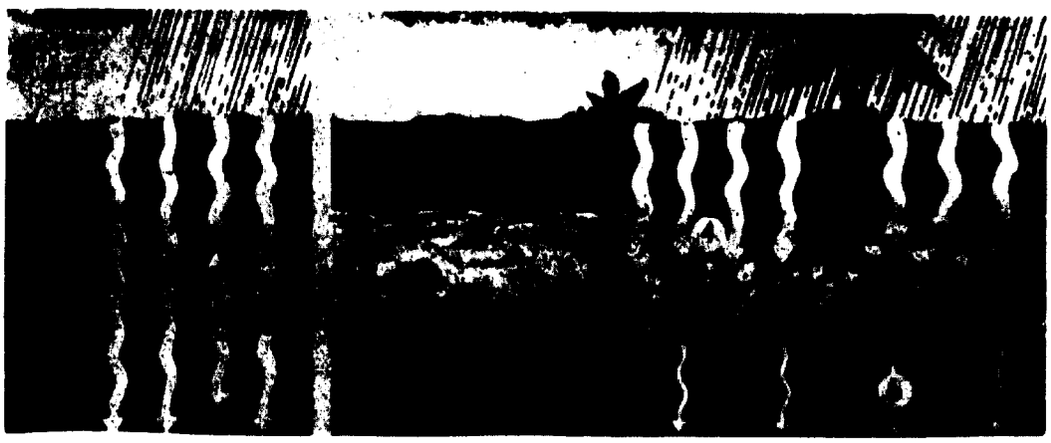


Fig. 1. Left: Water seeps into lower starts. Right : Water is caught in plastic foam (4), thus reducing seepage (6) and allowing seeds (2), plants (3) to draw on retained moisture and added plant nutrients (5).

PLASTSOIL is a newly developed method and materiel to loosen compacted soil and enhance its ability to retain moisture.

Plants need moisture, nutrients, light, warmth and air in order to grow.

The need of increased food production has focused the attention of the agronomist on the so called "marginal" lands, such as semi-deserts and exheusted soils.

It is well known that many desert soils are rich in nutrients and permit lush vegetation if irrigated. Such a case is the Imperial Valley in California, where 1,000,000 acres desert produce some of the finest vegetable and friut crops because irrigation water is being piped in over long distances. The productive limit of the Valley is set by the amount of water allocated. In a situation like this, two possibilities are open to increase production.

1) Increase the water supply - this can not be easily accomplished.
2) "Stretch" the available water supply by reducing evaporation and seepage.

PLASTSOIL, an organic, biologically compatible open called foam developed by Chemische Fabrik Frankenthal, can do that at a reesonable cost. The foam is produced on the field by a simple apparatus from two liquids and compressed air and applied directly in the desired thickness on the ground.

Water retention tests have shown PLASTSOIL to be a very effective water storege medium:

In the arabien desert Plastsoil was covered by a 6 " layer of sand and then irrigated until it held 10 times its own weight of water. After 10 days, during which the temperature reached 118°F in the shadow, the foam still retained 40% of its moisture whereas the ground sround it was bone dry.

In Saudi-Arebia 200 citrus trees were planted in foam and another 200 without it. The foam layer in the tree holes was 2 " thick. All trees planted in PLASTSOIL survived, whereas only 50% of the control group did.

Another serious problem in modern agriculture is compaction of the soil due to heavy equipment traffic during seeding and herveating operations. Peat moss, which has been thus far the medium used most widely is becoming scarce and expensive. Here again Plast-soil can replace at a lower materiel as well as application cost.

Fig. 2, Salad grown in PLASTSOIL. The roots embedded in the foam are clearly visible.

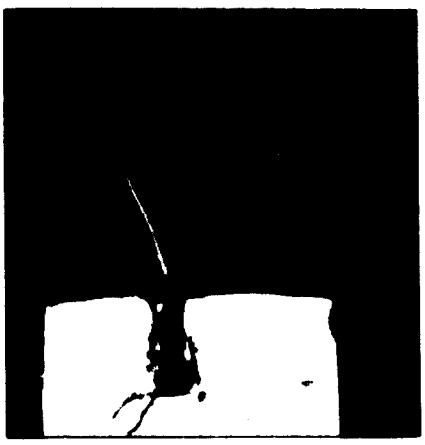


Fig. 3, Geranium 21 days after implantation

Fig. 4, Grass grown in foam. Grass seeds germinate in the dark, therefore they were covered with sand.

The various applications of PLASTSOIL can be described here only in short outlines:

NURSERIES use it as a growing medium by digging long channels where the trees are raised. When needed for transplatation, the tree that has to be removed is simply pulled out with the surrounding foam. No digging is neccessary. Transplantation of bushes is made easier by first depositing a layer of foam into the hole where the bush is planted. This gives the roots a good water reservoir.

HIGHWAY EMBANKMENTS are secured against erosion by depositing a layer of foam on the strile ground and then seeded and covered with dirt. This way quick and strong growth is assured.

HORTICULTURISTS raise flowers in foam and then cut out blocks in which the flowers are growing for shipment. Peat moss has been successfully replaced by PLASTSOIL in various garden soil mixes.

MINE SLAG MOUNTAINS which have been bare and devoid of vegetation for over 50 years have been successfully planted with trees and bushes. The slopes were cut in horizontal channels into which trees and bushes were plented. The second vegetative period produced enough organic matter from fallen leaves that now grasses and weeds are growing very well too.

IN HYDROPONIC GARDENS foam has reduced the need for frequent irrigations and the tricky task of balancing the nutrient solutions.

IN VINEYARDS the foam has succeeded in stabilizing the temperature veriations and prevented many frost damages. Dark pigments added to the foam absorb and store heat, and then give it off slowly. White foam will raise the temperature of the air 3 " above the ground 60 to 80% .

MUNICIPALITIES planting trees in gardens and on sidewalks have used the foam in lieu of horse manure as a wrap around the bark to reduce transpiration thus preserving the moisture in the tree for growth purposes.

As can be seen, PLASTSOIL has many useful applications. Is low cost makes it a very attractive material for the agronomist saddled with labor and materials supply problems.

PLASTSOIL is an Internationally Registered Trade name of Chemische Fabrik Frankenthal, Germany, and U.F. Chemical Corporation, 37-20 58th Street, Woodside, L.I., N.Y. 11377

Plastoponics – a new method of cultivation for arid soils.

By Heinz Baumann, chief engineer, Frankenthal/Pfalz. ×)

In the following lines we will describe partial results from experiments with foam plastics which permit soils in arid districts to be planted or replanted. Plants can also grow in foam plastics if they are hydrophilic and contain nutrient salts and trace elements. This method is called plastoponics, and the foam itself plastsoil. In this discussion we will deliberately not deal with such things as „water", „nutrient salts", „trace elements", and pH. Specialists will know the bibliography. In the introduction we will thoroughly discuss the problem of hunger, for the knowledge of this scourge of mankind has been and will be the guiding principle of our work.

In 1798 T. R. Malthus[1] declared that the future of mankind was discouraging. He said that mankind would be increasing in geometric progression (1, 2, 4, . . .), whereas the production of food would increase only in arithmetic progression (1, 2, 3, . . .). This theory is wrong, as we know now, and yet we are still confronted with the same problem, and the question is now, as it was then: "What can we say about the future development of mankind?" According to estimations of the competent United Nations bodies world population will increase in the next two years by 100 million (only about 65 per cent. of the world population are dealt with statistically). Consequently, world population would have doubled in fourty years. The total arable soil, by now about 9 million ha*, would have to provide food for about 6,000 million people in the year 2000.

* 1 ha is about 2½ acres

Among other reasons Malthus's prophecy did not come true because chemical research succeeded in laying the foundations of rational manuring, which, later on, by the technical synthesis of ammonia by Haber[3] and Bosch[4] proved to be a solution of the difficulties. An unqualified belief in science which – as it is often thought – can find its way out of nearly hopeless situations, may be a good thing, but it has not been proved yet in the least. For althaugh the conditions are given plant protection could not be improved so far that this would lead to a higher food production. In the German Federal Republic, for example, we have to reckon with a yearly loss of crop amounting to 3,000 to 4.000 million DM. In the whole world these losses total about 87,000 million DM (estimated), this is 95,– DM per ha of the total arable soil. Even when brought in the crop is still in danger. The corn weevil alone destroys 50 million tons** of corn a year, a quantity which

** metric ton

would suffice to supply the present population of Africa for one year with bread cereals.

A. I. Vittanen[5] advocates the view that, by intensifying agricultural production on the present acreage and by expanding it (there are still enormous possibilities on many continents), agriculture could provide food for not less than 20 million people, provided that there will be no internecine war.

In the last twenty years the percentage of people suffering from hunger rose from 38 per cent. to more than 60 per cent. The Food and Agricultural Organization of the United Nations (FAO) noted an increase in the production of food, yet it cannot keep up with the demand of mankind, which is increasing rapidly. From 1945 onwards the production of food decreased in Asia by 15 to 20 per cent., and the production of rice in the same period by 13 per cent. Two thirds of mankind suffer from hunger, thousands starve every year. This is a monstrous number which we can hardly imagine in our latitudes. Hunger has no influence on the increase of mankind, the birth-rate is higher than the death-rate, and no balance is established under the influence of hunger. A long standing, permanent irritation by hunger can bring about unforeseen reactions even of a political kind with the peoples exposed to it. This danger has to be banished for now and for the future.[34]

It is easy to prove historically that many states perished because of the lack of agricultural acreage. Mankind is involved in a permanent struggle to fulfil its most primitive needs – the need of food. That is why man tried to penetrate the mysteries of nature. Looking back in history we see the continuous struggle for existence of past generations and of our own. The first recorded ideas of the essential conditions and processes of life come to us from the year 300 B.C.[6]; it was supposed then that plants were to a large extent inactive and that they only had to transport substances which were provided for them by the soil already in organic form.

This theory was predominant up to the 17th century. But the following experiment was the impulse to a further development of the theory of vegetable nutrition.[7]

A willow, 5 pounds*** of weight, was planted in 200 pounds of soil and simply watered (without any admixture). In the

*** German pound = 500 grams (English pound = 453,592 grams)

course of 5 years its weight increased by 164 pounds, whereas the weight of the soil decreased by only 125 gms. This result could not be explained, yet it was a refutation of Aristotle's theory.

An Italian and a Frenchman[8] found out that the substances which the plants take in from the soil are changed chemically before they can form a component part of the tissue. Only much later it was demanstrated by a great number of experiments that the air plays a great part in the formation of organic substances in plants.[10]

There is a report of an experiment in 1699 according to which plants can be grown in aqueous solutions without soil.[11] In the 18th century we got to know of the assimilation of carbon oxide and the respiration of plants.[12]

Shortly afterwards two Frenchmen[13,14] explained the formation of organic vegetable substance, an explanation which came very near to the present theory.

But only Liebig[15] finally found out the real process. He wrote: "Men and animals depend for their nourishment and maintainance on vegetable organisms, that is on organic compounds. Plants, however, draw their nourishment exclusively from inorganic nature".[16]

1860 is the year where, for the first time, plants were cultivated without natural soil in salt solutions.[17,18] In 1929 Gerricke[18] reported on extensive outdoor experiments which were carried out with the aim of using water cultures for the production of food. He published the theory of hydroponics as opposed to geoponics (soil cultures).[20] While he went on with his experiments, there were several water cultures operating in Europe. The results of the one in the Russian Plodo Institute[21,22] were made use of already in the Russian polar expedition in 1937. Beside that there were Polish projects South of Lwow[23] and Hungarian ones in the Carpathians.[24] Both were raising early vegetables and ornamental plants. In Germany the first water culture was opened in 1938 in Steinheim Westf.[25]

Having penetrated the processes of nature man wanted to make use of them. While the theory of fertilizers was making progress, they were looking for means to improve the soil in order to find "substitute soils". One of the many proposed ways to improve the soil is from 1940: using foamed scraps of carbamide resin.[26] Flakes of this foam were to be ploughed into the soil together with fertilizers such as dung, humus, peat, green manure etc.

Foam resins, especially foamed urea formaldehyde resins, were used to a certain extent for decoration purposes in flowershops during the last years. Cut flowers are put into this foam resin, which provides a hold for them. The foam resin can be coloured at choice and is used largely as a substitute for moss.[27]

In 1953 it was tested for the first time whether a plant can grow for a longer period in foamed urea formaldehyde resin without the adding of nutrient salts. This experiment made it quite clear that the roots of plants cannot, in a short period, decompose the combined nitrogen from the foam resin and utilize it for vegetation.[28] Further experiments proved that foam resin can be used in hydroponics instead of inorganic or organic substances that had been used up to that time.[29,30]

The foam resin is all porous; its weight is 5 to 8 kg/m³. Its basic materials guarantee that the chemical composition is perfect. And since there are mobile units which permit foam resins to be produced at any place required, foam resins occupy a very important position now. It was proposed therefore to cover agricultural soil with foam to improve vegetation and to prevent the development of weeds, fungi and insects. There can be added fertilizers, insecticides, weed killers, colorants or pigments to the foam resins in the course of production.[30,31]

From 1957 onwards, since the first tests, the foam resins have been changed to a large extent as far as their chemical and biological qualities are concerned. Today we have a material which can replace natural soil and which, by way of hydroculture, brings up a new era in the cultivation of plants. It is self-evident that no plant will grow in foam resin without water. Water is essential, for it is not only a means of solution and of transport, but also a nutritional material. Beyond that it has to fulfil other physiological tasks, for example swelling the colloids. Without water no plant will grow, life would not be possible without it.

The foam contains a high percentage of air, which is also very important for the growth of a plant. Each animal and each plant must respirate. If the surface of the soil is silted up or if by a too high percentage of water the soil does not hold enough air the parts of the plant in the soil will suffer from lack of oxygen. In this case the micro- and macro-organisms, which are of great value for the plants, will be rivals because they themselves need oxygen.

Since trace elements and nutrient salts can be added to the foam resin the proposition to use them for the reconquest of arid soils *was not so much out of the way.[34]

A layer of foam resin, put into arid soil, will serve the plant as a reservoir of water and air and will provide the roots with the necessary substances (picture 1). The natural soil above the foam layer is manured and ploughed as usual after the first vegetational period.[35] But plants can also been grown from seed in foam resin; they are watered without nutrient solution. For all that it is necessary to introduce a new definition: Plastoponics – cultivation of plants in hydrophilic foam plastics containing nutrient salts and trace elements; or – the cultivation of plants in arid soils with the aid of foam plastics. The foam plastics for plastoponics are called PLASTSOIL.

Open-air experiments were preceded by tests and hot house experiments.

40 containers of the Mitscherling type were filled with sand and divided into four groups of ten pots. The sand used in these test series did not show bacterial growth when in liquid culture-medium, and no germs developed when on solid culture-medium. There were no organic substances (humus). According to these results the sand was sterile and could be used for the following experiments regarding the nutrition of plants.[36] The sand did not contain any moisture. In each of the pots a hundred grains of rye, which had not been treated chemically, were planted at equal distances. The average weight of 100 grains was 3 to 4 gms.* The pots were placed in a hot house at a temperature of 20 to 25 centigrades, relative atmospheric humidity 60 to 65 per cent., duration of the experiment: 23 days.

* 1 gram = 15.432 grains

1st series.

Ten M-containers were filled to the top with thoroughly glowed sand, and the grains of rye were planted 1 to 1.5 cm** under the surface. Each pot was watered with 3 liter*** of water from a watering can (pictures 2–5).

** 1 cm = 0.393/ inch

*** 1 liter = 1¾ pints

2nd series.

Ten pots were filled with sand and a layer of foam resin, 2 cm thick and containing no fertilizers, was put in 2 cm under the surface. The grains were planted in the upper layer of sand (pictures 6–9).

3rd series.

The ten pots were filled like in the 2nd series, but the foam layer was sprinkled with 0.4 gms. of HAKAPHOS before being covered with sand. The fertilizer was dissolved after watering and could be taken in by the plants. (pictures 10–13)

4th series.

The ten pots were filled like in the 2nd series, but 0.4 gms. of HAKAPHOS were foamed in during the production and thus regularly and thinly distributed in the whole foam layer. (pictures 14–17)

The pots of the series 2, 3, and 4 were, in contrast to the 1st series, watered with only 600 cm³ of water per pot from a watering can.

The average loss of moisture was replaced each day by the quantity measured in the checking pots.

At the end of the experiment the plants were pulled out (the sand and foam was washed off the roots with water), counted, weighed, incinerated, and analyzed. The results were as follows:

Table 1

experiment	number of plants that had taken root by the end of the experiment	total weight of the plants, washed out a. still moist, in grams
1	891	377.2
2	332	228.35
3	875	371.59
4	739	197.57

The results were compared with open-ground plants of 2½ months (table 2, line 5)

The plants of the respective series were photographed three times, twice after eight days and once after seven days.

In the first series most of the vertices had grown out of the soil after the first week. The growth of the plants was regular and good. Then there came the vertices of the third series.

After the second week we could gernerally note a good growth. By the end of the experiments the second series, but especially the third series had reached the same stage as the plants of the first group. The vertices of the plants of the first series were of a yellowish white by the end of the experiments. The radication of the different series was photographed and compared with open-ground plants. (Picture 18)

These experiments furnished valuable information on manuring and on the combination of the basic materials, so that a larger experimental field (sand, of 2 cm thickness and thoroughly glowed, was put on a concrete slate and covered with a foam layer of 2 cm thickness) could be planted successfully during three years with various utility and ornamental plants

and with trees, among them flowering and non-flowering kinds. We sowed the seeds in the foam, planted them out into foam again, and plated them back from open ground into foam. Other plants were allowed to grow from seed to flower. The flowered several times (pictures 19–23 and table 3).

Plastoponics can be used for the following purposes: conquest of virgin soil, stopping of steppe formation, prevention of erosion[37], afforestation (not only in southern countries), planting of dunes for consolidation, sowing of early vegetables[38], open-air planting of improved vine[39], growing of flowers.

After these favourable results open-air experiments were made in Saudi Arabia on a larger scale[40,41].
In a sand area of 100x40 m* 35 cm of the soil were removed by a caterpillar-tractor, a foam layer of 5 cm thickness was

* 1 m = 39.37 inches

put in and covered again with the sand. Under the pressure of the sand and the tractor the foam was pressed to a thickness of 3 cm. Then it was watered; the foam layer retained 6,5 liter of water per m². After having been exposed to the sun for three weeks at temperatures of 45 centigrades in the shadow the foam held still 2,6 liters of water, the parts compressed by the tractor about 1.8 l/m².

Fifty per cent. of the hundred lemon-trees, planted in the usual method, died off. Of a parallel series of 200 trees, planted in foam resin, all plants got on well.[42,43]

Experiments made in South Africa were positive, as well. The experiments are being carried on and will be extended to West Africa in the next moths. They will bring final results. Already now we can say that the method has every chance of being introduced because of its low cost, now that it is possible to produce foam resin at the place where it is required, so that this highly voluminous material need not be transported. Institutes in Germany and in other countries are examining the results that have been reached and help to lay and deepen the foundations that will be of decisive importance for the international application of this new agricultural method.

Table 2	results 1	2	3	4	5
percentage of water %	90.81	81.14	89.68	88.90	87.92
nitrogen %	0.17	0.24	0.22	0.26	0.40
nitrogen %	1.86	2.03	2.13	2.32	3.30
total phosphoric acid P_2O_5 %	0.054	0.081	0.080	0.084	0.075
P_2O_5 %	0.592	0.685	0.772	0.752	0.423
K_2O %	0.29	0.11	0.21	0.20	0.35
K_2O %	3.20	0.91	2.02	1.77	2.87

Table 3
Index of plants growing in foam resin.

English	Latin		
lattuce		ivy	hedera
radish	valerianella	fern	saint paulia
sugar beet	beta		cycas
oats	avena		asparagus
rye	secale		anthurium
tomato	solanum		begonia
lemon-tree	citrus		billbergia
African pine	pinus africana		billbergio nutans
spruce	picea	calla	helxine soleirolii
oak	quercus		Richardia, Zantedeschia
chestnut	castanea		chlorophytum
beech	fagus		clivia
grass			gloxinia
clover	trifolium		pandanus
	phyllocactus	saxifrage	peperonia
geranium	geranio		petunia
carnation	dianthus	tulip	saxifraga
edelweiss	leontopodium	daffodil	sparmannia
gum-tree	ficus elastica		tulipa
	sansevieria		pulsatilla
	philodendron		
	agave		
	aralia		

Notes.

× Scientific and technical manager of Schaum-Chemie und Chemische Fabrik Frankenthal, Pfalz.

1) Thomas Robert Malthus (1766–1834), professor in Haileybury, England; political economist.
2) T. R. Malthus: "Essay on the principle of Population" 1798.
3) Fritz Haber (1868–1934), professor in Karlsruhe, Germany; chemist, Nobel Prize 1918.
4) Carl Bosch (1874–1940), managing director of I. G. Farbenindustrie AG, Nobel Prize 1931.
5) Artturi I. Virtanen, professor in Helsinki, biochemist, Nobel Prize 1945.
6) Aristotle (384–322 B.C.), Greek philosopher.
7) Johann Baptist v. Helmont (1577–1644), Dutch physician and chemist (introduced gas as the third state of aggregation).
8) Marcelle Malpighi (1628–94), anatomist.
9) Edme Mariotte (1620–84), physicist and catholic priest, inquired into the osmotic pressure of plants, found the blind spot in the eye and Boyle's Law indepedent of Boyle.
10) Stephan Hales (1677–1761), English scientist, one of the founders of plant physiology.
11) John Woodward (1655–1728), professor at Grasham College, London; phisician.
12) Jan Ingenhousz (1730–99), Dutch scientist. (It is estimated (1945) that every year 150,000 to 200,000 million tons* of carbon

* metric tons

dioxide of the air are changed by an assimilation process into carbohydrates and the like with an energy content of 3×10^{21} cal.)

13) Theodore de Saussure (1767–1845), scientist.
14) René-Joachim-Henri Dutrochet (1776–1847), physician and scientist.
15) Justus Freiherr v. Liebig (1803–73), professor in Giessen and Munich, chemist, founder of the first German laboratory for instructional purposes, investigations in fulminic acid, aldehydes, acetone, alcoholic fermentation etc., introduced artificial manure and meat-extract.
16) J. v. Liebig: "Die Chemie und ihre Anwendung auf Agricultur und Physiologie" (1840).
17) Wilhelm Knop (1817–1901), professor of agricultural chemistry and director of the agricultural experimental station Leipzig-Möckern.
18) Julius Sachs (1832–97), professor of botany in Bonn Poppelsdorf.
19) William F. Gerricke, professor at the university of Berkeley California. (In the Second World War some American units were supplied with fresh vegetables produced by his method. The most famous hydroponics station was on the Ascension Islands, maintained by the Air Force. There was no vegetation, no soil on the isle, only lava rocks.)
20) In addition to hydroponics and geoponics the Swiss Robert Vatter coined the expression of "chemoculture". In this case the soil is replaced by organic substances such as peat, moss etc. The word hydraculture should be replaced by "gravel culture" to describe the method; it was coined by V. L. Pjatakowa. The beds are made from sterile inorganic substances such as pumice gravel, cinders, quartz etc.
21) D. N. Prjanischnikow, after called "Russian Liebig" in the bibliography.
22) Vera Pjatakowa, biologist, director of the project.
23) W. Piotrowszky, professor, director of the project.
24) Paul Röszler, professor in Göttingen (supervising the project), famous for his publication on the soilless method of plant cultivation.
25) F. Hörning. (The anthuria cultivated without soil won a prize at the Federal Garden Show for their outstanding quality.)
26) F. Döhler: "Bodenverbesserungsmittel" (Means for soil amelioration). DBP 839 944
27) FLORACEL of Chemische Fabrik Frankenthal, Pfalz.
28) H. Baumann: "Kunstharzschaumstoff für die erdelose Pflanzenkultur, Gartenwelt 57/1957 Nr. 16, p. 8.
29) H. Baumann, H. Schmidt, F. Graf: "Trägerschicht für den erdelosen Pflanzenbau mit Nährsalzlösungen", DBP 1 018 077.
30) Among others the experimental series of H. Schmidt, F. Mappes and H. Will, experimental station of BASF in Limburgerhof, and of P. Müller in Eltville.
31) Wilhelm Bauer, Essen, was the first to construct a machine which made it possible to produce foam from its two components synthetic resin and foaming agent at any place required. This procedure is of international importance for insulating, and it was brough on the market under the name of ISOSCHAUM. Its basic materials are of a different kind than those described here.
32) R. Gäth, F. Graf, V. Huppert, B. Wurzschmitt: "Verfahren zur Behandlung landwirtschaftlicher Kulturböden und zur Förderung des Pflanzenwachstums", DBP 1 028 594.
33) In cooperation with the AGRIA works, Möckmühl, Hubertus Schmidt developed a mobile spraying unit to cover the soil surface with foam resin.
34) H. Baumann: "Schaumstoffe zur Gewinnung von Neuland", Plastverarbeiter 11/1960, p. 197; Der Tropenlandwirt 1/1961; Entwicklungsländer 5/1961.
35) H. Baumann: "Feuchthaltung der Böden mit Hilfe oberflächenaktiver Stoffe", lecture, III. Internationaler Kongress für grenzflächenaktive Stoffe, Cologne 1960.
36) The analyses were made by Dr. Fritz Knorr (Bayrische Landesgewerbeanstalt, Nuremberg).
37) According to American statistics the loss of soil by erosion in the USA is estimated to 20 million ha of acreage in the last 150 years. And more than that, 80 million ha are damaged and 27 million ha threatened by sand. In the Federal Republic, too, one third of the cultivated area in the district of Stade was covered by blown sand. In Lower Saxony 250,000 Morgen suffer from sand drift, because the fields and the excessively drained soil cannot keep the humus. As a consequence crops decreased remarkably.
38) Because of the shortage of labour the large fruit and vegetable gardenings are dependant on women. It is easier to prick out plants from foam resin, there is no preparatory work as with peat.
39) The air included in the foam resin protects small roots from frost so that the plant can easier survive the change from the hot house to open ground.
40) H. Baumann: "Verfahren zur Bodenverbesserung für den Pflanzenwuchs", Patent Saudi Arabia, (El-Belad from Jan. 1, 1961)
41) Ch. v. Tresckow is directing the experiments.
42) H. Baumann: "Praktische Ergebnisse der Neulandgewinnung mit Schaum", lecture at the general meeting of the Gesellschaft Deutscher Chemiker, Aachen, Sept. 1961.
43) E. Baum: "Aufforstung von Wüsten", Chemikerzeitung 86/1962.
* In future "arid soil" will be said for "soil in arid territories".

Pictures.

1. Model of applied foam resin; left: (1) water oozes away into deeper layers; right: (2) seed grain in foam resin; (3) seed grain that has taken roots; (4) moisture seeps into the foam resin and is held there; (5) trace elements and nutrient salts are contained in the foam resin; (6) only when the foam is saturated with water the rest can ooze away.

2, 6, 10, and 14: grains of rye, eight days after planting.

3, 7, 11, and 15: grains of rye, 16 days after planting.

4, 8, 12, and 16: grains of rye, 23 days after planting.

5, 9, 13, and 17: radication of the respective series.

18. Plants of rye that have been grown 2½ months on open ground.

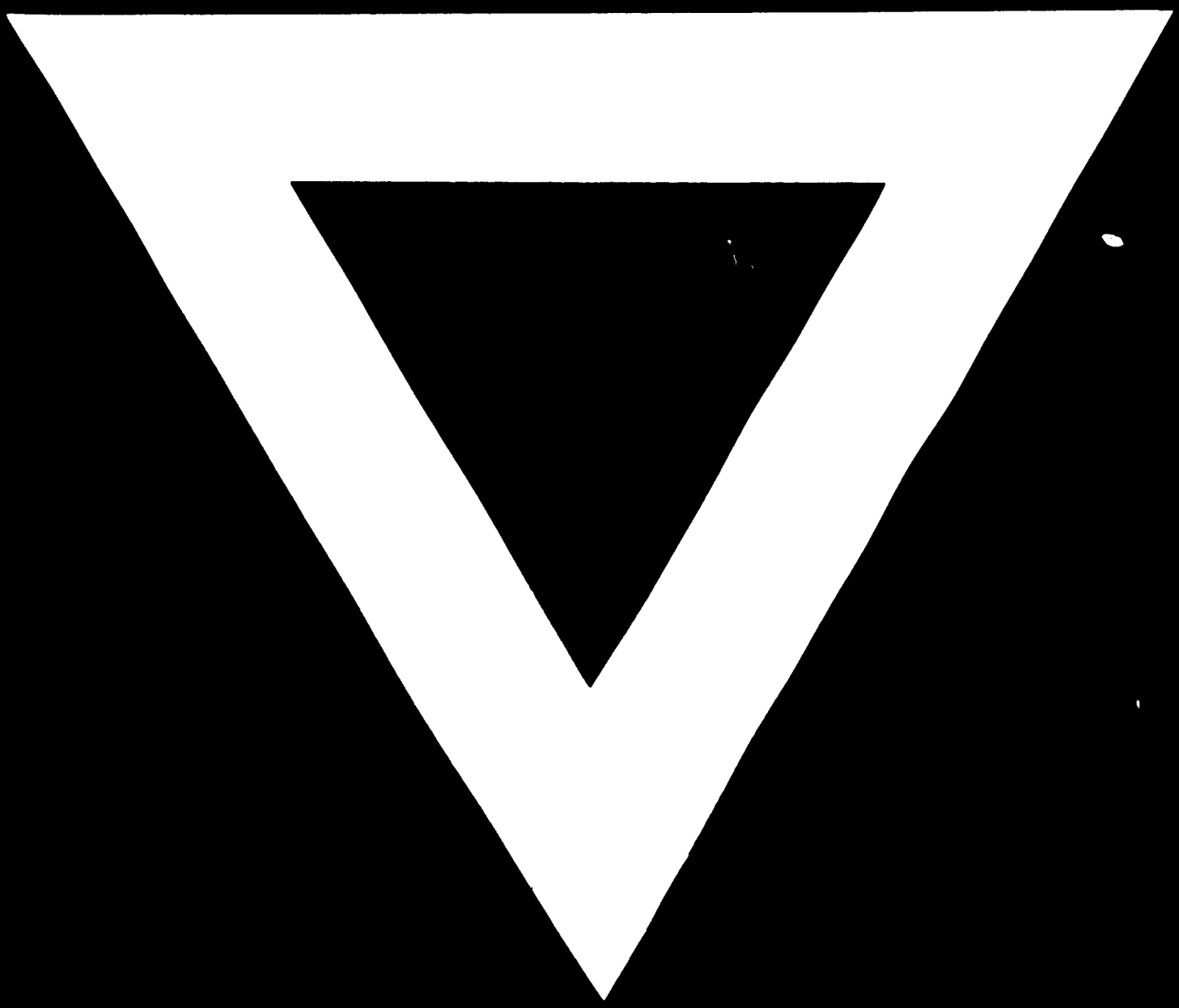
19. Grass grown from seed on watered foam resin. Beside the mark "V3" the layer of foam resin can be seen.

20. A shoot of geranium, 21 days after planting into foam resin. (A cross section through the foam layer shows that the roots of the shoot have already grown deep into the foam resin.)

21. This picture shows how the roots have grown through the foam resin. (The plant was pulled out and large pieces of foam were taken off.)

22. Lattuce in foam resin. (Radication and size do not differ from plants planted at the same time in soil.)

23. Bulbous plants also grow in foam resin. The picture shows daffodils in bloom.



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