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PLAINTIFF'S EXHIBIT

DOW-1054

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ANNUAL REPORT

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DOW CONFIDENTIAL
5/9/77

1971

CONSTRUCTION MATERIALS

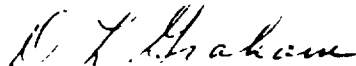
HIGHWAY PRODUCTS

RESEARCH AND DEVELOPMENT REPORT

Attached you will find a summary report on our 1971 activities. I believe you will agree that much progress was made this past year.

The "Highlights" described and illustrated on the first few pages are significant and self-explanatory. Detailed discussions on each product, market and project follow with goals for 1972.

This progress report represents the results of the cooperative efforts of many people and is not the results of our efforts alone. I hope every reader will appreciate the team effort involved, and will join me in acknowledging the invaluable contributions by the various research, production and marketing groups.



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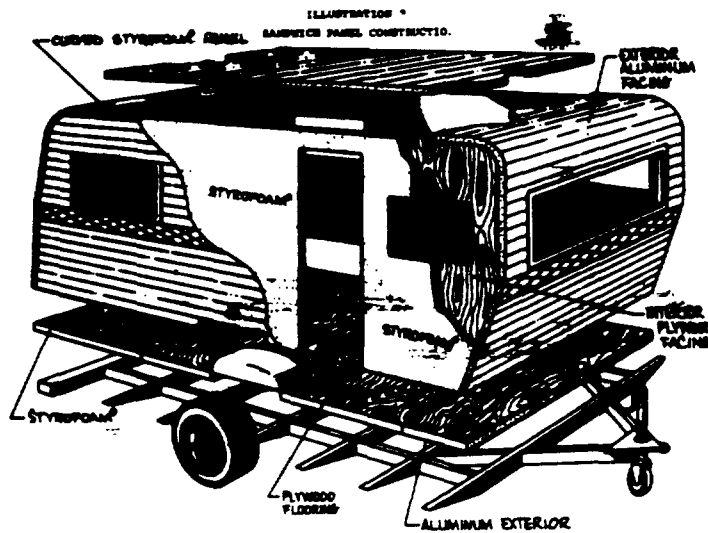
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Intensive technical service consisting of design, prototype production, and start-up assistance for prospective customers resulted in a banner year for the penetration of STYROFOAM PZ-1586 into the recreational vehicle markets. The use of this close tolerance skin material in sandwich panels resulted in a growth for STYROFOAM sales to this market from 11 million board feet in 1970 to 21 million board feet in 1971. The total number of locations using this technique increase from 46 at the end of 1970 to 70 at the end of 1971. (Number of manufacturing locations rather than number of customers is used as the measure of success because when existing customers expand their usage to other locations across the country significant increases in sales can result.)

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Technical developments during 1971 opened the industrial seating market for ETHAFOAM. TS&D was instrumental in establishing an industry standard test procedure for evaluating the safety-cushioning properties of snowmobile seats. The overall industry objective was to significantly reduce back injuries. Armed with a standard test procedure, a composite ETHAFOAM urethane seat was developed (see photo) which has superior cushioning to any other seat in the industry. The graph shows the increase in cushioning achieved when two inches of ETHAFOAM replaces two inches of urethane in a standard seat. An active seat design-testing program was initiated with all major snowmobile manufacturers. Five producers have specified ETHAFOAM seats and developments at ten other companies look promising. The potential is 1.5M bd.ft./year.

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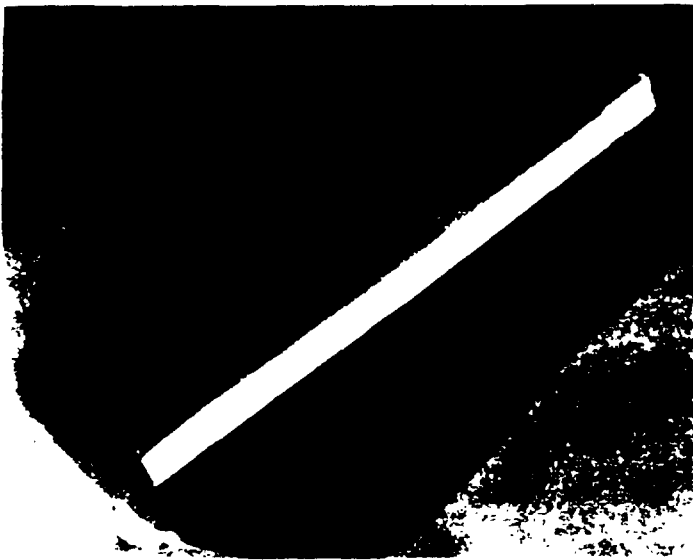
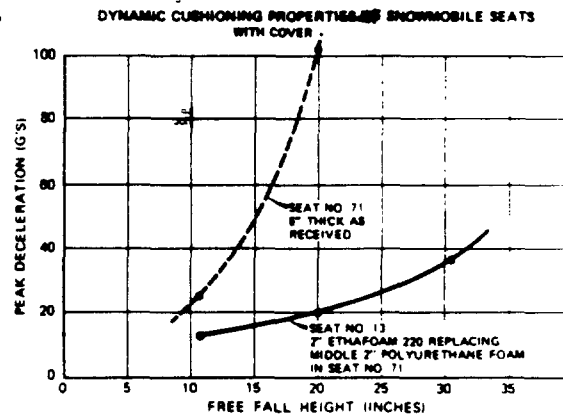


Figure 5



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DOW PAVING SYSTEMS

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Here a new type rotating cylinder machine finishes a full width deck overlayment on Interstate Route 96. The cylinder travels transversely suspended from a track which is shaped to the required roadway crown. An important breakthrough in the Dow Paving System for 1971 was the development of Modifier B (patent issued). An important advantage of Modifier B is the relative ease of surface finishing of portland cement compositions containing this second generation product because finishing tools exhibit less "drag" than with Modifier A. Most importantly, in every case measured to date, Modifier B exhibits superior physical properties to Modifier A.



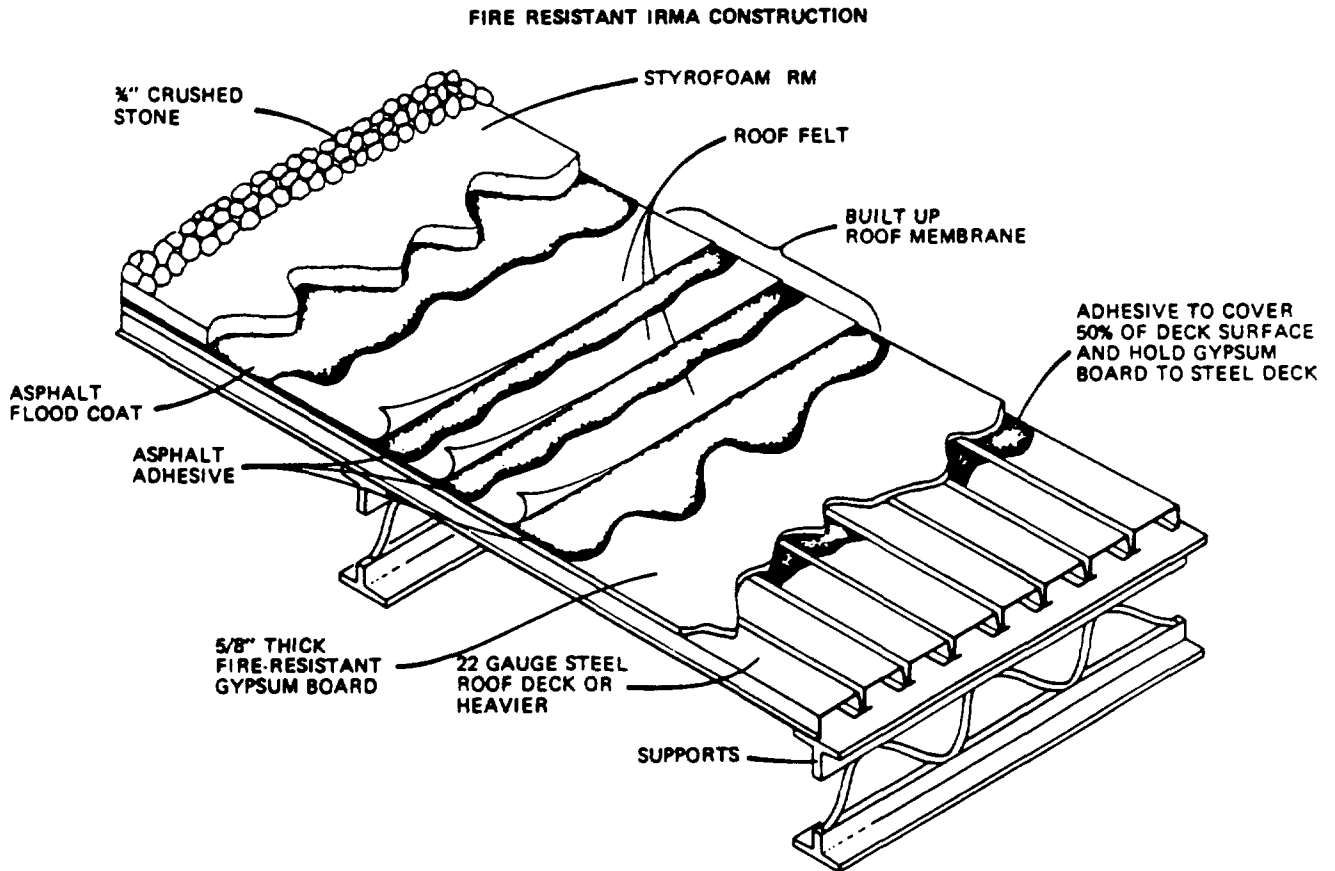
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A new fire resistant system for IRMA developed by Applications R&D in cooperation with Dow Canada TS&D quadrupled the potential for IRMA in the metal roof insulation market.

Seventy percent of all insulated metal roof decks are required to have resistance to the spread of an internal fire. A low cost underlayment was needed which would provide both fire protection for the asphalt membrane and STYROFOAM RM, and span across the flutes in the metal decks. Gypsum boards, fiberboard insulations, and Perlite insulations were evaluated as this structural and fire protective underlayment. Numerous combinations of underlayments and adhesives were tried and discarded before it was found that type "X", fire-resistant gypsum board containing glass fiber reinforcement maintained adequate strength and shrinkage resistance during the test fires to protect the asphalt built-up roof membrane and STYROFOAM insulation from becoming involved in the fire below the metal deck. This IRMA-gypsum system became the first roof system to pass both the wind uplift and fire resistant requirements of Factory Mutual and Underwriters' Laboratory.

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PELADOW® DG

A briquette calcium chloride designed to use fines resulting from regular PELADOW production and to satisfy markets in gas conditioning and other air and liquid dehydration applications. The product was developed to replace PELADOW "oversize", thereby improving the economics of regular PELADOW production. Formerly, the production of ten tons of regular PELADOW was sacrificed for each ton of the oversize material. Within five years the consumption is expected to double its present usage of approximately 3000 tons annually.

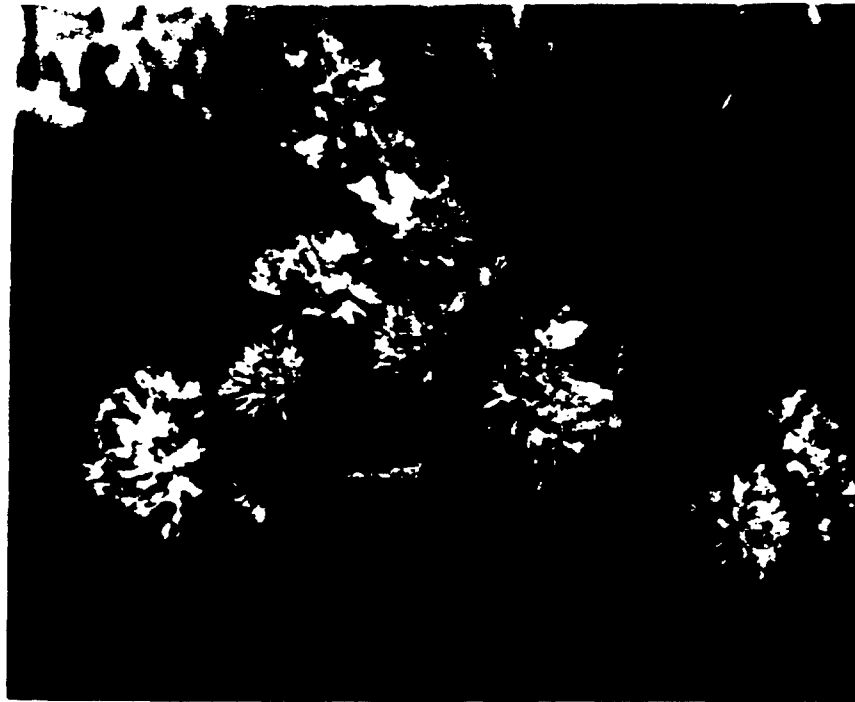


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FP-4041.00, an open celled rigid urethane foam, is now being test marketed through STYROFOAM DB fabricators to the floral market. TS&D has helped to define the needs of the market by analyzing cut flower life phenomena, competitive foam properties and market shares. The ultimate success of a wet foam as a flower arranging media is based on its ability to absorb water quickly, but retain it over long periods of time thus making it available to flower stems throughout the arrangement block. These characteristics have been obtained in a urethane foam developed by the THURANE Research Group in Freeport, by combining the technology of open cell flexibles and closed cell rigids resulting in a rigid foam with cracks, or windows.

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Rising 18 stories above the Everglades in Orlando, Florida is the tallest load-bearing concrete block building in the world. Constructed of ground block and THREADLINE, this 333-unit hotel will provide luxury accommodations for the rush of visitors to Disney World's amusement complex.

This structure was originally designed in concrete, changed to concrete masonry, and then to ground block and THREADLINE when the construction schedule became tight. Besides experiencing the normal increase in mason productivity, the general contractor, Austin Co., reports that even more significant savings are being realized in the simplified grouting procedures and reduced clean-up time from using THREADLINE. Occupancy is expected in the Fall of 1972.



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P R O D U C T S

CALCIUM CHLORIDE - K. E. Nelson, W. L. Shearer

For some time it has been recognized that our product profit picture could be improved if we could minimize the historical seasonal aspect of the business. Thus, an invigorated effort has been initiated to identify and develop positive technical and use data in the industrial area.

The combined effect of the public's accelerated concern over the environment, the normal technical problems associated with the use of calcium chloride, and reduction in field promotional activity on the part of PPG Industries, Inc. has put an increasing demand on our TS&D work effort. (Promotional efforts of the Calcium Chloride Institute and Wyandotte Chemical Company were discontinued a year ago.)

Accomplishments

1. Our newly formulated PELADOW® DG product containing polyethylene glycol (PEG) has been reasonably well received in the gas dehydration market. There have been a few problems associated with foaming which require further research effort for correction.
2. The Federal Trade Commission contested the wording on our PELADOW calcium chloride containers concerning the effect of PELADOW on concrete, contending that our use of such terms as "questionable quality" and "poor quality" concrete was misleading to the consumer and that we should state that the use of PELADOW would cause flaking and scaling of the concrete. We prepared and submitted a monograph on the subject of durability of concrete surfaces and documented our statements as to the relative effects of calcium chloride. As a result of this, they indicated their acceptance of our position which permits us to eliminate reference to quality of concrete and say merely that the product may contribute to or hasten the occurrence of flaking or scaling of a concrete surface. This, we feel, will strengthen our position in defense of claims against product.
3. Numerous contacts were made to discuss the use of calcium chloride in dust laying and stabilization of roads and shoulders. A part of the concern was prompted by the universal interest in environmental problems but there has also been a revival in the consideration of technical aspects of calcium chloride as compared with old-line competitive materials like road oil, cement, lime, etc.

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For example, the Bay County, Michigan, Road Commission sent about 17 of their group to Midland for an afternoon's exposure to the technical application of CaCl_2 . They, of course, were interested primarily in LIQUIDOW® because of its local economics. It is evident that a renewal in promotional effort on this subject is quite appropriate since, there have been numerous turnovers in highway maintenance and supervisory personnel at all levels of operation and there has been no concerted effort made in the nature of a national promotion for a number of years.

4. Our field studies relative to the effectiveness of various deicing chemicals and combinations thereof showed that the presence of a liquid CaCl_2 brine did improve the melting performance of rock salt at temperatures down to 12°F. Dry mixtures of rock salt and calcium chloride (3 to 1 by volume) were also effective--even at lower temperatures.
5. Of major concern to highway officials is the reduction in skid resistance due to the use of liquid deicing materials--brines, glycols, ureas. A cooperative study was conducted and report issued by the University of Tennessee (in contract with Dow), giving quantitative data which show, in a numerical way, the problem associated with putting liquids on ice.
6. As last year, we were unsuccessful in developing active interest on the part of metropolitan officials (Detroit and Ann Arbor) to consider the value of using CaCl_2 in reducing air pollution problems caused by air-borne recrystallized sodium chloride after deicing operations. Evidently, highway authorities are not being pressured by the environmentalists on this point.
7. Considerable progress was made in defining our position in the animal food industry. We have a statement from the American Association of Feed Control Officials (AAFCO) that our petition for recognizing our products will be recognized at their animal meeting next August. This anticipated action plus the fact that several of our products meet the Food Chemical Codex specifications, as endorsed by the Food and Drug Administration (FDA), will permit us to make aggressive moves in this marketplace.
8. Considerable time has been spent with people from the steel industry and research institute discussing the potential substitution of CaCl_2 for CaF_2 in steelmaking.

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A few small scale experiments were made by the steel industry which indicated that CaCl_2 would do the job technically. However, concern over handling hygroscopic, deliquescent material plus possible corrosive effluents when CaCl_2 is added to 3000°F steel have restrained the industry from making a production evaluation to date.

9. Dow participated in a panel discussion at the North American Snow Conference, sponsored by the American Public Works Association. Our primary responsibility was to present the case for the proper use of deicing chemicals to the meeting attended by approximately 300 municipal, state, federal and industry representatives. We, also, continued our activities on national committees of the Highway Research Board and American Society for Testing and Materials.

Goals

1. Continue to evaluate and develop methods, programs, and techniques in order to minimize seasonal aspects of our business by more aggressive activity in the industrial area. A marketing research project will define "industrial" areas of use in processing and products.
2. Improve our briquetted PELADOW DG product in order to overcome objectionable foaming problems.
3. Maintain surveillance over ice control market activities to improve our competitive position by working on appropriate national committees and conducting cooperative field performance programs with highway-oriented organizations, using pre-mixed materials, rock salt treated with various concentrations of brine solutions and other ice-melting chemicals.
4. Provide technical assistance to other Dow functions and in other use areas, such as concrete, refrigeration, summer maintenance work, terminalization, liquid dissolving operations, etc.
5. Develop information and data in the animal food supplement area and issue an appropriate bulletin for use in promotional activities.
6. Future plans are to run four heats in a 400 pound basic oxygen furnace at Colorado School of Mines Research Institute using CaCl_2 and one heat using CaF_2 . We expect to evaluate general characteristics of slags produced and to quantitatively identify particulate and non-particulate

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off-gas effluents. The final report will be written specific enough to quickly provide an entry back to the steel industry provided economics and/or technologies are altered.

DOW CERAMIC FOAM (PZ-3744.01) - D. M. Greason, W. G. Phillips

The Market Development Plant was started up in March after an eleven month shutdown for extensive modification and replacement of major components within the slab-forming furnace. Production experience culminated in the first commercial sale of material in December by AMSPEC for usage as industrial insulation. This foam was "on-specification" in all areas except thermal conductivity.

The primary market penetration for Dow Ceramic Foam will be as industrial pipe, tank and vessel insulation in competition with both Foamglas and "white goods" (temperatures up to + 1200°F). Additional markets under investigation are Low Temperature Space and such O.E.M. applications as cores for fire-rated doors, fire-rated walls for metal buildings, cores for panelized wall systems, etc.

Accomplishments

1. Approximately 30,000 BF of foam manufactured at Hanging Rock was installed at various production facilities within the Midland plant location. These applications varied in service temperature from -9°F to approximately 800°F. Feedback on this program from the fabricator, applicator and end-user levels was consistently positive and enthusiastic.
2. Feed and feeding changes developed by Research and Production during 1971 resulted in the elimination of coral build-up on the walls of the drop furnace and significant improvements in both cell size and density consistencies.
3. A sales training seminar was held in Midland for the Dow Industrial Foams sales engineers which included the first formal release of pricing, allocation, distribution and other general marketing plans/policies for Dow Ceramic Foam.
4. A toxicological study of Dow Ceramic Foam dust (i.e., generated during fabrication) was completed by the Biochemical Research Laboratory. The results were favorable with the dust being classified toxicologically similar to nuisance dusts, such as brick dust. This data is of significant marketing value to Dow in light of the current concern in the Industrial Pipe, Tank and Vessel Insulation Market over asbestos-bearing materials.

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5. During the last quarter a statistically-based testing program for characterization of Market Development Plant foam was initiated. The primary objective of this program was to measure the degree of consistency in the foam--with regards to density, k-factor, compressive strength, flexural strength and cell knit (WVTR). Data on product quality has been gathered and fed back to production for correlation to operating conditions. Quality and consistency has been encouraging. The test program will offer a basis for establishing the quality control audit program as required by the Foam Technology Center.
6. A significant accomplishment towards improving the Dow position in Ceramic Foam was the issuance of a patent to Dow (Brubaker/Waldman) covering partial pellet bloating in the drop tower with final pellet bloating and agglomeration on the collection belt.
7. Twenty-eight potential OEM customers for Dow Ceramic Foam were sampled with foam throughout the year. Applications have included cores for fire doors, cores for curtain-wall panels and metal-building walls, back-up insulation in industrial furnaces, residential boilers and commercial ranges along with grill scraper and wood sanding blocks. Feedback from this program has been encouraging.
8. Since material availability will be limited, a 1972 allocation plan was established for programs in industrial insulation, low temperature space and various OEM markets.
9. Thermal shock cracking of both DOW CERAMIC FOAM (DCF) and FOAMGLAS pipe insulation was observed in all high temperature test installations during the first quarter. Dimensions and geometry were recognized as critical factors in determining the thermal gradient which will cause failure; a given Δt will produce higher fiber stress in pipe installation sections than in flat block. From a practical standpoint, DCF retains sufficient integrity to stay in place (better than FOAMGLAS); cracks are fine enough that no adverse effect upon thermal performance is evident, and the only obvious drawback is inability to remove and reuse the insulation.
10. As small quantities of DCF became available in the second half of the year, field trials were initiated in Midland. Nine installations were completed, with insulation fabricated for two more. Applications ranged from 150 to 400 psi steam lines of 1" to 12" diameter, to Pfaudler reactors, large distillation columns and tanks with temperatures varying from -9°F to 700°F. An earlier installation cycles up to 1382°F.

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11. Successful fabrication and application of 36" long pipe insulation sections and curved sidewall segments twice as large as FOAMGLAS were demonstrated, and the reaction of virtually everyone concerned was enthusiastic acceptance of DCF.
12. Breakage of approximately 40-50% was experienced in the first rail car shipment of DCF, which went IDT to the Louisiana Division in December. The problem was traced to thermal shock micro-cracking immediately after in-line cutting of the foam and exposure of the hot interior of the slab to the much lower temperature of the annealing oven atmosphere. Only 3% breakage was experienced in the shipment of the first C/L actually sold by AMSPEC to Styrothane, Inc. in Freeport a few weeks later, and this problem is now under control.

Goals

1. Monitor and evaluate the entry of Dow Ceramic Foam into the Industrial Insulation Market through Amspec.
2. Complete the statistically based product characterization program. Initiate additional specialized testing to support market entry programs and to revise or issue new literature.
3. Define criteria and support entry into the Low Temperature Space market in competition with the Foamglas "Black-Box" system.
4. While initially restricting the maximum service temperature to 450°F for outside sales of DCF through AMSPEC, applications up to 1200°F will be evaluated in Freeport, Plaquemine and Midland through the second quarter of 1972 to help determine future policy relative to competition with white goods.
5. The impact on total installed cost of larger billet sizes (fabrication and field installation labor savings), and of higher k-factor relative to FOAMGLAS will be determined.
6. With continued favorable experience in Dow plants, maximum recommended service temperature will be raised to 1200°F for AMSPEC sales early in the third quarter of 1972.
7. Perform fire tests on various DCF composites in accordance with the standard time-temperature curve of ASTM E-119, to support entry into various OEM markets.
8. Complete structural analysis of DCF when used in composites.
9. Support Europe and Canada in their investigation of potential applications for DCF.

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DERASPAN® - Frank King, Jr., B. H. Krasnoff, I. B. Kritzman

The year 1971 was when DERASPAN panels turned the corner. Sales increased 12.5% to \$2.65 M net to Dow. This was done in spite of growing pains in connection with switching the marketing method from independent selling companies to direct sales by Amspec, Inc. and the move of the DERASPAN job engineering function from Cape Girardeau to Columbus. During 1972 it is hoped that new laminated insulation products in other markets besides low temperature space will further increase the growth and profitability of the DERASPAN products business.

Accomplishments

1. Conducted two full scale wall/corner panel fire tests and three panel propagation tests as part of the program to develop an FIA/FM approved fire resistant, economical panel system.
2. Conducted evaluation tests on several sheet finish materials having flame spread ratings of <25, in search of an improved Dow Sheet Finish.
3. Initiated a test program for evaluating doors made from DERASPAN panels.
4. Conducted a developmental flame spread test of a PZ-2020.03 (flame resistant urethane) core panel at Underwriter's Laboratory.
5. Developed design data for urethane core DERASPAN panels.
6. Conducted connection detail tests on PZ-2020.03 core panels having 32 mil aluminum facings.
7. Evaluated Bithuthene as a flashing/sealant material for use with panels.
8. Evaluated INCO M-4010 adhesive as an adhesive for bonding STYROFOAM® to STYROFOAM and various sheet finishes to STYROFOAM.
9. Developed, lab tested, and established a DERASPAN Agricultural Panel (Insulated Farm Siding), FP-4019.
10. Initiated a program to develop and introduce DERASPAN panels in LNG storage tanks.

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11. Worked with Pittsburgh-Des Moines Steel on developing a DERASPAN panel for their floating tank cover design.
12. Secured developmental sales of panels to Midland Schools.
13. Initiated development of DERASPAN panels for sign/display companies.
14. DERASPAN panels constructed of .032" embossed aluminum facings and cores of 3-1/2" STYROFOAM FR and PZ-1703 (SMA) foam were tested in a thermal cycling chamber. It was determined that the measured bowing was in approximate agreement with the theoretically predicted bowing and that the maximum one side temperature limitation is 180°F for panels with cores of STYROFOAM FR, while panels with cores of PZ-1703 were good to 220°F. At this temperature the test was stopped due to limitations of the testing equipment.
15. With TS&D assistance several process improvements were made at the Cape Girardeau plant. These included: (a) Improved quality control of Dow-B resin by calibrating the Zahn Viscosimeter used at the Cape with the Oswald Viscosimeter used by the Midland Dow-B formulation plant. (b) A 24 point thermal recorder was provided for periodic temperature checks at various points on the top and bottom platens of the heated press. (c) A drum agitator was added to the contact adhesive line for better mixing and control of the adhesive. This adhesive is used to laminate the aluminum overlays to the plywood skins.
16. Uniform wind uplift load tests were conducted at Reynolds Aluminum on XF-4019 (insulated agricultural roofing and siding). The tests were conducted on 109-1/2" x 38" panels fastened to 2" x 4" purlins on 36" centers. Six test specimens were prepared with three different fasteners-- (a) 3" Aluminum Screw Shank nails with washers, (b) 3" Stainless Steel Ever-Grip screws with washers, and (c) 2" Aluminum Ever-Grip screws with washers. Failure for each panel was designated as the test load at which fasteners pulled through the Rhino Rib sheet. Highest wind uplift failure loads were recorded from tests on panels having the 2" aluminum fasteners. Failures resulted at loads of 120 psf on the 3/4" STYROFOAM and 100 psf on the 1" STYROFOAM siding panels.
17. Plywood-faced sandwich panels made with 9" cores of either PZ-1623 or STYROFOAM FB were evaluated for cryogenic applications by exposing them to a temperature gradient

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across their thickness from -320°F to +78°F. In all cases cracking occurred in the foam, extending from the cold side toward the warm side due to the differential in thermal contraction between STYROFOAM and the plywood facings. Scoring and grooving of the foams made no obvious difference in the number of fractures or the patterns of fracture.

Goals

1. Develop an economical panel system to pass U.L. wall/corner tests, secure U.L. approval, and field evaluate in low temperature space.
2. Test at U.L. and secure a listing for a panel with less than 25 flame spread.
3. Replace Dow Sheet Finish with flame resistant sheet finish.
4. Secure "3/4 hour fire rating" via ASTM E-119.
5. Develop a roof panel system not requiring a built-up-roof.
6. Field evaluate Agricultural Panel FP-4019.
7. Publish a brochure depicting DERASPAN lamination capabilities and standard products in order to explore OEM opportunities.
8. Fabricate and perform flexure test on sandwich panels utilizing CERAMIC FOAM as the core to characterize the performance of the material when used in composite construction.
9. Continue development and evaluation of sandwich panels with various foam cores for cryogenic applications such as LNG tank storage.

ETHAFOAM® - R. L. Kuhn, J. S. Laing, G. D. Miller, L. R. Schanhals

Trade sales were up 9.4% over 1970. A majority of the increase resulted from increases in sales of high density products (underground telephone cable padding) and sheet (mainly increased auto floor underlayment business).

The majority of TS&D input in 1971 was targeted towards short term sales. The following summarizes manpower allocations:

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	<u>% Effort</u>
1. Technical Service to Established Applications & Markets	26
2. Quality Problems	7
3. Self-extinguishing Foams	13
4. New Applications Development	42
5. New Products Development (Cross-linked Foams, High Density Sheet, Antioxidants, UV Stabilizers)	<u>12</u>
	100%

The most significant inputs in 1971 were rapid penetration of self-extinguishing foams into the marketplace, implementation of programs placing increased emphasis on upgrading of general product quality, action taken to keep competition from becoming a significant factor in the gym mat market, and penetration into the snowmobile and all terrain vehicle seating market.

Accomplishments

1. ETHAFOAM Headliners

A joint program with Inmont was undertaken to develop a one piece snap-in headliner for the Vega. It was established that a cross-linked foam sheet was the most practical foam backer material to bond to the exposed vinyl surface. Early in 1971 there was considerable pressure from GM to finalize a design to meet the 1972 model year. Efforts were slowed considerably when GM changed the target date to the 1974 model year. This program will be reemphasized once we have a cross-linked P/E foam product.

2. Dow Training Sessions

TS&D played an active role in the Industrial Foam National Sales Meeting held in Midland. Two training programs were held for new Dow salesmen.

3. AT&T Cable Padding

Technical data was generated and presented to San Francisco Long Lines Division comparing anticipated performance of 6 pcf versus 9 pcf foam padding. This input plus pricing increases on 9 pcf ETHAFOAM resulted in conversion of all 1971 business to 6 pcf foam which is more profitable to Dow.

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Cost of AT&T fabrication via Styro Fabricators, Inc. for 90 miles of business was renegotiated by TS&D and reduced by 32% under 1970 price. This resulted in \$25,000 of additional profit in 1971.

Twenty thousand lineal feet of 6 and 9 pcf sheet was produced and installed in Pennsylvania for evaluation as a low cost general purpose padding on the bottom of the cable. This was our first attempt at production of high density sheet in the semi-plant. Product quality was excellent, and the installation went well. Based on the success of this installation, efforts are underway to gain acceptance at AT&T Corporate headquarters. Technical literature covering ETHAFOAM cable padding was published. This data will be used to further promote ETHAFOAM within AT&T as well as promotion in Europe and Japan.

4. ETHAFOAM for Ford Air Conditioner Duct Insulation

ETHAFOAM (4, 6 and 9 pcf) was evaluated as a replacement for Haskon's polypropylene foam duct insulation at Ford Motor. Tests were run according to Ford spec. #ESA-M4D 303-A plus installations were made at Ford. Heat distortion was not good enough to be acceptable and further work has been stopped. Potential was 1.2 M bd. ft./yr.

5. ETHAFOAM in Auto Child Seating

Bunny Bear Products, a child seating manufacturer from the Boston area, specified and purchased ETHAFOAM 220 cushioning in their infant seats. The application was recommended to Bunny Bear by Bolt, Beranek, and Newman, a consulting firm which TS&D worked with to gain ETHAFOAM acceptance.

6. ETHAFOAM 220 Versus Haskon's L-200 at Ford

A study comparing ETHAFOAM and Haskon's L-200 by Ford's P/E foam gasketing specification was completed. Properties of both products were very similar indicating no major technical advantages for either product. Claims by Haskon that L-200 is significantly softer and has better recovery than 220 were not borne out by this testing.

7. ETHAFOAM Cushion Packaging

- A. TS&D provided technical backup to marketing in the following trade shows:

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1. AMA National Packaging Exposition
 2. SPHE National Packaging Exposition
 3. AOA-NSIA Military Packaging Show
- B. Twenty-one Technical Packaging presentations were given to military and government specifying agencies. Key military contacts were identified for systematic TS&D calls including Wright-Patterson AFB, NAD Earle (Colts Neck), Redstone Arsenal, Picatinny Arsenal and Eglin AFB.
- C. TS&D attended three packaging training seminars. The AMA Packaging Show Seminar was primarily concerned with ecology and recycling packaging wastes. At Michigan State University, new laboratory equipment was demonstrated as part of a shock and vibration seminar. The last seminar at the University of Wisconsin dealt with the package shipping environment.
- D. Through contacts maintained at Michigan State University, confirming dynamic cushioning data was obtained showing equivalency between ETHAFOAM 220 and Haskon L-200 and not the 25 to 50% superiority claimed by Hercules. An ETHAFOAM Newsletter was published to the field.
- E. TS&D presentations discussing ETHAFOAM packaging concepts and highlighting our high density products were made to our major packaging fabricators. These included Republic Packaging, Wilshire Foam, DonRay Products, Tainer Tech, United Packaging and Federal Packaging Corporation.
- F. Mil Spec C-26861B was issued in 1971 by the USAF Packaging Evaluation Agency and now covers portions of all density products by type and grade. A field newsletter was written describing these ranges. The MIL Spec C-46842A proposal has been reviewed and submitted to Redstone Arsenal for final issue. This revision is expected to describe all standard ETHAFOAM plank and sheet sizes and should issue in July, 1972.
8. Self-extinguishing ETHAFOAM
- A. Plank - A production scale up run of self-extinguishing plank was made in June and repeated in September. The product produced closely resembles ETHAFOAM 220 and is self-extinguishing by ASTM 1692, FAA 25.853B and Motor Vehicle Safety Standard 302. The product was advanced to FPS status in October as FPS-4005.00 carrying a 25% price

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premium over ETHAFOAM 220. Sales transfer is anticipated in July, 1972. Major applications are as follows:

Aircraft Flotation Seating - FPS-4005.00 has replaced PVC foams as the flotation seating device in United, TWA, and Continental Airlines new and replacement seating applications. Lighter weight, lower cost, less smoke and longer service life are all advantages for FPS-4005.00. Sales in December, the first active month, were for 7,000 bd. ft. In spite of declining new aircraft orders a potential of 250,000 bd. ft. is projected for 1972. All major domestic airlines are being contacted.

Packaging - Unless forced by local codes, the potential for FPS-4005.00 in the packaging market will be restricted to military packaging. Only a small potential was found primarily for U.S. Navy ship board storage.

Gym Mats - FPS-4005.00 was evaluated as gym mat padding. Product performs well technically and Nissen Corporation, our largest mat customer, plans to offer mats incorporating this foam in 1972. Potential at Nissen is projected to be 50,000 bd. ft./yr. and will be offered in addition to ETHAFOAM 220 mats. Other mat producers have not seen the need for SE mats; however, this attitude is anticipated to change as local fire marshalls become more critical on accessories going into schools.

- B. Sheet - Scale up in production of an ASTM D1692 SE grade sheet product under the designation of FPS-4005.01 was accomplished in June. The product does not pass the current Underwriter's Laboratory Subject 94 test due to flaming drip characteristics. No interest has been achieved except for a low volume wrapping and padding application in aircraft interiors.
- C. Automotive Sheet - A lower flame retardant additive level was developed and is being sold exclusively to the automotive market as PZ4139.29. Major usage is for floor underlayment. PZ4139.29 was developed specifically to

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meet the requirements of the U.S. Department of Transportation Motor Vehicle Safety Standard 302, effective September, 1972 for interior components. In 1971 100,000 bd. ft. of PZ4139.29 was used in Ford, Dodge, Chevy, and GMC trucks and in the Dodge Charger and Chrysler Imperial. This volume is forecasted to increase greatly in 1972 to at least 1.2 million bd. ft.

9. Product Quality

General improvement of ETHAFOAM product quality was a prime goal in 1971. The prolonged strike at Hanging Rock partially hindered this effort; however, several steps were taken which have and will continue to improve product quality.

- A. A quarterly summary report for MSR's was developed by TS&D and presented to Quality Assurance for implementation. This report is proving valuable in pin pointing problem areas and providing improved direction to R&D effort on product problems.
- B. Sealant Backer rod quality was upgraded. A cooperative program between Production, Foam Products Research Lab, Physical Research Lab and TS&D resulted in a cell size reduction which improved appearance and a density increase which improved toughness.
- C. Product specifications for ETHAFOAM 220 plank, 220 sheet, and large rounds were completely rewritten to better conform with market needs and production capabilities.
- D. The need for new tests to measure significant product properties was recognized. At TS&D request, Foam Testing developed a much needed compressive test for ETHAFOAM sheet, a quantitative test for measuring skin quality, and the QC test procedure for compressive set was revised.

10. General Literature

The ETHAFOAM SB sealant backer bulletin and the general technical bulletin on ETHAFOAM were completely revised in 1971.

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11. ASTM Activity

Committee C-24, Building Sealants: A TS&D member was appointed chairman of the task group writing specifications and recommended practices for sealant backer materials.

Committee F-8 Protective Sports Equipment: A TS&D member is continuing as secretary of the subcommittee on playing surfaces and as a task group member considering specifications for athletic mats.

12. Fire Tests

Tunnel tests (ASTM E-84) were conducted on ETHAFOAM 220 sheet, FPS-4005.01 (SE sheet) and FPS-4005.00 (SE plank) in 1971. Excellent ratings of less than 25 for sheet and less than 75 for 1-1/4" SE plank were obtained which qualify ETHAFOAM for various construction and related uses.

13. ETHAFOAM SB Sealant Backer

ETHAFOAM SB sales were brisk in 1971 at \$350,000, domestic-- up 40% over 1970. Canadian and overseas sales nearly match domestic.

A goal of improved product quality was realized by reducing cell size and increasing density. Complaints concerning sealant blistering and product quality occurred, but were minimal and successfully handled with no loss of business or major payouts.

14. FP-4009 - Oxidation Resistant Foam

Degradation of ETHAFOAM at elevated temperatures by oxidation has proved to be a problem in some application areas. A foam with significantly improved oxidation resistance has been developed by addition of an antioxidant Irganox 1010. One week's production of ETHAFOAM including Irganox was made at Hanging Rock.

15. UV Resistant Foam

Weatherability or degradation of ETHAFOAM by ultraviolet radiation has proved to be a problem in oil boom flotation and water sports applications. Improved UV resistance is a must, to expand our business in oil booms where a potential of well over 1 M board feet exists.

Research runs of ETHAFOAM rounds with UV inhibitor have been successfully made.

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16. Sporting Goods Applications

Gym Mats: The use of ETHAFOAM as padding in gym mats represents about 15% of our ETHAFOAM business.

- A. Mat manufacturers have periodically experienced dimensional stability problems with ETHAFOAM. Studies have shown this plank typically may grow about 2% after 30 days aging and another 1% in the 30-60 day period. To head off these periodic growth problems, a 30 day plant inventory has been initiated and complemented by recommendations to customers of additional inventory time.
- B. Haskon attempted late in 1971 to cut into our gym mat business with L-200 cross-linked plank. TS&D conducted comparative testing of properties particularly relevant to gym mat use. The results showed E/F has advantages for repeated impact cushioning, compressive creep, and stability which should prove valuable in maintaining our competitive position.

17. Tile Underlayment

Acoustical requirements by the city of New York have given rise to considerable interest in polyethylene foam as tile underlayment--an estimated 10-20 M ft.² potential. Wood tile flooring systems with 1/8" ETHAFOAM 220 sheet vinyl asbestos tile systems with 1/8" skived ETHAFOAM 900 have passed the acoustical requirements. Flame spread tests on 220 sheets met the fire code requirements and ETHAFOAM 900 flame spread tests are scheduled. In the wood tile market we face a competitive pricing situation with Voltek at E. L. Bruce Company, a major wood manufacturer.

18. ETHAFOAM Folding Blankets

To improve ETHAFOAM sales in concrete curing blanket use for mass concrete dams, a need was recognized for larger size and greater insulating capability. A promising folding blanket design has been developed by TS&D with the Nissen Corporation, our largest gym mat customer. ETHAFOAM plank with nylon reinforced vinyl hinges form blankets of any practical length and widths up to 20'.

Dam Use: To prove performance to dam contractors, folding blankets have been sampled to Grand Conlee, Lower Granite and Dworshak dams, key contacts in the Pacific Northwest.

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Performance compared with Ensolite, a vinyl foam enjoying most of this dam business, will determine our future in this business.

Ice Control: Another potential use for ETHAFOAM folding blankets is an insulation for the control of ice around navigable waters. The St. Lawrence Seaway Development Corporation, The Corps of Engineers, and The Dow Chemical Company all have significant interest in extending the shipping season. SLSDC purchased \$5,000 worth of blankets for investigating control of ice around locks, docks, and pilings this winter season. Dow is also studying ice control with folding blanket areas 36' x 40' at two locations--Ludington and the Oglebay-Norton dock on the Saginaw River.

19. Nuclear Power Plants

ETHAFOAM 220 plank has found a rather unique use in construction of boiling water reactor nuclear plants as an air gap filler between the reactor and surrounding mass concrete biological shield. A review of planned nuclear plant construction through 1976 was made showing a potential of 2 M board feet of ETHAFOAM over the next five years. A newsletter was sent to the field relating this construction activity to sales potential. Public relations has also initiated a story on the Duane Arnold Nuclear Power Plant under construction for Iowa Electric Power near Cedar Rapids, Iowa.

20. Synthetic Turf Underlayment

Technical data and pricing were generated which made ETHAFOAM competitive with Ensolite PVC foam as turf underlayment with Monsanto's Astro Turf. Efforts to gain acceptance at Monsanto were halted; however, then their management was committed to produce PVC foam in house for this application. Technical data was presented to American Biltrite and E. L. Burce; however, synthetic turf developemnts are on hold with both concerns pending the outcome of the National Football League ban on new field installations.

21. ETHAFOAM Small Rounds - Soffet Gasket

A special density rod developed for Wolverine Pentronics Soffet Gasket use has been performing well. The contract anticipated with this rod has been obtained for all 1971 Wolverine business estimated at about 4.5 M lineal feet of 1/2" and 3/8" diameter rod.

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22. ETHAFOAM 220 Plank for Snowmobile Seats

In late 1970 we began to realize a possible application for ETHAFOAM 220 plank in snowmobile seats to protect drivers and riders from experiencing back injuring deceleration forces when subjected to riding over rough terrain and unforeseen sudden drops or jumps.

In 1971 we launched a program to capitalize on the superior dynamic cushioning properties of ETHAFOAM (specifically 220 plank). An annual total market potential for this material was determined by TS&D to be at least 2.6 M bd. ft. in North America.

Dow became an active member of the Snowmobile-All Terrain Vehicle Occupant Protection Subcommittee of the Society of Automotive Engineers which was composed of chief engineers of many snowmobile manufacturers. The top priority item for this subcommittee's work was to establish testing and design standards for snowmobile seats. Our participation included the development of a practical and reliable testing method for evaluating the dynamic cushioning properties of snowmobile seats.

This test method has been well accepted as a standard in the industry, and will be proposed to the main body of the SAE for official standardization.

Using this test method we educated most of the industry in dynamic cushioning and evaluated some 300 commercial and prototype snowmobile seats. Design and testing assistance was provided to fourteen snowmobile manufacturers. Through this work we developed a sandwich construction concept utilizing flexible polyurethane foam and ETHAFOAM which proved to be an improvement over all commercial seats tested. This composite concept combines the comfort properties of polyurethane foam with dynamic cushioning properties of ETHAFOAM.

Chaparral, Harley Davidson, Skidaddler, John Deere, and Mercury have specified ETHAFOAM seat construction for some of their 1973 models. Development programs continue to look promising at Scorpion, Polaris, Arctic Cat, Raider, Massey Ferguson, Bombardier, Moto Ski, Sno Jet, Alouette, and Boa Ski. The volume goal in 1972, in North America, is 1.5 M bd. ft.

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23. ETHAFOAM FX - PZ4139.21 Self-extinguishing Tubing Insulation

Product and market development efforts in the refrigeration/mechanical contractor field were discontinued. Major reason was lack of contractor acceptance due to installation handling characteristics in comparison to competition. Contractor acceptance was poor in spite of significant material cost savings. Sixty thousand dollars of tubing was sold to the OEM market (Kelvinator).

Goals1. SE Plank & Sheet

Gain sufficient penetration into the auto floor underlayment and aircraft markets to justify transfer to sales by the third quarter, 1972. Penetrate appliance gasketing, pending an Underwriters Laboratory proposed revision of the UL 94 SE test procedure.

2. High Density Sheet

Define manufacturing capabilities, evaluate as a floor underlayment, and gain AT&T acceptance. Also define miscellaneous markets and develop additional technical data.

3. Fine Cell Plank

Determine the market potential for this product.

4. Cross-linked Foam Sheet

Voltek route - start market penetration within 3 months after contract closing.

Toray route - obtain Toray technology.

5. Improve Oxidation Resistance and UV Resistance

Establish production capabilities and product mix. Penetrate the building closure strips, water sports, and oil boom markets.

6. SE Tubing

Define the market potential (Refrigerator OEM) pending the increased capacity in the 2-1/2" extruder line at Hanging Rock.

7. Packaging

Expand cushioning and vibration data, publish a technical

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article, participate in the MSU School of Packaging sponsorship program, provide design assistance to customers, develop an antistatic coating, and revise the military specification for high density foams. Purchase a new impact tester. Maintain close liason with key Federal specifying agencies.

8. 220 Plank with New Polymer
Define the product properties. Achieve improved plank dimensional stability for the gasketing market.
9. Recreational Vehicle Seating
Provide design and test service. Investigate boat and motorcycle potential for the concept.
10. Auto and Motorhome Flooring
Determine the technical acceptance of ETHAFOAM systems.
11. Gas and Oil Pipeline Padding
Evaluate various systems for acceptable performance.
12. Concrete Curing Blankets
Determine the acceptance of hinged blankets.
13. Adhesives
Update the adhesive bulletin.
14. ETHAFOAM Versus Competition
Provide technical comparison via the sales broadcast system.
15. St. Lawrence Seaway
Determine if ETHAFOAM is applicable for ice management.
16. Testing Procedure Standardization
Maintain ASTM Activity in the packaging, athletic, and sealant backer committees.
17. Specifications
Update all Customer and Sales specifications.

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18. General Marketing Services

Provide technical trouble shooting, technical training, technical support at trade shows, and customer sales meetings. Keep literature updated, coordinate special product requests, and coordinate quality problems.

19. ETHAFOAM Sealant Backer

Reduce compression set on reels.

SARABOND®/THREADLINE® - R. B. Clipper, D. G. Grenley, L. A. Kuhlmann, L. F. Lamoria, E. L. McMaster

THREADLINE sales in the United States were \$138,000 net to Dow, up 165% from 1970. Sales by foreign subsidiaries were about constant at \$70,000. SARABOND sales in the United States were \$225,000 net to Dow, up 290%. Sales by foreign subsidiaries were up substantially at \$63,000. Price increases in both products were accepted by the trade and resulted in no loss of business.

An increase in the availability of ground block (18 grinders versus 5 a year ago) has been a strong factor in the increase of ground block construction with THREADLINE. A decision by Besser to lease grinders to block manufacturers (avoiding a capital investment of approximately \$40,000) removed the last barrier to availability of ground block throughout the country. The availability of ground block also negates the need for MONOWALL®, never a popular concept with designers. Sales to this type of construction have declined substantially and we have dropped rights to the patent, saving large royalty payments. Our sole competitor in the THREADLINE market has stopped infringing on composition of matter patents and later admitted plagiarizing our technical literature and has agreed to stop.

The listing of our masonry products by New York State's Urban Development Corporation led to three significant projects during 1971 with several others on the boards. Construction news media featuring articles on SARABOND and THREADLINE included Engineering News Record, Civil Engineering, and Masonry Magazine.

Accomplishments

1. We have established 10 masonry prefabrication contractors whose process depends on our masonry products. Their presence assures rational bidding on Amspec's specification sales in the areas where they operate.

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2. One day training schools for mason contractors were conducted by Dow and Amspec personnel.
3. Several requests for speeches at trade association meetings were accepted; five technical papers by Dow authors were published.
4. A training session was held for Amspec masonry oriented salesmen, including a full week of classroom and laboratory exercises. Initial field calls were made with salesmen where requested.
5. The Structural Clay Products Institute has agreed to test brick for its member companies for compatibility with high bond mortar, at the expense of the brick manufacturers.
6. After persistent prodding on our part, the National Concrete Masonry Association has established a Task Force to investigate specifications for construction with thin bed adhesive mortars in concrete masonry. They have accepted our thinking which would require rather stringent tests after exposure of the masonry to a variety of environments. ASTM has finally recognized a need for a specification for high bond mortar and has also tentatively accepted our position that the specification must be written in terms of performance rather than chemical composition.
7. The largest load-bearing concrete block building in the world was begun in Orlando, Florida using ground block and THREADLINE. This 18 story Travel Lodge will provide housing for visitors to nearby resorts. Completion of this project in 1972 should result in significant trade press publicity.
8. Filming for the THREADLINE movie was completed at 4 job sites. Responsibility for the completion of this project has been transferred to Amspec.
9. Fire testing accomplished during 1971 enables us to specify a four hour rated block wall.
10. Transfer of the THREADLINE packaging operation from an outside contractor to Dow has resulted in savings of 25-30% in production cost. In addition the plastic bags which contained the epoxy resin and hardener have been replaced with cans which are much more acceptable in the marketplace.

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11. A formulation which combines the four components of the present THREADLINE into two components has been developed and initially evaluated. Tests to date indicate the new formulation is more workable than the four component and an improvement in terms of pot life and packaging costs. Five patent cases protecting this concept have been filed.
12. An exploratory program aimed at a single component thin bed adhesive for block construction was completed. Technology of these systems is not compatible with field requirements at this time.
13. We have yet to lose a request for code approval for high bond mortar. Recent significant acceptances of SARABOND include the cities of Philadelphia and Los Angeles, the Uniform Building Code of the International Conference of Building Officials, and BOCA.
14. Yields of SARABOND have been increased 10% per batch by suggestions made to production which reduce coagulum. A more stable product also results with increased board-life. New packaging processes and machinery are currently being evaluated by production.
15. A fire test on a brick spandrel built with high bond mortar gives us a three hour rating as protection for steel and an opinion written by Underwriters' Laboratory based on previous tests gives us a four hour rating for single wythe brick column covers. In view of the ever increasing stringency of fire protection requirements and the problems in the field use of asbestos, we view these test results as extremely important sales aids.
16. A series of studies on the structural performance of connection systems for prefabricated brick masonry has been partially completed; further studies will be made in early 1972 and results published.
17. An aging study of the affect of high bond mortar on the corrosion of metal attaching devices is about half completed. Results indicate the corrosion is neither more nor less severe than with conventional mortar or concrete. This contradicts scare rumors which circulated in the marketplace several months ago.

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18. Several new sources of workability additive were approved and about 80 brick evaluated for bonding properties with high bond mortar.
19. The prefabricated masonry for the Philadelphia National Bank was completed in a mason contractors yard and is now being installed on the structure. Again we were able to demonstrate savings in masonry costs, the ability to compete with precast concrete, and significant savings to the general contractor through elimination of time and scheduling problems associated with laid-in-place masonry.
20. Considerable testing and instruction was furnished and is continuing for Medusa Cement Company and Riverton Cement Company to enable them to package a premix of cement, workability additive, and pigment, suitable for use with SARABOND and conforming to our specifications.
21. A masonry paver system similar to the IRMA concept has been developed, tested in laboratory, and a suggested specification written. An installation in Manhattan has been described as excellent by the customer and two more projects have been sold. From the bottom up the system reads: concrete deck, mastic sealant, 2-4" STYROFOAM, 1" high bond mortar, brick grouted with high bond mortar.

Goals

1. Complete the laboratory evaluation of a two component thin bed adhesive, XF-4047-L. Complete small scale tests and full scale walls where required. Measure cure rates and workability as a function of field conditions. Procure, install, and start up necessary production equipment. Design and test new package and complete necessary changes in technical literature.
2. Evaluate the feasibility of specifying ground block and THREADLINE using higher allowable design stresses than presently permitted by building codes for concrete masonry.
3. Continue pressure on trade associations and ASTM for adequate specification for thin bed adhesives and high bond mortars.
4. Develop test information on the use of masonry products at low temperatures for in-place field use during winter construction seasons.

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- 5. Develop high temperature cure schedules for use by masonry prefabricators.
- 6. Publish an engineering compendium of all of the structural test data completed to date on high bond mortar for use by code authorities and designers.
- 7. Cooperate with Amspec in the intensive training of an expanded masonry sales force.
- 8. Expand the market for present products by exploring non-masonry applications.

SARALOY - D. M. Greason

All SARALOY 640-R remaining in inventory was sold during the first quarter. Sale of SARALOY 240 (for shower pans) to The Nobel Company continues, with a disappointing 1400 rolls sold during 1971. IAPMO approval was finally obtained early in the year. An arrangement was made with Noble in October to promote sale of the entire remaining inventory (approximately 3000 rolls) during 1972, after which we should consider a license-royalty agreement and assist in establishing a source of supply from a third party (probably Good-year) on a toll calendaring basis.

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STYROFOAM - L. J. Donovan, D. T. Ferge, N. J. Guziak, B. H. Krasnoff, W. H. Werst

Total STYROFOAM sales in 1971 were 231 million board feet, down one million board feet from 1970. Strong growth was exhibited by STYROFOAM as the core material for sandwich panels used in recreational vehicles, volume increasing from 11 million board feet in 1970 to 21 million board feet in 1971. The start-up of Amspec on January 1, 1971 represented a major milestone in the history of the STYROFOAM business.

Accomplishments

- 1. All United States STYROFOAM DB production was converted to a flame retardant formulation on December 1, 1971. This took place after laboratory testing and customer evaluations of approximately 200,000 board feet of PZ-1666 indicated there were no major drawbacks to this conversion.
- 2. An extensive series of laboratory testing on STYROFOAM PZ-1623 (high compressive strength, flame retardant material for LNG tank bottom insulation) was virtually completed. This testing to determine long term creep

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characteristics of the foam, compatibility of the foam with LNG, and its cryogenic k-factor resulted in approval of the material by 4 of the 5 major tank builders in the U.S. and sales of 400,000 board feet.

3. A rough market study of the potential for SMA foam in U.S. markets revealed potential in industrial panels, dual-temp pipe insulation, and some elevated temperature tank insulation.
4. A meeting was held with STYROFOAM DB fabricators to discuss FR-DB, the methyl chloride monitoring program, quality of the product, and other subjects of interest. In addition, several fabricator plants were visited in continuing these service programs.
5. Vigorous activity in technical service and market development for the use of STYROFOAM PZ-1586 in the recreational vehicle industry has again been successful in promoting the rapid growth of the product in this market. Sales in 1971 of STYROFOAM to this market rose to 21 M bd. ft. from 11 M bd. ft. in 1970.
6. Two test markets were initiated with Amspec to study the ability of an extruded polystyrene foam to significantly penetrate the comfort/residential market when priced the same as beadboard in one market, and at a \$.01 premium over beadboard in the other. The material for these test markets is designated as FPS-4021 and is a grey, cut cell, board of low density and 0.26 k-factor at 75°F. The test market in Boston at beadboard competitive prices began on November 1, 1971 and the test market in Minneapolis at a 1¢ premium over beadboard began on December 1, 1971.
7. Additional developmental jobs were secured outside of Midland which will be used in advancing the shallow foundation concept from development to sales status.
8. Three additional ice rinks were instrumented and the program was transferred to sales status by turning it over to Amspec.

Goals

1. Summarize the results of the property monitoring program for low density skinboards which was conducted throughout 1971. Determine whether further monitoring is necessary and if so, arrange to have it carried out.

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2. Follow the introduction of all flame retardant decorative billets carefully for the first six months of 1972. Pay special attention to MSR's and customer complaints as a safe guard against unforeseen product problems which could get out of hand if not identified and resolved quickly.
3. Explore the potential for STYROFOAM in several OEM areas heretofore untapped, i.e., metal building insulation, curtain-wall in fill panel cores, door cores, modular housing panels, etc. Identify at least one new usage and develop three new accounts in 1972.
4. Obtain approval for and actual usage of PZ-1623 in an LNG tank constructed by Chicago Bridge and Iron Company. Transfer PZ-1623 to sales as STYROFOAM HD-1623 during the first quarter of 1972.
5. Carry out product testing and field evaluations of 4 foot wide STYROFOAM TG when it becomes available from the Midland STYROFOAM plant.
6. Assess the potential for gasoline resistant buoyancy billets in light of the product and production problems experienced during the two runs conducted during 1971. This assessment will include market potential versus price and the probability of technical success versus the cost to achieve it.
7. Follow the test market of FP-4021 with particular attention paid to presence or absence of in use problems as the density is reduced toward 1.3 lb./ft.³ Coordinate with marketing the meaning of the data collected and contribute information, when appropriate, to the STYROFOAM Management Team as they decide future product and pricing strategy.
8. Assess the future of STYROFOAM FB with particular attention paid to the severity of fabrication problems, the need for superior properties to those possible with a polystyrene foam (i.e., urethane heat distortion), the impact of price reduction, and the impact of the resolution of FB's present susceptibility to warping.
9. Optimize the properties of PZ-1586 in conjunction with the requirements of the foam to perform satisfactorily in the recreational--vehicle sandwich panel application. This optimization includes optimizing foam production costs in line with the needed properties.

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10. Laboratory and field evaluate pilot plant produced fire-retardant SMA foam in the panel core and pipe insulation areas. Use this input along with significant input from Dow Europe to justify construction of polymer and foam production facilities.
11. Laboratory and field evaluate (with Amspec) the revised size tongue's and groove's of STYROFOAM TG in the comfort and agricultural markets. Scrutinize product quality to prevent further incidents of excessive complaints which resulted in significant lost business in 1971.

THURANE® - A. J. Hoffman

THURANE sales volume for 1971 was 19.1 million board feet up 8% from 1970. Competitive conditions within the rigid urethane foam market remained severe. While the total foam market was growing at 15 to 20%, the market for billets and cut boards was gradually losing some of its share to laminated boards, preformed pieces, and foamed-in-place systems. The first six months of sales going through the newly formed Amspec were slow. The 4 month Hanging Rock plant strike resulted in additional burdens and costs to the THURANE business but not one order was lost due to inability to supply. Our hats are off to the production unit and all those who helped to make things go as smoothly as they did during the strike.

Accomplishments

1. A new THURANE brochure was written.
2. Evaluation of competitive urethane foams was continued-- data demonstrates our competitive, and in most cases, superior product quality and thus, value when selling at the going market price.
3. High density THURANE production capabilities were established and Technical Data sheets written for PZ-3851.03 and PZ-3851.05.
4. PZ-2020.03 scale-up was completed at the Hanging Rock plant.
5. PZ-2020.03 Fire Testing was completed in three major areas:
 - A. DERASPAN® panels with PZ-2020 cores, showing no fire propagation along the panels.

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- B. Fabricated pipe insulation sections with a system containing 2-1/2" of PZ-2020 gave one hour fire protection to the pipe.
 - C. Underwriter's Laboratory evaluation on smoke, fuel and flame spread resulted in a 30 flame spread but unfortunately not the coveted 25.
- 6. A floral market research study was completed showing a worthwhile although limited market of about 15 M bd. ft.
 - 7. Competitive floral foams were characterized.
 - 8. Floral foam specifications and capability to produce were established.

Goals

- 1. Complete floral foam test marketing by April, 1972.
- 2. Transfer floral foam to sales status during the second quarter of 1972.
- 3. Edit and produce a fire protection movie extolling the virtues of PZ-2020.
- 4. Complete the market development of Industrial Pipe fire protection systems with PZ-2020.
- 5. Transfer PZ-2020 to Sales during the third quarter.
- 6. Conduct a dual temperature pipe testing evaluation of THURANE versus low density THURANE, PZ-2020 and competitive foams.
- 7. Explore the feasibility of a 1.5 lb./ft.³ density urethane formulation.
- 8. Support the applications research work on kerfed laminates, wrap around, or similar forms of new pipe insulation systems.
- 9. Develop a fire rated DERASPAN panel with a PZ-2020 core.
- 10. Continue to pursue a less than 25 flame spread rating for PZ-2020.

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M A R K E T S

AMSPEC LIAISON - N. J. Guziak

The formation of Amspec on January 1, 1971 and their locating in Columbus, Ohio effective March 1, highlighted an innovation for Dow in marketing strategy to the construction industry. The transfer of Technical Service personnel from Construction Materials TS&D in Midland to Amspec resulted in Dow TS&D reorganization along product lines to better serve all of the Amspec and Dow OEM markets.

Accomplishments

1. From 88 requests by Amspec for Dow back-up work or information in their various markets, 37.5% were completed. Of the remaining 55 requests, 54 are being worked on and completion dates have been established, most of them falling in 1972.
2. Several meetings of Amspec personnel with Dow Business, Management, and Target Teams were held to clarify goals of the respective businesses as they pertained to R&D projects and priorities.
3. We maintained good lines of communication between Dow R&D personnel and Amspec TS&D and Business/Market Managers.
4. Several training meetings were attended which were conducted by Amspec for their field salesmen. Through these a better insight into their product needs in the various markets was obtained.
5. Rough drafts of all literature prepared by Amspec for publication were reviewed.
6. Trade shows and conferences which illustrated Amspec market needs were attended throughout the year.

Goals

1. Establish an overall priority of importance on requests from Amspec for further Dow work.
2. Establish an order of priority within each market group in Amspec on their requests of Dow TS&D and other functions.
3. Promote better communications between R&D personnel and Amspec Market/Business and TS&D Managers thru:

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- A. Scheduled meetings between Dow product and Amspec Market personnel.
 - B. Direct contact on a one to one basis.
 - C. Target, Management and Business Team meetings with Amspec personnel present.
4. Maintain a degree of field contact to better appreciate customers problems and Amspec needs to solve these problems.
 5. Define longer range goals for Dow R&D to meet Amspec market needs beyond one year. Conduct studies to define opportunities and potential volume along with Amspec personnel.
 6. Provide expertise to Amspec on Dow manufactured products.
 7. Develop products and/or systems utilizing Dow technology that have marketable value through Amspec.

ORIGINAL EQUIPMENT MANUFACTURERS--SANDWICH PANELS - F. King, Jr.,
I. B. Kritzman, W. P. Hovey, D. Ferge

Total sales attributed to OEM accounts exclusive of recreational vehicles and decorative billets was \$606,000. Of this total, one metal building company provided \$214,000 in sales. Six additional metal building accounts offer a potential of \$1,400,000 with six smaller firms adding an additional \$300,000. Additional TS&D effort toward this market was initiated in December, 1971. Several industrialized housing builders (panelized and mobilehome) have developed plans to build prototype sandwich panel structures utilizing STYROFOAM as the core material. Additional knowledge and test data developed in 1971 should lead to successful field and market development in the industrialized housing market in 1972.

Accomplishments

1. A sandwich/stressed skin roof panel that will pass the FHA design requirement of 40 psf loading with 1/240 span deflection was developed.
2. An 800 square foot addition was added to a sandwich panel home built in 1952 by Alden B. Dow and Associates. The new panels consist of 1/4" clear fir plywood facings bonded to 1-1/2" STYROFOAM FR. This addition marks the beginning of historical data on the performance of an elastomeric adhesive system for sandwich panel construction in housing

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utilizing STYROFOAM as the core material. Samples with a 20 year history of performance were taken from the original structure for testing and evaluation of the thermoset adhesive system.

Goals

1. Fabricate and perform racking and transverse load tests on hardboard faced sandwich panels utilizing STYROFOAM as the core material. Attempt to obtain ICBO approval for use in post and beam construction.
2. Fabricate and perform flexure tests on sandwich panels utilizing CERAMIC FOAM as the core, to characterize the performance of the material when used in composite construction.
3. Develop for sales and TS&D use, a package of technology on sandwich panels for the industrialized housing market.
4. Set up long-term flexural creep tests on panels with various foam cores (STYROFOAM, THURANE, DORVON, etc.) to determine their performance in different thermal environments.
5. Develop a technique for using water based adhesives to bond various facings (metal, wood, etc.) to STYROFOAM in fabrication of sandwich panels. This system would replace the presently used solvent (aromatic, aliphatic ketone blends) based contact adhesives.
6. Develop a method for making double faced curved sandwich panels for application in the recreational vehicle and pre-engineered metal building industries.
7. Establish target accounts for concentrated market development effort in the OEM area which represent major potentials and monitor our progress with them.

PIPE AND VESSEL INSULATION - W. J. McMillan, I. B. Kritzman,
F. L. Acker

Research this year was concentrated on developing pipe insulation systems with emphasis on (1) segmented "wrap around" systems, (2) fire resistant systems, and (3) performance characteristics of Dow CERAMIC FOAM systems.

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The development of segmented wrap around insulation is a new approach for utilizing STYROFOAM, CERAMIC FOAM, and THURANE in Dow manufactured insulation systems for the expanding oil and gas pipeline insulation market. It is also a potential method for placing THURANE in the commercial dual temperature insulation market.

As a result of the increased emphasis on fire resistance as the controlling insulation criteria for light hydrocarbon petro-chemical processing, we became involved in fire resistance testing of THURANE and Dow CERAMIC FOAM pipe insulation for this market.

Research showed Dow CERAMIC FOAM performance equal or superior to Foamglas and potentially competitive with "white goods" in the 500 to 1200°F temperature range.

Accomplishments

1. Design information for several segmental pipe insulation systems was generated for Alyeska, Dow Europe, and Amspec. These systems were based on 24 or 36 segments per circumference.
2. Computer studies were conducted which showed that cutting half-round sections of pipe insulation from 24" x 48" billets produces 28% to 60% waste if the cores are not utilized. Waste for kerfed insulation is 2-1/2% to 23% and for cut segmented insulation from 1/2% to 12%.
3. A segmental "wrap around" insulation, composed of Dow CERAMIC FOAM segments bonded to asbestos felt, was developed for steam pipe insulation.
4. A preliminary economic study was conducted which indicates that Dow CERAMIC FOAM wrap around segmented pipe insulation should be competitive with white goods.
5. An experiment was conducted which showed post heat treatment of THURANE and PZ-2020 for four hours at 250°F resulted in a much more dimensionally stable product under humid aging conditions than untreated URETHANE FOAM. This treatment also modifies the THURANE from 1.88 pcf density to 1.2 $\frac{1}{2}$ pcf and its K factor from .171 to .185. (BTU in h-°F-ft.²)
6. The Union Carbide fire resistance test for pipe insulation was modified and improved. Insulation performance was found to be very sensitive to local flame temperature.

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7. Fire resistance tests using the modified Union Carbide method were conducted on THURANE, PZ-2020, CERAMIC FOAM, and phenolic foam. These tests showed:
 - A. Three inches of PZ-2020 with a 10 mil steel jacket will provide one hour of fire resistance (pipe to 1000°F).
 - B. Fire resistance increases an average of seven minutes for each half inch of PZ-2020 pipe insulation.
 - C. Fire resistance is heavily dependent on the jacket material.
 - D. Dow CERAMIC FOAM must be secured to the pipe by steel bands or a steel jacket.
 - E. Two inches of Dow CERAMIC FOAM with a 10 mil steel jacket will provide one hour of fire resistance.
 - F. Dow CERAMIC FOAM with a steel jacket is still functional insulation after a fire.
 - G. A steel jacket is more effective for increasing fire resistance of phenolic foam than adding clay fillers and increasing the foam density to 18 pounds per cubic foot.
8. High humidity chamber tests were conducted on Dow CERAMIC FOAM and Foamglas. The results showed that the vapor barrier and the effectiveness of its application contributed more to satisfactory performance of the system than any difference between the two insulation materials.
9. Temperature cycling tests were conducted for seven months, from approximately 660°F to approximately 1370°F, on a process pipe with 3 inches of Dow CERAMIC FOAM insulation. The insulation fractured with barely discernible cracks but remained functional. Laboratory data showed these cracks produced negligible changes in heat loss over the entire temperature range.
10. A cursory test of adhesives for Dow CERAMIC FOAM was conducted. These tests showed that a Sauereisen Cement No. 31 provides a stable bond up to 1200°F, in most high temperature cements fracture at the cement-Dow CERAMIC FOAM interface, adhesives which will "burn-out"

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require an inorganic residue to prevent flame impingement for fire resistance, and an adhesive compatible with high temperature performance is needed for pipe insulation fabrication.

Goals

1. Continue Fire Resistance testing of Dow CERAMIC FOAM to establish fire resistance specifications for the product and to demonstrate the superiority of Dow CERAMIC FOAM over Foamglas.
2. Analyze the need for expansion joint systems for Dow CERAMIC FOAM Pipe Insulation in the temperature range of 500-1200°F.
3. Continue to study the economics and design of segmented Dow CERAMIC FOAM Pipe Insulation systems for steam lines. The design is to include an insulation product for the steam lines from Dow to the new Nuclear Power Plant.
4. Develop pipe line insulation performance criteria with particular reference to segmented insulation products.
5. Test Dow and competitive foam products in dual temperature pipe insulation systems.

RECREATIONAL VEHICLES - L. J. Donovan, F. King, Jr., I. B. Kritzman

Accomplishments

1. Dow participated in two trade shows where the concept of sandwich panels for recreational vehicles was illustrated. A booth in the form of a cutaway travel trailer was used to visually illustrate the various aspects of the sandwich panel concept.
2. Start-up assistance was provided to many manufacturers in setting up production lines for panel manufacturing.
3. At the close of 1971 we had about 70 locations using STYROFOAM. This is 24 more than we had at the end of 1970. (Location rather than number of customers is used as a measure of success as we have existing customers who are expanding their use of panels to other lines and other locations across the country.)
4. Sandwich panels produced from STYROFOAM, PZ-1586 close tolerance skin board, were tested in T-peel and tensile bond to determine the bonding characteristics of the foam to the facings in relation to the physical properties

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of the foam. Density, cell size, vertical compressive modulus, polymer and process conditions were examined for possible correlation to panel strength.

Goals

1. Provide technical service to manufacturers who are evaluating STYROFOAM for sandwich panel construction, including new plant design and start-up assistance.
2. Provide technical back up to existing customers on panel problems and generate new supporting data for sandwich panels.
3. Minimize MSR's by continuing a search for new and better adhesives.
4. Continue to perform tensile bond and T-peel tests on PZ-1586 in order to find a correlation between the physical properties of this material and its bonding characteristics.
5. Assist in qualifying production plants other than Pevely to produce PZ-1586.
6. Transfer STYROFOAM PZ-1586 to sales status after developing meaningful specifications which when met will assure proper performance of the foam in sandwich panels.
7. Assist field sales in broadening the use of STYROFOAM in travel trailers, at companies where it is used to a limited extent at present.

ROOFING - K. A. Epstein, F. L. Acker

The major emphasis of Dow's activities in roofing in 1971 was placed on obtaining fire and wind ratings on IRMA roof systems to meet insurance and building code requirements. Without these ratings, the sales areas in which IRMA could compete would be quite limited. The insulated, metal deck market for fire-rated roof systems is approximately 880 M sq. ft., of which we can now compete for 45%, versus 10% prior to 1971.

Accomplishments

1. The IRMA system with 1000 pounds per 100 square feet of 3/4" crushed limestone (placed on the STYROFOAM) as the roof covering, passed Underwriter's Laboratories "Class A" roof

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covering test. This rating indicates that the stone is an effective covering against severe fire exposure originating from adjacent buildings.

2. The IRMA system with 5/8" thick fire-rated (Type "X" core) gypsum board as the underlayment for the roof membrane on steel decks passed the two requirements (heat contribution to a fire inside a building, and minimum wind-uplift resistance of 60 pounds per square foot) of the Factory Mutual (F.M.) "Class I" test. IRMA became the First System to be listed by Factory Mutual. Normally, F.M. lists only approved individual components. The use of gypsum boards with a Type "X" core made the difference between passing and failing. The F.M. approval is restricted to the use of cold-applied adhesives directly on the steel deck.
3. The IRMA construction with Type "X" gypsum board easily passed the Underwriters' Laboratories "Fire Acceptable" test. This test measures flame spread of the roofing system when exposed to an internal building fire. The successful IRMA/gypsum board construction allows the use of steep asphalt or cold-applied adhesives to adhere the gypsum board to the steel deck. This same U.L. IRMA construction with type "X" gypsum board and asphalt adhesive passed the Underwriters' Laboratories "Class 60" (134 miles per hour wind) wind-uplift test. The IRMA/gypsum system became the first "Fire Acceptable" roof assembly to also pass the wind-uplift test. The success of IRMA with respect to the wind-uplift and fire ratings opened up a segment of the metal deck roofing market (approximately 400 M sq. ft.) which was formerly unavailable.
4. IRMA test installations with different foams were made on sloped and flat, ponded roof sections in Freeport and 1702 Building. These roofs were thermocoupled and will allow measurement of effects of densities and WVTR of different foams on water pickup and heat transfer. One IRMA test installation became one year old and is being monitored to obtain data to substantiate Amspec's Guarantee Claim that the insulation value (k) of STYROFOAM RM will not change more than 20% in ten years.
5. The oldest IRMA roof (21 years old) was finally torn off 334 Building. No leaks had occurred during the time that the IRMA roof had been in place. The membrane was cut up to provide samples for possible sales promotion purposes.

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6. Two types of screens (aluminum and glass) and asbestos felts were laid loose over an IRMA roof which had joint growth problems. Stone was then placed on top of these coverings. The application is being tested as a possible solution to the problems created by the use of small stones on IRMA roofs.

Goals

1. Develop a single-ply liquid roofing membrane for replacement of the asphalt built-up roof membrane in the IRMA roof system, to give better bonding of STYROFOAM RM, better waterproofing, less buoyancy problems, and no creep. These property changes will allow the substitution of an ultraviolet protective coating in place of stone ballast.
2. Determine if coal tar pitch is compatible with STYROFOAM in IRMA.
3. Gather information from IRMA roofs on water pickup, "k" factor changes and effects of densities on these changes.
4. Develop a computerized, mathematical model for determining water pickup versus "k" relative to high humidity, seasonal and daily driving forces, and ponded plus unponded roofs.
5. Determine the effects of high humidity (>70% R.H.) on fire-rated IRMA roof systems with gypsum board.
6. Investigate spray-in-place urethane roof insulation systems and determine their applicability to reroofing and new roofing. Make recommendations on Dow and Amspec activity with respect to spray-in-place urethane.
7. Determine if there is a chemical difference between asphalts from the West Coast, Midwest, and East, and the differences among dead level, Type II, and steep asphalt.

SOIL INSULATION - F. M. Giachino, G. A. Mackey, A. J. Maki,
L. J. Percha, W. J. Smith, W. G. Williams

In 1971 particular emphasis was placed on those phases of product development which (1) were required to allow massive application of the insulated pavement concept and (2) would greatly effect the competitiveness of the insulated pavement application. In addition to continued market development efforts on STYROFOAM HI in the lower 48, an effort was made to be sensitive to opportunities associated with the extraction of oil from Alaska's North Slope.

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Some effort during 1971 was directed to this area (the application of STYROFOAM HI in permafrost regions) because it appears to be a better short-term opportunity for highway insulation.

In 1971 the longest continuous stretch of STYROFOAM HI usage to date, was designed by the Pennsylvania Department of Transportation. The section is 0.98 miles in length, has been bid and will be constructed in late 1972 or early 1973.

Accomplishments

1. During 1971 special effort was directed toward obtaining a better understanding of the differential icing phenomenon sometimes noticed between insulated and uninsulated pavements. This work was triggered by the action taken by the state of New York where they discontinued the use of STYROFOAM HI pending an investigation of the phenomenon. The following are some of the major efforts carried out during 1971 in an attempt to put the icing phenomenon into perspective:
 - A. An extensive literature search into the technical and legal ramifications of the problem was conducted.
 - B. With the assistance of the Computation Research Laboratory (CRL) a heat transfer model capable of taking into account conduction within the section and various surface characteristics such as solar radiation was developed for the prediction of highway surface temperatures.
 - C. Comparisons of various sections of highway pavements such as bridge decks, asphalt and concrete surfaces, were compared with insulated sections and indices for icing potential were derived for both the continuous and intermittent applications.
 - D. Sensitivity studies for the major variables were conducted to substantiate the general relationship which were observed.
 - E. The results of the study indicate that the icing potential for continuous sections of insulated pavement is no greater than any other type of pavement section. According to the index selected for intermittent applications, the differential icing potential between insulated and uninsulated pavements

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is equal to or less than other differentials commonly encountered in highway pavements. It was also found to be an order of magnitude less than the potential differential between a bridge deck and the approach slab.

- F. Several meetings to discuss and present our new findings in this area were held with the New York State Department of Transportation. While New York will be continuing their general investigation of icing on pavements, they have given us permission to talk to their design people for the inclusion of HI in new construction projects, although no projects are to be advertised for bid until completion of their own studies.
2. Another area of major emphasis during 1971 was the development of a structural design procedure for insulated pavements. This procedure would take into account all of the direct and indirect advantages of the insulation in order that economic comparisons of equivalent performance could be made between insulated and uninsulated pavements. Implication of such a design approach by various highway departments should greatly enhance the competitive position of HI on large new construction projects.
 - A. An extensive literature search of pavement design procedures which have been utilized or are postulated for use in the future, as well as a review of design techniques used by highway departments was conducted.
 - B. With assistance from the Computations Research Lab modifications were made to the Barksdale three layer and four layer elastic structural programs.
 - C. An insulated flexible pavement design procedure was prepared using the four layer elastic analysis. This procedure will allow the selection of various thicknesses of asphalt, granular base and insulation to withstand specific number of loads and is based on the design criteria of tensile strain for the asphalt layer, compression for the insulation layer and normal failure criteria for the base coarse and subgrade soil. An attempt is made to take into consideration the fatigue characteristics of both the asphalt surfacing and the insulation layers.

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Although the basic philosophy of this procedure is well fixed, specific designs will have to be worked up in conjunction with engineers in the various states to render this approach useful for each individual state.

3. Theoretical calculations and laboratory experiments have been and are currently underway to study the partial protection aspect of the insulated pavement concept. Investigation of the partial protection concept is most important because most states provide partial protection against frost with gravel and because we design insulation for 100 percent protection we are often at an economic disadvantage.
4. A one dimensional thermal analysis has been developed in conjunction with the Computations Research Lab for use in designing conventional and insulated pavements in permafrost regions. This program has been verified with some field data and is currently being utilized for proposed designs in the Arctic. Program capabilities include the allowance of multi-layer cross-sections made up of soil, pavement, insulation and even heat sinks. A two dimensional extension of this program has been worked out to handle edge configuration geometry. Initial output from this program also looks encouraging.
5. Some refinements have been made to the permafrost thermal model for use in seasonal frost applications. This tool is particularly necessary in areas where our present empirical design is unsatisfactory and for the partial protection concept, for which, no design presently exists.
6. A formal internal report describing tests conducted on various types of foam plastic under actual field construction loading was completed.
7. A laboratory test aimed at examining the fatigue characteristics of equivalent compressive strength STYROFOAM of varying density was carried out. From these tests it appears that not only will a minimum compressive strength be required for highway insulation but also a minimum density.
8. Laboratory evaluation of an asphalt-bead composite for use as earth insulation was completed. Although the results of most tests were acceptable, the structural fatigue of the material in laboratory repeated load tests was most disappointing, with extensive creep being shown at relatively low load levels and number of applications.

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9. A test was conducted to determine the minimum granular cover required above HI before hot asphalt could be applied without thermally degrading the STYROFOAM. This test was carried out for the Wisconsin Department of Transportation and showed that structural considerations are more critical than thermal restrictions.
10. Samples of STYROFOAM were retrieved from Test Road No. 1 and tested for moisture content and thermal conductivity. Performance of the insulation is still good after 10 years' service in the ground.
11. A training session was held for Highway Products salesmen which emphasized the "basic factors and techniques useful in selling HI."
12. A design for insulating the back slope of a large hydro-electric dam facility at Ludington, Michigan was proposed at the request of the consulting engineering design firm. Insulation was considered to provide protection against frost action damage during drawdown periods. However, it is not anticipated that such a high degree of protection will be required.
13. Various insulation design configurations for protection of the roadway against differential heaving were provided to the Alyeska Pipeline Service Company for segments of their pipeline which crosses Alaska Highway Department roads.
14. During 1971, visits and technology exchanges were conducted in Midland with personnel from the Alaska Highway Department and the Alaska Division of Aviation.
15. A presentation on HI was made at a Highway Engineers Workshop at the University of Wisconsin.
16. Presentations and design work were conducted in conjunction with Dow Canada for an upcoming permafrost installation in the Canadian Northwest Territories. Also participating in this test will be the Canadian Department of Indian Affairs and Northern Development, and the National Research Council of Canada.
17. Back-up work was done for Dow Canada in the Provinces of Ontario and Quebec during 1971.

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Goals

1. Work with Alyeska on a one to one basis to determine the need and application of earth insulation for permanent and/or temporary embankment constructions such as highways, airfields, and pump stations.
2. Capitalize on earth insulation opportunities with other major builders in the Arctic such as member companies of Alyeska.
3. Install a test section of insulated roadway embankment over permafrost near Inuvik in the Northwest Territories. Collect data for varification of one dimensional and two dimensional analysis.
4. Work up insulated pavement design alternates for Michael Baker Alyeska haul roads.
5. Communicate findings on the differential icing study to states presently using HI and complete work on the capacitance index for both continuous and intermittent applications.
6. Change the present image of the insulated pavement concept (exotic, expensive problem solver pertaining to specialized situations and having little or no application on general highway construction) by conveying to our customers some of our recent technological application work. More specifically:
 - A. Demonstrate the far reaching effect and general impact of insulated pavements on highway construction.
 - B. Bring into focus the total economics of insulated pavements thus changing the general competitive image.
 - C. Convey the special engineering tools and technology necessary to fully investigate the practical application of the insulated pavement concept.
7. Work with Dow Canada to promote the use of earth insulation.
8. Push, in some selected states (nine or less), to get HI specified on some large construction projects by optimizing structural designs, and exploring the total economics of insulated highway construction.

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9. Continue the investigation of the partial protection concept and if applicable promote its application in the field.
10. Revise and refine the present thermal design in areas where the present empirical procedure is not adequate and for areas where consideration of the partial protection concept is desired.
11. Continue testing of asphalt modified beads and other potential materials for highway insulation.
12. Develop a promotional piece for use in the market development of STYROFOAM HI in permafrost applications.
13. Retrieve insulation samples from Midland test roads to continue the documentation of long-term thermal and structural performance.

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P R O J E C T SARCTIC PIPELINE INSULATION - N. J. Guziak

In late 1971 Dow management decided that an opportunity exists for insulation applied conventionally on oil and gas pipelines projected for construction in arctic areas such as Alaska and Canada.

Accomplishments

1. Coordinated the assembling of information for Alyeska Pipeline Service company--Houston, Texas for potential of 70 miles of 4 ft. diameter underground oil pipeline.
 - A. Assembled longevity information on STYROFOAM and THURANE in low temperature underground applications to show performance on thermal stability and moisture resistance.
 - B. Assembled information on four design proposals using STYROFOAM and/or THURANE along with projected economics on each system.
2. Established a one to one contact between Alyeska and Dow on conventionally insulated pipe.
3. Initiated a testing program to prove performance of Dow plastic foams on underground 145°F pipelines in high water content permafrost soil.

Goals

1. Define potential market and timing for Dow foams in pipeline insulation in Arctic Area.
2. Complete the test program of Dow insulation for the 145°F pipeline and estimate their performance for 30 years in an underground, high water content, soil application.
3. Design and refine insulation systems for application to hot oil (145°F) underground and above ground pipelines in Arctic regions for Alyeska Pipeline Service Company. Design systems for above and below ground cold natural gas lines for gas line consortia in Alaska.
4. Interface with oil company R&D personnel for their feeder line insulation needs in Arctic Areas.

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5. Contact pipeline contractors for information on pipeline construction and to promote Dow insulations and/or insulation systems.

DOW PAVING SYSTEMS - L. Percha, N. Foor, W. Smith, H. Shafer

The second year, 1971, of full commercialization for Dow Paving Systems, was a critical period in which some rough edges were smoothed. An important one, customer financing of the work, was stimulated when the Federal Aid Highway Act provided matching funds for repair of bridges. However, the directive did not reach the states until year's end, delaying the impact until 1972. Sales of the system doubled over 1970 to \$650 M, on an average price of \$240 per cubic yard of material and service.

Accomplishments

1. Second generation product evaluation was completed and a research report issued. The product, a blend of 75 percent saran and 25 percent styrene butadiene latexes with anti-foamer was integrated into the program as Dow Paving Systems Modifier B. Product SM-100 was redesignated Modifier A.
2. Modifier production was transferred from the SB latex plant to Soluble Saran Plant where both are mass blended before drumming. Quality Control during start-up revealed the need for minor corrections in the blending operation.
3. Technical-sales literature was revised to reflect the systems concept, the choice of modifiers tailored to end use, and the broader scope of concrete surfaces other than bridge decks.
4. First contracts covering use of the system to repair concrete roadway slabs were completed; New York Thruway - Modifier B and I-95 near Richmond, Virginia - Modifier A.
5. A test section using Modifier B at 25 percent solids level was placed in a canal invert for the Los Angeles County Flood Control District. Badly eroded inverts afflict many miles of these canals.
6. The results of two laboratory investigations showing superiority of latex modified portland cement compositions compared with unmodified compositions, in terms of freeze-thaw durability and impermeability, were disseminated to the Highway Research Board and Federal Highway Administration officials.

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- 7. Corrosion of reinforcing steel has been defined as a primary cause of deck deterioration. We have assembled a non-destructive corrosion potential detection device according to instructions by the Federal Highway Administration.
- 8. Cooperative development work with a prominent paving equipment manufacturer, Gomaco Corporation, along with operational improvements in the Dow finisher during the year have gone a long way toward solving the surface finishing problem. The Dow finisher is used in lane-at-a-time paving and the Gomaco for full width paving.

Goals

- 1. Conduct a corrosion detection deck monitoring program to demonstrate the effectiveness of the system in preventing deterioration due to reinforcing steel corrosion.
- 2. Provide Technical Service and Market Development activity and laboratory back-up to expand the market during 1972.
- 3. Continue cooperative activity with the Operations group to consolidate the Dow position in latex modified concrete construction.
- 4. Work with American Concrete Institute, Highway Research Board, and the Federal Highway Administration to promote Dow interests in the concrete construction field.
- 5. Conduct a product quality control program for Modifiers A and B and portland cement amenability. To monitor end use quality control in support of continuing improvement of the system.

EROSION CONTROL - G. H. Brandt

Accomplishments

- 1. NC1556.2L was field tested in Iowa, Virginia, Maryland, Louisiana and Alaska, both as a tacking agent for straw and as a stabilizer for soil surfaces without mulch. Some competitors' materials were included in adjacent field tests. Two potential Dow replacements for NC1556.2L were also field tested but were found to be essentially equivalent to the present material. All three Dow materials were based on polyacrylamide polymers which degrade after about three months field exposure to ultraviolet light.

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2. An erosion control market study was completed during the year. This study determined that the quantity of water required to apply our materials was excessive. Marginally acceptable performance of these chemicals further restrict their potential market. The excellent performance provided by straw and asphalt tends to fix the product cost. The market study further indicated the temporary erosion control market is still largely uncertain, and that a reasonable market potential exists for a colorless straw tacking agent to replace asphalt. These and additional factors indicated NC1556.2L and other polyacrylamide based materials are inadequate for market acceptance.
3. An erosion and sediment control systems analysis capability was developed during the year while completing a study for the Office of Water Resources Research, titled, "An Economic Analysis of Erosion and Sediment Control Methods for Areas Undergoing Urbanization."

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Goals

1. Find and install a limited field test of a colorless replacement for asphalt at a premium price.
2. Supply an erosion control systems analysis capability to help Dow establish a unique position in erosion and sediment control.
3. Test potentially superior erosion control systems.

EXPLOSIVE BARRIER SYSTEM - A. J. Palfey, V. L. Hannaford

The major implementation effort in two contracts totaling \$103,000.00 for the Defense Nuclear Agency was completed in 1971. These contracts were to develop a protective barrier wall for explosive storage.

Of all commercial foams evaluated, STYROFOAM (PZ-1623) 3.5 pcf density, FR boards proved to be the best selection, structurally and economically, for the application.

Accomplishments

1. Full scale walls were fabricated and tested in the Midland laboratories.

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2. A full scale prototype (12,000 bd. ft.) was prefabricated in the Dow Shops. It was shipped in kit form to the Naval Air Depot, Earle, New Jersey where a successful installation was made in a storage magazine.
3. After three months of satisfactory service in the storage mode, the system was inspected by the Armed Services Explosives Safety Board.

Goals

1. Obtain official approval of this system from the Armed Services Explosives Safety Board.
2. Market this barrier system to the military as a complete prefabricated kit.

HIGHWAY JOINT SEALANTS - Al Kott

Highway departments throughout the United States have been extremely critical of presently available commercial joint sealants because of short service lives. A Dow urethane sealant, XF-4028L survives laboratory tests which commercial sealants rapidly fail. Potential Dow sales in this highway market are estimated to range from \$300,000 to \$2 million per year. Estimates are that the commercial construction market is even larger.

Accomplishments

1. XF-4030L, a superior primer for urethane bonded to concrete, was perfected.
2. Thermal stability of XF-4028L sealant was improved to allow intermittent service at 160°F, the highest design temperature required in the continental United States.
3. Dow sealant samples passed rigorous Michigan and Minnesota acceptance tests performed in highway department laboratories and duplicated at Dow.
4. A laboratory synthesis was scaled up to allow sufficient production of sealant for field tests.
5. Field evaluation tests joints were successfully installed in Oklahoma and New York.
6. A thorough investigation of the joint sealant market was made in an attempt to delineate potential Dow sales.

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Goals

1. Demonstrate superior performance of Dow sealants to highway departments and contractors.
2. Install more field test joints in highways and structures.
3. Work with highway departments to influence adoption of performance tests which competitive sealants cannot pass.
4. Study the effects of raw material specifications and manufacturing techniques on the properties of the finished sealant.
5. Improve the adhesion of water immersed sealants.
6. Develop primers which are effective on materials other than concrete.
7. Produce non-sag, colored, and machine applied derivatives of XF-4028L to compete with all types of highway sealants.
8. Explore potential applications in the construction sealant market.

LIGHTWEIGHT CASTABLE MATERIAL FOR HOUSING MODULES - H. S. Smith,
S. J. Waling

The investigation and development of lightweight castable materials for three-dimensional housing modules has continued during 1971 under contract with HUD, (Type B, Operation Breakthrough). The purpose of this effort is to develop a material with the advantages of fire resistance, increased insulation, and the economic advantages which accrue from weight reduction.

The lightweight concrete development has utilized several existing and potential Dow products with varying degrees of success. Expanded ceramic aggregate is a necessary component of such materials and warrants further evaluation as a potential Dow product.

Accomplishments

1. The requirements of the HUD contract have been completed with the following results:
 - A. Fifty to seventy pcf concrete formulations have been derived with superior structural, fire resistance and insulating properties.

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- B. It has been determined that the newly developed materials satisfy the structural requirements of typical modular configurations.
- C. Economic advantage will be realized by utilizing the 50-70 pcf material in 3-D modular systems.
- 2. A research proposal has been submitted to HUD for continuation of the lightweight concrete development. The immediate work would include further material formulation, a study of manufacturing characteristics, and a study of the performance of steel reinforced sections.
- 3. Discussions have been held with Skidmore, Owings and Merrill, Architects/Engineers and the E. J. DelMonte Corporation to conceive a commercial, project oriented application of the new material to a modular building system.

Goals

- 1. Obtain government funding of continued lightweight concrete research and development.
- 2. Solidify and commence a joint effort with Skidmore, Owings and Merrill and the E. J. DelMonte Corporation to develop and market a building system utilizing the new lightweight concrete.
- 3. Assuming continued favorable economic indications, develop a source of Dow expanded ceramic aggregate.
- 4. Investigate the requirements and economic potential of a broader scope of applications of lightweight concrete.

PRESSURE RELIEF JOINT FILLER - J. L. Borin

The evaluation and/or use of Dow Pressure Relief Joint Filler in over 20 states was responsible for sales approaching nearly 150 M board feet in 1971. Increasing LTL and LTC quantity sales encouraged us to sign a distributor agreement with W. R. Meadows of Chicago.

National recognition of concrete pavement growth as a costly and hazardous problem prompted an ASTM draft specification for pressure relief joint filler and in addition, equipment has been designed expressly for cutting relief joints in concrete pavements.

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Accomplishments

1. We successfully changed all customer thinking, production, and sales orientation to encompass the new higher density, black foam.
2. We expanded our sales to 14 new states and municipalities and installed evaluation joints in 11 others previously unfamiliar with the product.
3. W. R. Meadows and its nationwide network of dealers signed an agreement with us to purchase and resell 250 M board feet of Dow Pressure Relief Joint Filler from September 1971 to September 1972. Our own salesmen will continue to specification sell and compete with Meadows on truckload and carload quantity sales.
4. We have effectively delineated those adhesive products which will function compatibly and effectively with our material.
5. Through the use of controlled comparison conditions, and the cooperation of Michigan Department of State Highways, we successfully demonstrated "blow-up" protection on adjacent stretches of pavement on U.S. 23.
6. The final draft of an ASTM specification was produced which has been submitted to the subcommittee for approval by letter ballot.
7. We successfully introduced and sold Dow Pressure Relief Joint Filler in the south and mid-south, where "blow-ups" were reportedly no problem.
8. Along with others, we generated an increased awareness of the pavement growth problem which has prompted two equipment manufacturers to design products specifically for cutting pressure relief joints. This equipment with its speed and ease of operation could greatly enhance our sales of joint filler.

Goals

1. Function actively within the ASTM subcommittee to ensure action on and passage of the proposed specification.
2. Continue to provide technical assistance to our sales effort.

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- 3. Develop a more satisfactory, new construction installation technique.
- 4. Aggressively pursue state specifications in those states presently using material without an adequate spec.
- 5. Function as a "sounding board" and problem solver for off-spec material complaints.

REFLECTIVE BEADS (S/DVV) - J. L. Borin

Although our level of effort in 1971 was not high, electron microscopic examination of beads exposed to field conditions revealed the flaw which may have caused the reflectivity losses. Lab simulated tests have been initiated to determine whether "purified" materials are affected similarly.

Goals

- 1. Complete lab testing and microscopic examination of "purified" samples versus control.
- 2. If results of lab tests are encouraging, participate in the 1972 Michigan State Department of Highways field tests, held every two years to evaluate new stripping materials and reflective products.
- 3. Examine the economics of "purified" materials.

RODENT REPELLENT FOR STYRFOAM - E. L. McMaster

Accomplishments

- 1. Availability, price, toxicology data and samples of the proposed chemical additives for rodent repellent foam were procured from the manufacturers. Also the Differential Thermal Analysis and Thermo Gravimetric Analysis were determined for each of the materials to determine their explosive sensitivity. The foregoing was furnished to the Foam Products Research Lab for Brabender Plasti-Corder and pilot plant studies.
- 2. Samples of pilot plant STYROFOAM containing 1 and 2% of tri-n-butyltin fluoride and 2 and 3.5% of tri-n-butyltin chloride were submitted to WARF Institute, Inc. for wild mice repellency studies. Under the test conditions, the panels incorporating the repellents in the foam were not effective in repelling wild field mice. A laboratory research report (FPS-435-4310304-1) was completed.

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Goals

1. Investigate economics of surface coating the exposed foam face and edges of insulated agricultural foam panels (XF-4019).
2. If the market can afford to pay for such a treated panel then efforts will be made to formulate the hand applied coatings to all four edges and the exposed face of the XF-4019 panel for subsequent testing with mice.

SPIRAL GENERATION--DOW DOMES - H. S. Smith, G. L. Emig, C. R. TenEyck, S. J. Waling

Technical service and engineering support was provided to the Environmental Control Systems for their Dow Domes Construction Group.

Accomplishments

1. Continued engineering support for design, construction, field testing and quality control of Dow Domes.
2. A partial solution to the vertical foam cracking problem caused by solar radiation was determined.
3. Redesign of the edge ring on large domes to significantly reduce costs and installation labor was accomplished.
4. Began a program to evaluate compatibility of Dow Latex 460 and shrinkage compensating cement. Completed an experimental field application of latex modified concrete with shrinkage compensating cement which demonstrated reduction of shrinkage cracks in the shell.
5. Incorporation of METHOCEL® 228 into the finish coat mix has reduced the cracking in the finish coat and improved the appearance of the completed dome.
6. Initiated research into the use of #10 wire as the weld-line reinforcement for the foam shell, to increase our size capabilities with minimum equipment modification and reduced production costs.
7. Reevaluated our field pull-testing program and purchased more reliable equipment.
8. Design a product specification for the STYROFOAM dome stock and carried out a testing program to determine optimum foam properties such as strength and flexibility.

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9. Developed a computer program for plotting a critical envelope for the dome shape. The actual dome profile is plotted on the curve in the field, to be maintained by Environmental Control Systems as a permanent record.

Goals

1. Continue engineering support, quality control and testing of Dow Domes.
2. Improve latex modified concrete quality control through the use of automated mixing equipment.
3. Utilize shrinkage compensating cement for domes requiring a water resistant shell and continue to investigate the behavior of latex modified concrete with shrinkage compensating cement.
4. Revise the Dow Domes Design Manual.
5. Investigate Dow Domes and various materials handling equipment combinations for bulk storage applications.
6. Continue the foam testing program.
7. Complete investigation into the use of #10 wire weldline reinforcement.
8. Investigate air supported and buckle shell forms for non-circular shapes.
9. Complete the computer design program to assure safe design procedures at reduced costs.

SPIRAL GENERATION, FOAM-IN-PLACE - H. S. Smith, A. J. Palfey

The follow-on contract funded by the U.S. Army to test the Spirally Generated wall sections produced in the initial feasibility contract was completed. The testing indicated that shell structures up to 100 feet in diameter could be produced with the general cross section designs developed.

A second follow-on contract for \$295,000 was awarded to design, build and test a complete field unit for the fabrication of shell structures by the foam-in-place technique. This project is actually supported by the Air Force and will be developed for the fabrication of hangars, shops, and other base facilities.

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The work will require approximately two years for completion. This method of Spiral Generation is of interest to the military because these long span structures can be built at distant locations with minimum manpower, equipment, time and logistical support. Also very inexpensive buildings can be fabricated for relatively short term situations.

Accomplishments

1. Tests on Spirally Generated wall sections were completed.
2. Analysis of the wall section tests with fire and water resistant paper skins indicated that structures up to 100 foot diameter would meet design performance criteria.
3. Preliminary work on the design of the field spinning unit was initiated.

Goals

1. Complete prototype wall section designs.
2. Test new wall designs.
3. Complete engineering of the field spinning unit.
4. Develop a program for utilization of the foam-in-place Spiral Generation concept to insulate liquid natural gas storage tanks.

SPIRAL GENERATION, APPLICATION TO LNG TANKS - H. S. Smith, K. F. Nacke, F. N. Giachino

The need for ship transportation of Liquefied Natural Gas (LNG) is now a reality. A number of relatively small developmental ships have been built and operated in the last six years. Today ships capable of carrying 120,000 M³ or more of LNG are being built. Much of the technology utilized in ship tanks was developed in Norway. At the request of Dow Europe, we are cooperating with the Moss-Rosenberg shipyard who have been a leader in Norway and the world for the design and building of ships for low temperature gas transportation. This firm has licensed leading shipyards in Europe, Japan, and the U.S. to build tankers using their designs which utilize spherical, pressure vessel, tanks.

We have concentrated on adapting the Spiral Generation technique to automatically apply insulation systems to the LNG tanks. This approach makes practical new improved designs, reduces manpower, and speeds up the installation process.

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Accomplishments

- 1. The feasibility of an outside the tank STYROFOAM insulation system fabricated by the Spiral Generation technique for LNG service was demonstrated.
- 2. A contract valued at \$450,000 to develop spiral generation equipment and the insulation cross section for Moss-Rosenberg built ships at Stavanger, Norway was obtained.
- 3. Development work was begun on inside the tank insulation systems utilizing rigid polyurethane foam-in-place materials.

Goals

- 1. Complete spiral generation equipment and STYROFOAM insulation cross section development work for delivery in Norway by November 29, 1972.
- 2. Obtain funding either by the U.S. Government or private sources for an evolutionary program to develop spiral generation foam-in-place urethane equipment and systems. First emphasis will be for application to the exterior of the tanks, then evolve to inside the tank systems.
- 3. Evaluate the possibilities of utilizing the Dow Spiral Generation-LNG concepts to land storage tanks.
- 4. Evaluate the new LNG Spiral Generation equipment and processing techniques for the present commercial Dow Domes program.

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TESTING SERVICES - G. M Hart, R. B. Clipper

In addition to the specific accomplishments noted, consultation was provided on testing (especially cryogenic testing); and maintenance and safety of test equipment.

Accomplishments

- 1. Cryogenic Testing
 - A. Report No. PY-4310304-4 was written giving plate shear, tensile, and compressive test results at 75°F, -75°F, and -260°F on THURANE, STYROFOAM FR, STYROFOAM HD-300, and PZ-1623 (high density, fire resistant STYROFOAM).
 - B. Test enclosures were constructed from 4 inch thick PZ-1623 for the purpose of conducting compressive creep tests at -100°F and -260°F. Foam panels at

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top, bottom, and back were rigidly glued to the end panels. On cooling, to -260°F, large interior cracks which did not propagate to the exterior surface were noted.

- C. Jigs were made to machine and hold for testing a dumbbell foam tensile specimen (ASTM D-1623, Type A specimen). This because earlier tests at cryogenic temperatures using foam adhered to metal tensile jigs (ASTM D-1623, Type B specimens) showed poor properties due to differential shrinkage between the foam and metal.
- D. An apparatus, modeled after one developed at Battelle, was assembled to measure thermal contraction of rigid plastic foams down to -260°F.

2. Compressive Creep

The principle of time-temperature superposition was used to predict the creep behavior of STYROFOAM PZ-1623. Report No. FPS-435-4310304-5 was written which gives the results of compressive creep run at 73°F, 104°F, and 123°F. A predictive curve based on these runs indicated that at 73°F, we would be below 3% creep at 40 psi load in 20 years. Time-temperature superposition theory says that at cryogenic temperatures, creep will be less than at 73°F. Tests at lower temperatures are underway to confirm this.

- 3. A brochure was written for W. A. Dunlap giving simple field procedures for the identification of common plastic foams. These identification procedures were requested by Fire Underwriter inspectors.
- 4. A substantial revision and updating of the STYROFOAM panel handbooks has been prepared. Major revisions were made in the section on "Flexural Characteristics". As soon as the proposed revision passes a laboratory review board, it will be published as a laboratory report with publication as a bulletin by TS&D to follow.
- 5. A final report was published by the government on research contract DACA 39-70-C-0022 in May 1971 as Contract Report C-71-1, titled Latex Modification of Fast-Fix C-1 Cement for the Rapid Repair of Bomb - Damaged Runways by R. D. Eash, and G. M. Hart.

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Goals

1. Obtain compressive properties at 75°F, 145°F, 165°F, 185°F, and 205°F on SMA (styrene-maleic anhydride) foam, STYROFOAM HI (60 psi), THURANE PZ-3851.03 (50 psi), and PZ-1623.
2. Obtain cryogenic properties of the following Dow foams: STYROFOAM FB, STYROFOAM FR, STYROFOAM SM, STYROFOAM HD-300, PZ-1623, THURANE and CERAMIC FOAM. Tests will include tensile, flexure, compression, shear, and thermal contraction down to -260°F.
3. Continue compressive creep tests of PZ-1623 and STYROFOAM SM at 73°F and obtain creep curves at 30°F, -100°F, and -260°F (if possible) on PZ-1623.
4. Complete tests and write a report on compressive testing and short time compressive creep testing on varying thicknesses (single and multiple) of STYROFOAM SM and PZ-1623.
5. Pending acceptance, co-author a paper with C. F. Balazs on the use of time-temperature superposition to obtain the long time creep properties of STYROFOAM for the Third International Cellular Plastics Conference.
6. Evaluate the procedure and mathematics used to obtain bond strength of mortar used in laying bricks. This principally involves relations between size and number of bricks used to construct and test prisms for flexural testing. Professors Clare Monk and Fred McGarry will be consulted.

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TRANS-ALASKAN PIPELINE SYSTEM - J. S. Best

Accomplishments

1. The concept for protecting Arctic permafrost from hot members such as a hot oil pipeline was pursued with The Alyeska Pipeline Service Company as to its application in construction of the proposed trans-Alaskan pipeline. The Alyeska Pipeline Service Company project description submitted to the U.S. Interior Department did contain a version of the Dow system for use where special construction techniques are required. Indications are that the Alyeska Pipeline Service Company sees the need for special treatment on at least 50 miles of the line.

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2. Laboratory studies of the Heat Sink behavior on the pipeline was set up during 1971 and is continuing into 1972. These studies are being conducted by DIGS Engineering.

Goals

1. Develop a manufacturing method to make high density polyethylene plastic modules of components for the Dow pipeline concept. The objective is to make a number of prototype Heat Sinks for field testing in conjunction with Arctic road and/or airport construction.

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CODES, INSURANCE AND SPECIFICATIONS

BUILDING CODES - W. A. Dunlap

The year 1971 was a year of paradox for the building codes. There was a fairly strong movement underway toward uniformity of codes across the country, being led by the model code groups attempting to resolve their differences and reach agreement on both content and format of their model codes. However, as a result of the three major fires in newly completed high-rise buildings during 1970, there was an emotional upsurge that something had to be done about the building codes for high-rise buildings. There were numerous publications during the year which indicated that high-rise buildings were being constructed with no regard to life safety. This in itself is somewhat of a paradox since high-rise buildings are statistically one of the safest type of buildings to be in. Most of the furor was raised due to five lives being lost in the three fires recorded in 1970. However, it should be noted that there were no lives recorded lost in 1969 nor in 1971 as a result of fires in high-rise buildings. There were numerous changes brought about by political pressure. One example of ridiculous over-reaction is in New York City where prior approvals of combustible insulation materials are being ruled invalid on the basis that the materials are combustible (even if the material is to be totally encased in masonry). Code changes or new interpretations made under strong political pressure generally work against uniformity.

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The trend continues for states to become more involved with building codes under their jurisdiction as more states propose legislation to control factory built housing as well as job site construction. To date over thirty states have proposed or adopted state-wide building codes.

Another influence toward greater uniformity is the federal government. Major cities which persist in restricting new materials by outdated codes have found federal funding being withheld from construction projects. A recent example is San Francisco which refused to permit use of plastic pipe in applications widely accepted in the rest of the country. Operation Breakthrough will also have some effect on modifying local codes to greater uniformity. Another influence that the Federal Government will have in the future is the OSHA Fire Protection Regulations published as a result of the Occupational Safety and Health Act of 1970. The OSHA regulations are primarily to ensure safe working conditions for employees; however, they literally have the authority to write building codes.

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Accomplishments

- 1. Obtained approval to use SARABOND in one major bank building in Philadelphia.
- 2. Obtained approval by the Board of Standards and Appeals to use SARABOND in the city of New York.
- 3. Combined separate approvals of THREADLINE and MONOWALL into one approval at ICBO and at BOCA.

Goals

- 1. Obtain general approval of SARABOND in Philadelphia.
- 2. Amend the New York City approval of SARABOND to permit the use of higher strength values.
- 3. Amend the New York City Approval of STYROFOAM to permit use under new code interpretation.
- 4. Revise the Uniform Building Code (ICBO) to include provisions for wall insulation (including foamed plastics).

INSURANCE - W. A. Dunlap

The insurance companies are still continuing to discourage all uses of plastic foam insulation. We have established good communication with members of the Factory Mutual System and Factory Insurance Association, both as an individual company and in conjunction with SPI activities. We have found the FM position to be much more reasonable than FIA. Basically FM will accept use of foamed plastics as insulation within a building providing it is covered with a non-combustible facing and the building is sprinklered. FIA, on the other hand, insists upon a thermal barrier good for 20 to 30 minutes between the foam and the inside of the room even with sprinklers. FIA will accept successful results from the corner test as an indication of meeting the thermal barrier requirements. FM suggests use of the corner test only for unsprinklered applications.

Accomplishments

- 1. Obtained FM Class I roof classification of an IRMA metal deck assembly.

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- 2. Obtained UL Fire Acceptable rating of an IRMA metal deck assembly.
- 3. Obtained UL Wind Uplift Class 60 on the Fire Acceptable IRMA metal deck assembly.
- 4. Obtained UL Class A roof covering for IRMA over wood decks.

Goals

Gain greater acceptance of foamed plastic insulation in reasonable applications by FIA and other stock insurance companies.

GOVERNMENT SPECIFICATIONS - W. A. Dunlap

This has been a relatively slow year for results in government activities of our products. We have several projects in process but they seem to require relatively long incubation periods.

Goals

- 1. Revise Federal Specification HH-I-524a to:
 - A. Provide realistic requirements for STYROFOAM.
 - B. Include provisions for higher compressive strength (higher density) material.
- 2. Revise Department of Defense and Corps of Engineering requirements that all building wall insulation (including cavity walls) have a maximum smoke developed value of 50 as determined by ASTM E-84.
- 3. Obtain national acceptance of SARABOND by FHA (material release or engineering bulletin).

MISCELLANEOUS ACTIVITIES - W. A. Dunlap

- 1. SPI Plastics in Construction Council.

We participated in a two day fire prevention seminar sponsored by the California State Fire Marshal in Sacramento. Our part of the program included a talk on foamed plastics and their applications. The seminar was attended by 205 men, representing 60 fire departments plus a few architects, Building Code and Industry representatives.

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2. SPI Coordinating Committee on the Safe Use of Plastics.

The purpose of this committee is to establish communication between the various segments of the industry including construction materials, automotive, furniture, etc., based on the premise that problems of flammability are common to all.

3. SPI Cellular Products Division, Flammability Committee.

This committee has become very active in the last year in promoting large scale fire tests primarily for the benefit of insurance interests to prove that plastic foams properly used offer reasonable risks. The first full scale tests will hopefully be conducted in the second quarter of 1972 and will probably involve rigid urethane and polystyrene foams.

4. ASTM Committee E-5.

This committee is charged with the responsibility of fire test methods for building materials, including E-84, E-119, and E-136.

5. NFPA (National Fire Protection Association).

Work on the subcommittee on plastics under the Building Materials Committee was resumed after a period of dormancy. The subcommittee is made up of representatives of the plastics industry, insurance interests and testing laboratories. The purpose of the subcommittee is to draft a guideline which will aid insurance underwriters in evaluating risks involving plastic materials and in making reasonable recommendations on their use.

6. BIMRC (Building Industry Manufacturers Research Council) - Fire Load Task Group.

This task group was made up of members of various industries including plastics, wood, steel, aluminum, etc. The task is to evaluate what is presently known about fire loads in buildings (combustible contents) and to propose additional investigation if necessary.

7. SFPE (Society of Fire Protection Engineers).

A talk was presented at the Fire Technology and Architect Seminar presented by the Detroit section. The subject of the talk was Fire Research on Plastics at Illinois Institute

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of Technology Research Institute sponsored by SPI. In addition to the fire protection engineers present, there were also about 35 architects in the audience.

8. BRI (Building Research Institute).

As representatives of the SPI, a one day seminar on Plastics in Construction, was presented to the Building Research Institute Fall Conference. Our part of the program was Plastic Foam Applications.

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STAGING STATUS REPORT

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PRODUCT PZ No.	DATE ADVANCED TO				PRODUCT DESCRIPTION
	I	II	III	IV	
1586			2/68	1/71	STYROFOAM for Sandwich Panel Core.
1614.01			9/69		STYROFOAM GR for Bouyancy
1623.00		4/69	4/70	1/71	SE High Density STYROFOAM for LNG Tanks
1623.01				11/71	SE High Density STYROFOAM for Explosives Storage.
1641.01				1/70	Dow Sheet Finish
1641.02				6/70	Dow Sheet Finish Clad Plywood
1703.00		5/69			Styrene-Maleic Anhydride Co-polymer Foam.
1703.01		10/70			SMA Foam for Pipe Covering.
1703.02		1/71			SMA Foam for Panel Cores.
1703.03		3/71			SMA Foam for Roof Insulation
2020.03		7/71	7/71		Flame Resistant Urethane Foam
2292.21, .31, .61, .81			1/68		Cargo Containers
3679		7/67			Tension Rod & Spline
3744, .01		9/67	8/69		Ceramic Foam Insulation Grade
3745		11/68			Ceramic Foam Refraction Grade
3851.03		5/71	10/71		2.7 lb/ft ³ THURANE.
3851.05		6/71			2.4 lb/ft ³ THURANE.
4139.19		5/66	2/67	10/67	ETHAFOAM - 4 pcf Density
4139.21	4/67	9/67			SE ETHAFOAM Tubing
4139.22		5/66	2/67	10/67	ETHAFOAM - 6 pcf Density
4139.28	9/70		12/71		Fine Cell Polyethylene Foam Plank.
4139.29	12/70		6/71	10/71	Self-extinguishing Sheet for Auto Floor Underlayment.
4595		1/68			Fiberglas Board Mfg. by Certain Teed for Low Temp. Space Applications.

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PRODUCT FP NO.	DATE ADVANCED TO				PRODUCT DESCRIPTION
	I	II	III	IV	
4005.00	12/70		6/71	10/71	Self Extinguishing General Purpose ETHAFOAM Sheet.
4005.01	12/70		6/71	10/71	Self Extinguishing General Purpose ETHAFOAM Plank.
4009	5/71				ETHAFOAM With Antioxidant Additive.
4021		7/71	10/71	11/71	Low Density, gray, extruded polystyrene foam for test market in comfort markets.

PRODUCT XF No.	DATE ADVANCED TO				PRODUCT DESCRIPTION
	I	II	III	IV	
4019		7/71			Insulated Agricultural Panel
4040					DERASPAN Urethane Core Panel.
4041.00L		6/71	12/71		Open Celled Polyurethane Floral Foam.
4047L	10/71	12/71			Two component THREADLINE System.

PRODUCT NC NO.	DATE ADVANCED TO				PRODUCT DESCRIPTION
	I	II	III	IV	
1556L		5/67			Soil Erosion Control
1662		1/68			DL 464 + DC Antifoam B.
1663		1/68			Blended DL 464 and DL 460 + DC Antifoam B.
1740		8/68			SDVB Reflectorized Beads
1866L	4/69				Concrete Sealant and Water-proofing Agent.
1886L	4/69				Concrete Sealant and Water-proofing Agent.
2133			11/70	4/71	Dow Pressure Relief Joint Fil Lubricant Adhesive.

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PROJECT NO.	DATE ADVANCED TO				PRODUCT DESCRIPTION
	I	II	III	IV	
103		7/66	8/67		Insulated Roof Membrane Assembly Foamed Joint System.
106		3/63			
109		5/63		6/65	Frost Barrier Insulation.
CID 10311		10/69			Second Generation SM 100.
CID 10319		5/68	11/69		ETHAFOAM - Highway Compression Relief Joints.
CID 11883			1/69	3/70	SM 100 Bridge Deck Restoration.

PRODUCTS REMOVED FROM STAGING

NUMBER	DATE	DESCRIPTION
PZ-3961	4/71	Xylene Aerosol Spray Cans - Used with SARALOY which has been discontinued.
PZ-3962	2/70	Product Cancelled
PZ-2020.02	7/71	Cancelled-Replaced by PZ-2020.
NC 2152	12/71	Transferred to Sales.

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NEW OR SIGNIFICANTLY REVISED PUBLICATIONS
DURING 1971

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BULLETINS

- 172-125 ETHAFOAM Expanded Polyethylene Foam
- 172-556 Lighter, Stronger Recreational Vehicles with
STYROFOAM.
- 172-580 Comfort Insulated Wall Systems.
- 172-621 Prevent Pavement Blow-up with Pressure Relief Joints of
Dow P.R. Joint Filler.
- 172-627 Durable Concrete Roadway Surfaces with Dow Paving
Systems.
- 172-629 Protect Buried Cable with ETHAFOAM Plastic Foam.
- 172-632 Calcium Chloride in Portland Cement Concrete.
- 172-642 THURANE Brand Plastic Foam.

SWEET'S CATALOGS

- 172-576 Insulation for Pipe and Vessels
- 172-577 Low Temperature Insulation and Systems
- 172-578 Polyethylene Foam Sealant Backer
- 172-579 THREADLINE Brand Adhesive Mortar for Block Masonry
Construction.

TECHNICAL DATA SHEETS

- 172-145 Dow Insulation Mastic No. 7

RED BORDER - DEVELOPMENTAL PRODUCT TECHNICAL DATA SHEETS

High Density Urethane Foams

FP-4021 Foam

PZ-1614.01 - Gasoline Resistant Buoyancy Billets.

STYROFOAM SM Brand Plastic Foam For Artificial Ice Rink
Floors.

PZ-1623 Plastic Foam

Procedure and Table for Determining Thickness of
PZ-1623 Extruded Polystyrene Insulation.

PZ-1703.01 Plastic Foam

PZ-1703.02 Plastic Foam

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STATISTICS

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	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
A. <u>Training Courses Conducted</u>							
Total	18	12	15	25	50	55	11
Sales Training	14	10	2	3	11	44	4
B. <u>Patent Activity</u>							
Disclosures					14	11	5
Cases Filed	3	1	2	14	8	8	2
Patents Issued	3	4	0	11	8	3	4
C. <u>Talks Given</u>							
Non-Dow Groups	20	61	51	77	111	106	90
Dow Groups (Other than Sales)	11	3	5	32	17	30	21
D. <u>Articles Published</u>	7	2	3	13	9	11	5
E. <u>PZ & NC Materials</u>							
Taken Out	8	15	13	9	12	15	18
Advanced to Sales	9	5	2	3	2	1	1

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