

GEORGIA-PACIFIC CORPORATION
BESTWALL GYPSUM DIVISION

PLAINTIFF'S EXHIBIT

GP-1314

R&D REPORT FOR LAST 6 MONTHS OF 1965

<u>TABLE OF CONTENTS</u>	<u>PAGE NUMBER</u>
Foreward - - - - -	1
Market Performance of New Products - - - - -	2
Chart of Increasing Sales and Profits Resulting from Research- - -	3
1965 Distribution of R&D Expenditures- - - - -	4
 <u>PROJECTS COMPLETED</u>	
Vinyl Joint Compound- - - - -	5
Ready Mix Joint Compound- - - - -	8
Dens-Cote Projects- - - - -	8
Trowel Finish Plaster - - - - -	9
Firestop Tile Backer Board- - - - -	9
Cooperative Fire Tests with Owens-Corning - - - - -	10
Sound Test Program- - - - -	11
Assistance to Sales - - - - -	14
Assistance to Legal Department- - - - -	14
Plant and Quality Problems- - - - -	15
Particle Size Studies - - - - -	15
 <u>PROJECTS NEARING COMPLETION</u>	
Fire Rating for Dens-Cote Partition - - - - -	17
Pre-Decorated Wallboard - - - - -	17
 <u>PROJECTS UNDERWAY</u>	
Industrial Uses for Gypsum- - - - -	19
Firestop Formula- - - - -	19
Glass Fibers in Wallboard - - - - -	20
Special Densite Products- - - - -	21
Hummer System Studs - - - - -	21
Synthetic Gypsum- - - - -	22
Lightweight Wallboard - - - - -	23
New Grainboard Products - - - - -	26
Gypsum Acoustical Tile- - - - -	26
Weight Reduction of 5/8" Firestop - - - - -	27
Glass Fiber Reduction of 5/8" Firestop- - - - -	28
One Hour Partition with 1/2" Firestop - - - - -	28
Microscopic Studies - - - - -	29
Steel Roofdeck with Lightweight Metro Mix - - - - -	32
Gypsum Firedoor Filler - - - - -	32
SUMMARY- - - - -	34

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FORWARD

This report covers the activities and accomplishments of the Research Department for the past six months. Since this is the year-end, some of the figures shown encompass the results for all of 1965 as well as for the six month period.

The total research budget for 1965 was \$184,000. The total expenditures were \$186,790 and the approximate distribution of this expenditure is shown on page 4. The total budget for 1966 will be \$210,000 and plans are to proportion this expenditure in approximately the following manner:

Fundamental or exploratory investigations	15.0%
Wallboard and Joint System	12.6%
Lath and Plaster	3.8%
Industrial Gypsum Products	9.6%
Fire, Sound, and Structural Systems	24.5%
Acoustical Tile	10.3%
Plant Problems	1.6%
Other	5.8%

The budget provides for the addition of two new men, one of which has already been obtained. Mr. Maturo, was transferred to Paoli from the Grand Rapids plant and will be handling all of the research on industrial gypsum products. Another addition to the Research Staff is planned later in 1966.

The market performance of new products on page 2 shows the sales and estimated gross profit from the products which have been developed through research. The graph on page 3 shows the growth of Bestwall sales and profits from research since 1961. These figures do not include cost savings, product improvements, or the effect of such work as fire and sound testing. The sale of Firestop continues to increase with 1/2" up 157% and 5/8" up 15.6% in 1965 compared with 1964 sales. Joint System production, an area where a lot of effort has been devoted to product improvement, shows an increase of 5.1% in sales not including Ready Mix which has also gained. A new product called "Triple Duty Joint Compound" will be released nationwide after undergoing comprehensive field testing and finally being marketed in four sales districts to further evaluate its potential. Even with such a limited distribution, approximately 800 tons of Triple Duty were sold during the past 6 months.

The main section of this report is devoted to progress of the individual projects during the past six months. Those which have been completed are listed first, followed by those which are nearing completion, and finally those in which work is underway.

1965 MARKET PERFORMANCE OF NEW PRODUCTS

<u>PRODUCT</u>	<u>SALES VOLUME</u>	<u>LAST SIX MONTHS</u>	<u>ESTIMATED GROSS PROFIT</u>
		<u>GROSS SALES</u>	
Dens-Cote Base (all)	8460 M sq.ft.	\$ 351,227	\$ 91,696
Dens-Cote Plaster (all)	1665 tons	98,612	11,251
Tile Backer Board	1278 M sq.ft.	98,875	29,884
Tru-Grain Wallboard	523 M sq.ft.	36,059	3,404
Firestop 120 Tile	443 M sq.ft.	59,557	12,532
Triple Duty Joint Comp.	800 tons	141,840	23,236
Ready Mix Joint Comp.	39,501 cans	154,172	5,228
One Day Joint Comp.	125 tons	35,316	6,153
Bestex A, B and C	14,385 bags	36,516	874
Model Densite	17 tons	807	274
Ram Process Plaster	6.6 tons	650	278
High Expansion Densite	1.1 tons	59	-
Dens-Cote Tape	11,579 rolls	12,145	4,862
Tile Backer Tape	227 rolls	1,608	746
Grabit Adhesive	137 tons	11,217	3,116
TOTALS		\$1,038,660	\$193,534

<u>YEAR 1965</u>		
<u>SALES VOLUME</u>	<u>GROSS SALES</u>	<u>ESTIMATED GROSS PROFIT</u>
14,223 M sq.ft.	\$606,683	\$172,493
2698 tons	160,809	17,837
2091 M sq.ft.	161,651	50,407
809 M sq.ft.	54,051	4,151
755 M sq.ft.	102,846	22,893
915 tons	162,540	29,296
60,840 cans	239,819	17,286
346 tons	74,543	14,215
17,915 bags	50,067	2,247
35 tons	1,659	557
6.6 tons	650	278
1.2 tons	64	-
20,806 rolls	21,040	8,301
436 rolls	3,042	1,532
191 tons	20,105	6,273
	\$1,659,569	\$347,766

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\$1,600,000

1,400,000

1,200,000

1,000,000

800,000

600,000

400,000

200,000

SALES & PROFITS

FROM NEW PRODUCTS

\$30,322

\$12,783

\$235,179

\$71,849

\$755,595

\$243,455

\$1,659,569

\$347,766

Sales -

Profits-

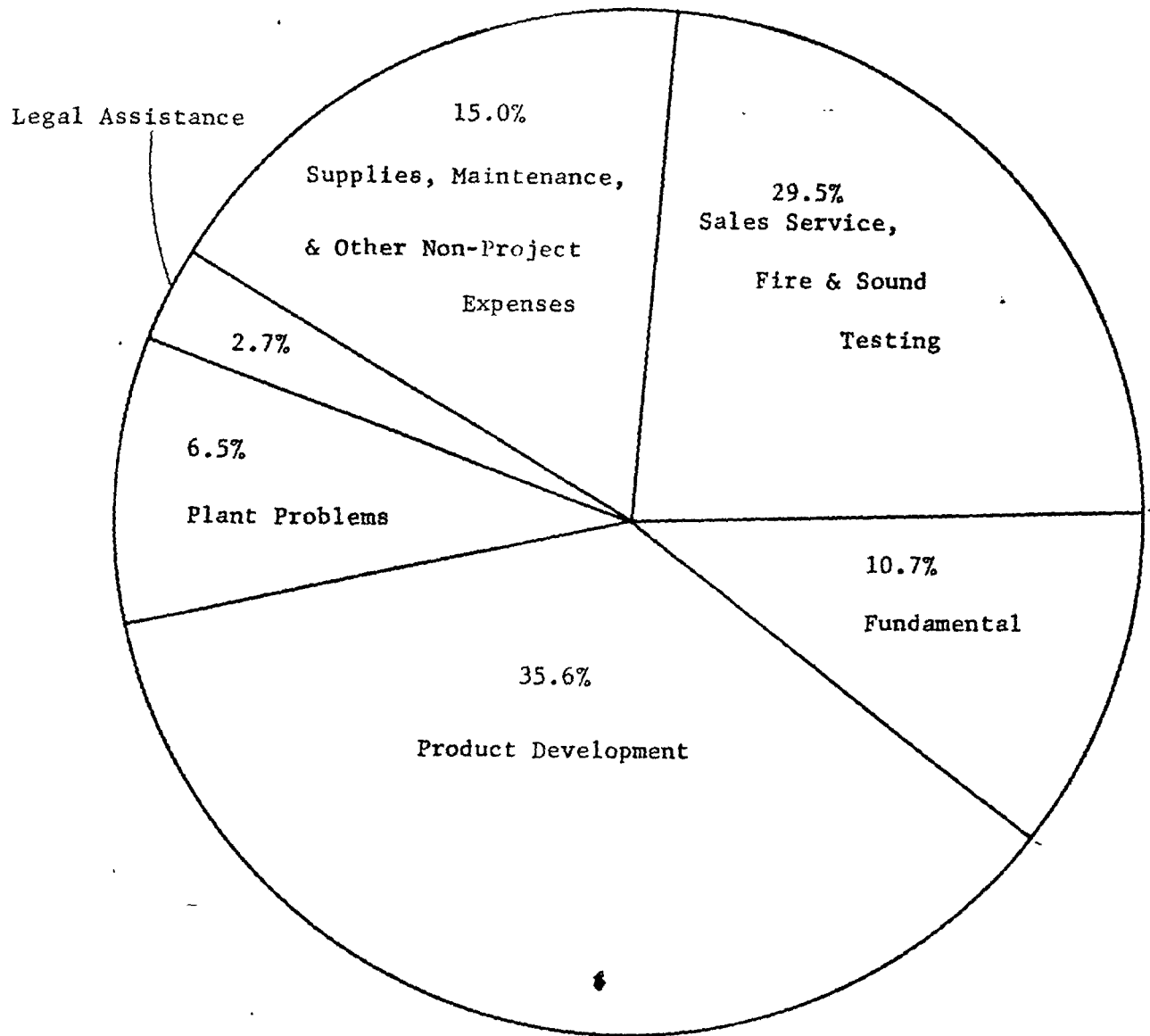
1962

1963

1964

1965

1965 RESEARCH EXPENDITURES



PROJECTS COMPLETED

1. DRY VINYL JOINT COMPOUND - R&D 211

Objective:

To develop joint system products with vinyl or other synthetic resin binders.

Investigation:

This product was under development for about four years without any degree of success. At one point the objective was a vinyl topping compound, but Sales advised us that they were not interested in this product, and dropped the project from their list. In spite of our previous lack of success and the low level of sales interest, two factors caused us to continue the experimentation. One factor was the sharply increasing cost of casein, which started early last year. The increase in casein cost induced us to consider other binders, even the higher priced vinyl binders. The second reason was a formulation breakthrough made by Mr. Morrone which permitted certain previous bonding limitations of vinyl joint compounds to be overcome.

After successful field testing with one customer, the vinyl joint compound was tried by other contractors in the Wilmington Sales district. Finally it was released for sale in the entire district. Some slight formula modifications were made from time to time to improve the product. After a few months, the product was released for sale in the Brunswick, Detroit, and Cleveland sales districts to gain field experience in different climates. It was sold at a price slightly higher than our regular joint compound. During the past 6 months, 800 tons of dry vinyl joint compound has been sold in these limited market areas. Just recently, successful field trials were held in Chicago and on the West Coast. All of this experience has shown good acceptance for the product. Ageing and other testing in the Laboratory indicates that the product has no significant weakness.

Conclusions:

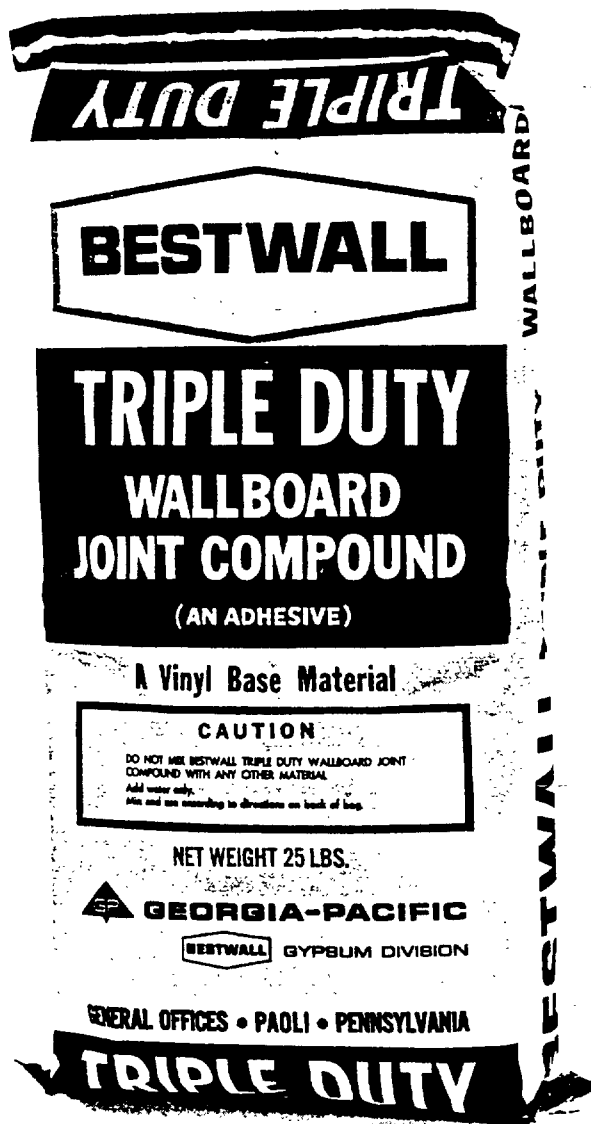
On the basis of the experience and testing which has been so successful, it has been decided to release the product nationally under the trade name "Triple Duty Joint Compound". The contractor advantages we plan to promote are:

- a. The single product can be used for taping, finishing, and texturing operations.
- b. It has lower shrinkage than regular casein products.
- c. It is easy to sand.

- d. It has excellent application properties.
- e. It has complete viscosity stability.
- f. It has outstanding resistance to spoilage.

The latter two advantages are of greater interest to contractors, since Triple Duty can be mixed in large quantities and put into pails for subsequent use - like Ready Mix. The company advantages for this product are:

- a. A more consistent product can be furnished, because synthetics are more uniform than casein. This should result in fewer complaints.
- b. The product is more resistant to being affected by adverse weather conditions and the like, so this should also contribute to a reduction in complaints.
- c. Easier and better manufacturing control can be achieved, because it requires fewer ingredients and there is no alkaline reaction to control, as we need to do with casein products.
- d. There is a better profit potential. Although there isn't much difference in the cost of Triple Duty and regular joint compound at the present time, the price trend for casein is rising and the price trend for vinyls is falling.



2. READY MIX - R&D 211

Objective:

To improve the quality and cost structure of Ready Mix Joint Compound.

Investigation:

In the last report it was noted that a new Ready Mix formula was being field tested in St. Louis. During the past six months the field testing was extended to Brunswick. Subsequently, both the Fort Dodge and Brunswick Ready Mix operations were converted to the new formula because of better acceptance in the field. Recently, Akron was also converted to the new Ready Mix.

Conclusion:

Since the new formula was adopted, our complaints on Ready Mix have largely disappeared, and the new product has received much better acceptance even by those who were satisfied with the old formula. In addition to the improved acceptance, the freeze-thaw and cold bonding properties have been improved. A raw material savings of \$.20 per pail also has been realized which will benefit the profit picture.

3. DENS-COTE PROJECTS - R&D 219

Objective:

To improve our Dens-Cote line by developing new products and by finding new uses for the current products.

Investigation:

A formula consisting of tubed stucco, graded sand, and a small amount of lime was developed to be used as a basecoat application of a two-coat system. The finish coat is the same lime-putty gauging which is used over regular basecoat plaster. Field testing was conducted in the Detroit and Syracuse areas, and the reaction to this product was quite favorable.

In cooperation with the Purchasing Department, an improved glass fiber tape was found. This tape is J. P. Stevens 10 x 10 mesh as opposed to the Owens-Corning 7 x 11 mesh, which we have been furnishing. The J. P. Stevens tape is stiffer and therefore easier to handle than the old tape. A number of rolls of the new tape were tried in the field and received very good acceptance. This was done in the "nick of time", as Owens-Corning has just announced that they are withdrawing from the glass fiber tape business.

Another facet of thincoat plaster which has been undergoing investigation is its application in radiant heating systems. This system involves the application of Dens-Cote Base to the ceiling joists; stapling the electric

)
radiant heating cables to the Dens-Cote Base; embedding the cables with Dens-Cote plaster; and finishing the ceiling with another application of Dens-Cote. Our texture finish Dens-Cote was tried first and the field tests were satisfactory. The smooth finish Dens-Cote is currently being evaluated, both in the field and in the laboratory. A small test house was built to provide means to test radiant heating systems of all kinds under actual conditions. Our smooth finish Dens-Cote and USG Red Top radiant heating plaster are currently being evaluated in the test house.

Conclusions:

The Dens-Cote Base plaster for the two-coat system has been made available out of Akron and Grand Rapids. A new Dens-Cote tape specification has been written, and all future purchases of this glass fiber tape will be of the improved type. A radiant heating system in which our texture finish Dens-Cote is used over electric heating cables has been approved, and a specification for use in promoting this system has been issued.

4. TROWEL FINISH PLASTER - R&D 228

Objective:

To develop a premixed finish plaster which can be used in lieu of the conventional lime-putty gauging finish which is mixed on the job.

Investigation:

After the initial laboratory work, two different formulas were tried in the Texas market where USG was promoting their premixed finish material. One of the two formulas was regarded as satisfactory. The formula which was considered acceptable consists of a mixture of 60% lime and 30% gauging, which is the normal proportion used in lime-putty gauging. The rest of the formula consists of limestone and clay to improve working properties and a retarder for set control.

Conclusion:

This product has been released for sale out of the Acme plant only and should be helpful in meeting the competitive situations in the Texas market.

5. FIRESTOP TILE BACKER - R&D 291

Objective:

To develop a 5/8" Firestop version of our water resistant tile backer board.

Investigation:

Laboratory investigations indicated that there should be no significant difference in fire resistance between Firestop Tile Backer and regular

Firestop. A short plant run was made to be certain there were no problems in manufacture. A fire test was then arranged with Underwriters' in response to our request that we wished to extend the ratings for partitions to this board. A wood stud partition (Design #5) was tested to compare performance with regular 5/8" Firestop Tile Backer. The construction passed the one hour test and provides the 1 hour rating for this construction. Some additional exploratory tests will be made by U. L. to determine whether they will extend the rating to include some other partition assemblies.

Conclusion:

5/8" Firestop Tile Backer will be added to our list of fire rated assemblies, and to our listing service. Sales now can promote its use in bathrooms between apartments where both the fire endurance properties and the water resistant qualities are required.

6. COOPERATIVE FIRE TESTS WITH OWENS-CORNING - R&D 210

Objective:

Develop 1 hour fire ratings for two metal stud partitions with 7/16" Fiberglas Noisestop and 1/2" Firestop board facings .

Investigation:

These partitions are representative of those being used in the large Mansion House job in St. Louis, Mo. The fire tests were conducted at the request of Sales to prove to the various persons involved in the Mansion House construction that the partitions will provide satisfactory resistance to fire. The fire tests were planned in cooperation with Owens-Corning who are also sharing in test costs. Sound tests were also arranged and these are reported under our sound testing program on pages 11, 12 and 13.

The first fire test was made at Underwriters' Laboratories and consisted of 2 1/2" metal studs, 7/16" Noisestop both sides, and 1/2" Firestop both sides. Underwriters' put thermocouples directly over fasteners, and the temperatures recorded over these fasteners resulted in failure at about 46 minutes. The test was nevertheless continued at our request, and it was 69 1/2 minutes before any of the other thermocouples exceeded the allowable temperature. We have lodged a strong protest regarding the U. L. procedure of locating thermocouples over fasteners.

In the meantime, it was agreed that if we could pass the hose stream test, we might convince certain building officials and code groups

(ICBO & BOCA) that the wall will provide the one hour rating, even though U. L. does not consider the test as meeting their one hour requirements. The hose stream test was successfully made, and we have asked U. L. for a complete letter report spelling out why the partition was failed; the fact that its performance otherwise was outstanding; and the fact that the hose stream test was passed. This report will be reviewed by us before it is issued and will be used to obtain the approval of the building groups mention above.

Another fire test was conducted at Ohio State University, consisting of 2 1/2" metal studs, 2" friction-fit glass fiber insulation in the cavity, 7/16" Noisestop on one side only, and 1/2" Firestop on both sides. This construction passed the fire test (Ohio State doesn't locate thermocouples over fasteners) but failed the hose stream test by 10 seconds. A second hose stream test was made and this time it passed.

Conclusion:

We have apparently been able to satisfy the requirements on the Mansion House job from the fire tests which were made. In addition, the ratings will be available to promote 1/2" Firestop in conjunction with Owens-Corning's Noisestop on other jobs. We will receive the benefit of Owens-Corning's promotion of these partitions, in addition to our own promotional efforts.

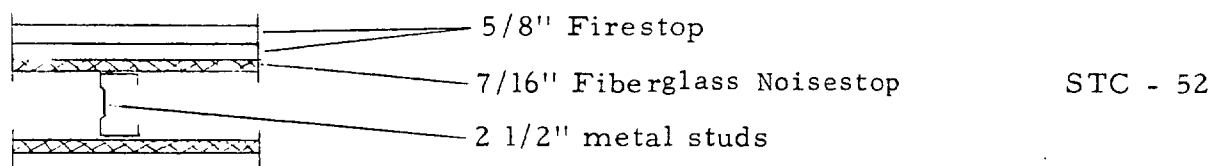
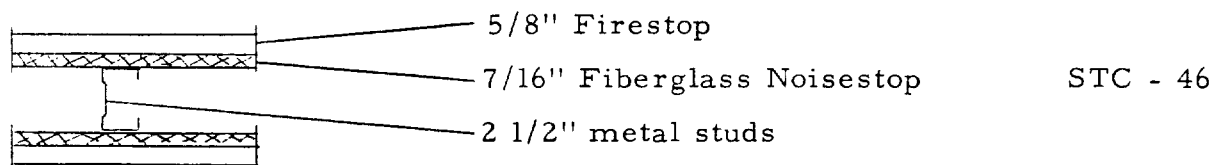
7. SOUND TEST PROGRAM - R&D 276

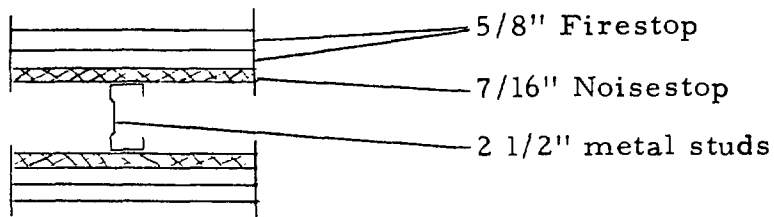
Objective:

To conduct sound transmission tests on a series of partitions at Ohio Research Corporation.

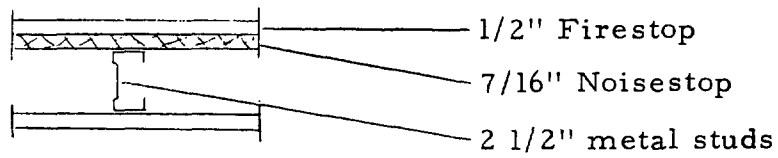
Investigation:

The following partitions were tested and gave the indicated resistance to the transmission of sound:

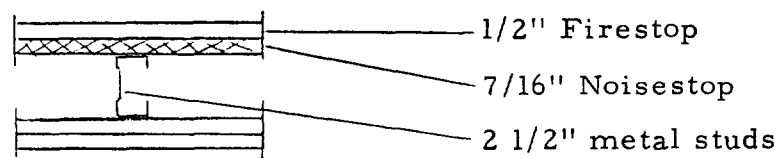




STC - 55



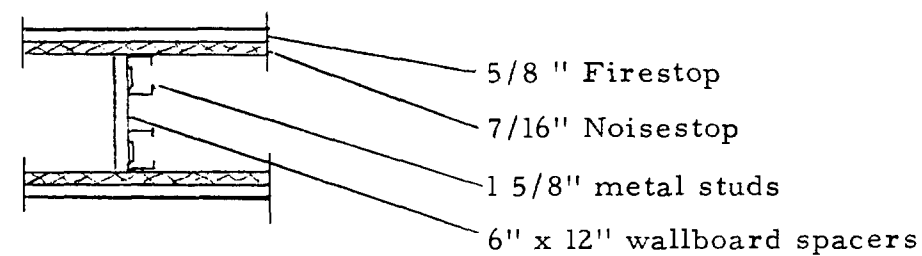
STC - 40



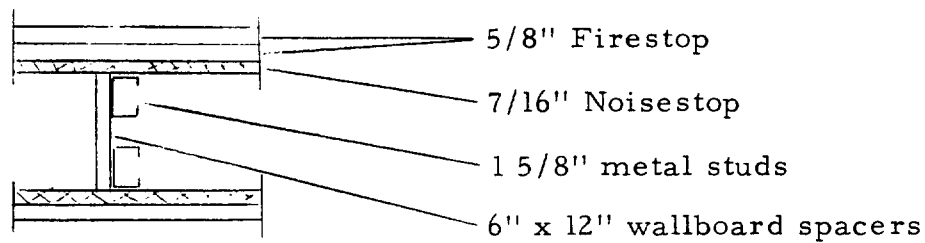
STC - 46



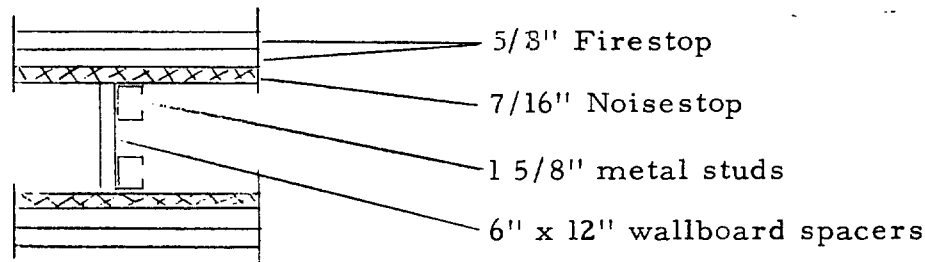
STC - 51



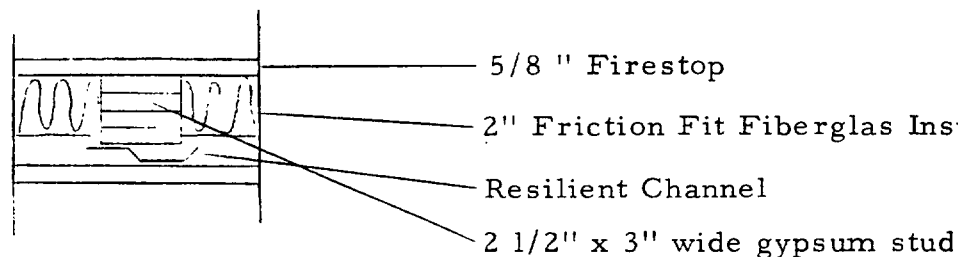
STC - 49



STC - 51



STC - 54



STC - 51

Conclusion:

The STC value is a one figure rating which means that a partition will provide a minimum amount of resistance to sound at each frequency and can thus be compared to other partitions on this basis. The higher the STC number, the better the performance. In general, an STC of less than 35 would be fair to poor; an STC of 35-45 good; an STC of 45-55 very good, and over 55 excellent. As can be seen, practically all of these partitions fall in the very good range. These ratings will serve as tools to promote the sale of our products.

8. ASSISTANCE TO SALES - R&D 5

Objective:

To provide technical information to the Sales Department.

Investigation:

We supplied the following information to Sales during the past 6 months:

- a. An impact test and a racking test were made on a metal stud partition with Fiberglas Noisestop and Firestop. This type of partition was found to have adequate resistance to impact. The racking test was made to approximate some of the forces that would occur in a flat slab construction. The latter test showed that tape wrinkling at the corners can be expected, but the metal studs will deform before the face boards crack, if severe crushing loads are imposed. Crushing loads may therefore be less critical for this type of partition.
- b. A wire stud lath and plaster partition was constructed and tested for impact resistance. This partition will subsequently be tested for sound transmission and fire endurance, so that it can be sold competitively against the same construction which USG is promoting in certain areas. The partition has satisfactory resistance to impact.
- c. Field sound transmission testing of one of the walls in the Beekman Towers job in New York City was arranged, and the tests were observed by us. The customer asked Sales for the information, and they in turn came to us.

Conclusion:

It is hoped that the data provided has helped our sales' effort and promotion of the products which were involved.

9. ASSISTANCE TO THE LEGAL DEPARTMENT - R&D 6

Objective:

To provide data as required to seek patents or to protect inventions for which patents have already been granted.

Investigation:

It was decided to try to patent the idea involving the use of portland cement to reduce the ageing of high-expansion plaster if this could be done with a minimum of effort. Two series of tests were made, and some of the

results were contradictory. At this point an even larger number of tests would be necessary, so it was considered not advisable in view of other more important work.

Other patent applications already submitted to the patent examiner include synthetic gypsum processing; One Day Joint Compound; Dens-Cote Base; Dens-Cote plaster; and Grabit Adhesive.

Conclusion:

We will not seek a patent on the high-expansion plaster with improved ageing properties, since the importance of getting a patent is not sufficient to justify spending the amount of time which would be required.

10. ASSISTANCE FOR PLANT & QUALITY PROBLEMS - R&D 2

Objective:

To assist with plant joint system quality problems and to train quality personnel to handle these problems in the future.

Investigation:

A training program was initiated in the first 6 months by Mr. Morrone to train Messrs. Murphy and Schaeffer to handle the joint system quality responsibilities at Paoli and Acme, respectively. This involved all joint system quality work including plant, field, and laboratory phases.

Also, Mr. Morrone made a trip to Brunswick to rework some ready mix joint compound and determine if it was possible to salvage about 850 pails which were considered unsatisfactory for a number of reasons.

Conclusions:

The training program was completed and Mr. Murphy has assumed the Paoli responsibilities and Mr. Schaeffer the Acme quality duties. This was a very successful program well conceived and well managed with the result that the trainees responded very well.

The 850 pails of low-quality ready mix at Brunswick were reconstituted and have been shipped without complaint.

11. PARTICLE SIZE STUDIES - R&D 263

Objective:

To be able to make particle size analyses of gypsum and other materials with the Coulter Counter. Sieve analysis often provides size determination of less than half of the material.

Investigation:

Coulter Counter particle analyses have now been made on many different stucco grinds, Densite products, limestones, and ground landplaster samples. In certain cases duplicate tests were made and it was found that the results are very reproducible.

Conclusion:

Mr. R. W. Hinkle has become very proficient in the use of the Coulter Counter so this provides us with a means for determining the particle size and distribution beyond what we were formerly able to do with sieves. Future particle analyses will be made in connection with some other project. As an example, the Coulter Counter is now being used in conjunction with the lightweight board project.

PROJECTS NEARING COMPLETION

1. FIRE RATING FOR DENS-COTE PARTITION - R&D 219

Objective:

Fire test a partition consisting of wood studs, 1/2" Firestop Dens-Cote Base, and Dens-Cote plaster to obtain a one hour rating.

Investigation:

It was decided to conduct the test at the University of California at Berkeley, since Pabco and Flintkote have obtained ratings on thincoat assemblies there. We previously tried to get a rating on a metal stud partition with 1/2" Firestop Dens-Cote Base and Dens-Cote plaster at Underwriters', but were unsuccessful. The University of California test appears to be less severe than Underwriters' because of lower loading (2000 lbs. /stud instead of 2400 lbs. /stud) and smaller partition size (9' height instead of 10'). Also, West Coast Sales are the ones needing the rating, since it is only being promoted on the West Coast by competitors. The University of California tests are not generally recognized in the rest of the country.

The fire test was passed, but the hose stream test did not pass. A second attempt to pass the hose stream test also failed. A series of small scale tests at Paoli subsequently has convinced us that the highly absorbent Dens-Cote Base is causing the water from hose stream to soak through quickly, thereby weakening the board and allowing the water to break through the partition. We have asked Pryor and Sigurd to make some special paper and Dens-Cote Base which will be used in exploring this problem further. As soon as the special 1/2" Firestop Dens-Cote Base is received, we should be able to determine whether it is advisable or not to run still another hose stream test at Berkeley.

2. PRE-DECORATED WALLBOARD - R&D 215

Objective:

Develop a product competitive to USG's Colorcast. This is a 3/8" wallboard product to which a coated and embossed paper has been laminated.

Investigation:

Through the G. P. Hopper Paper Division, a satisfactory coated and embossed paper has been developed which appears to be satisfactory in every respect. The only remaining problem is that the company who applies the coating (Hopper merely furnishes the paper) cannot coat the

necessary width for wallboard. Before they invest in equipment to accommodate greater widths, they would like to be assured of sufficient business to warrant the expenditure. Sales is now uncertain whether they want the product, since the original request was based on a large job which has long since been lost. A sales survey is currently underway to evaluate the market for such a product. It has been established that the product will be profitable if it can be sold in appreciable volume. The coated paper costs about 1.7¢ per square foot, and the end-product sells for 8¢ per square foot.

PROJECTS UNDERWAY

1. THE INVESTIGATION OF INDUSTRIAL USES FOR GYPSUM PRODUCTS - R&D 25

Objective:

This project was set up to permit exploratory investigations of Industrial gypsum products to take place before any definite project number is assigned. It will also include time which Mr. Maturo is spending becoming familiar with previous research on the Industrial product line.

Investigation:

Industrial Sales submitted a list of projects and subsequently presented an estimate of the potential of each project. The list includes lightweight roof deck, improved ram process plaster, improved tooling Densite, and improved Pottery plaster among their most urgent needs. The program will be submitted to management to have priorities assigned, so the program can be handled in an orderly manner.

A series of tests was made with various mixtures of perlite and gypsum to establish limits of perlite addition in regard to compressive strength and to enable the cost of these formulas to be calculated. Selling prices were obtained at various points surrounding Brunswick and Acme, which are the two plants where Sales feels they need to have lightweight Metro Mix. The figures show that we would stand to lose money on lightweight perlited Metro Mix unless there was some opportunity to obtain a better price for the product. The fact that USG has their own perlite deposit and expands their own perlite accounts for their ability to undersell us. It appears that we are up against an economic impasse in attempting to use perlite, and we need to find some other type of lightweight deck, if this can be done. Another aspect of lightweight Metro Mix is being considered in conjunction with Bethlehem Steel's slabform deck. This is reported under R&D 294 on page 32.

2. FIRESTOP FORMULA - R&D 76

Objective:

Improve the fire endurance properties of Firestop Bestwall.

Investigation:

It has been found that certain siliceous materials such as clay or colloidal silica improve the dimensional stability of gypsum during exposure to temperatures of over 1600°F. They also seem to act as

a binder at these elevated temperatures. In exploratory fire tests, the presence of an aluminum silicate clay (ASP 102) seems to provide outstanding fire endurance properties. Based on this finding, an investigation is underway to evaluate clays and other siliceous materials which hopefully will provide these improved fire endurance properties. One of our concerns is that National Gypsum or some other competitor may have already applied for a patent involving the use of clay. In conferences regarding our glass fiber patent, National Gypsum stated that they had applied for a patent on a new fire rated board formulation but we are uncertain, of course, as to what they are claiming. If the improvement in fire endurance can be realized, this may provide the means for us to manufacture a lightweight fire rated wallboard. We plan to push on with this work in spite of the possibility of a competitive patent. Then, if a patent does issue, we will be in a better position to know what action to take.

3. GLASS FIBERS IN WALLBOARD - R&D 131

Objective:

To evaluate new glass fiber types which will result in better quality or economics for our wallboard products.

Investigation:

Past investigations have involved different binders and finer filaments. Recently, a new high temperature resistant type of glass fiber (called "S" glass) was seen in a technical article by Mr. Sundberg. A sample was obtained from Owens-Corning and exploratory tests show this fiber does improve the fire endurance properties; but the cutting characteristics were unsatisfactory. At our request, another spool of type "S" glass was submitted by Owens-Corning and this sample had better cutting properties. Our tests indicate that the same fire endurance properties in Firestop can be obtained, with half as much type "S" glass. However, the type "S" glass is currently in short supply because of government uses, and it is priced at \$.96/lb. The type "S" glass is not too attractive at this time due to the high price, but it is conceivable that the price may be reduced in the future. In the meantime, our experiments are all being documented in the event that patent possibilities exist. Also, a sufficient amount of type "S" glass has been ordered to enable us to make a plant run to confirm our Lab results.

There are other types of experimental fibers being developed that may hold some interest for us. One of these is boron nitride. This fiber is said to withstand temperatures of 4800°F. Only experimental quantities are available, so we have ordered 4 ounces at a cost of \$75. It is felt that we must keep abreast of all new developments in this field.

4. DEVELOP SPECIAL DENSITE PRODUCTS - R&D 132

Objective:

Improve our tooling Densite, Ram Process Densite, and High Expansion plaster.

Investigation:

Sometime ago a small amount of development work was done on each of these products but without complete success. With greater emphasis being placed on the Industrial Gypsum product line, these projects will be resumed. The first step is to have Mr. Maturo become familiar with the end product uses. It has been recommended that Sales arrange visits to shops which use the various Densite products which we will be trying to improve.

5. ACCESSORIES FOR HUMMER SYSTEM - R&D 209

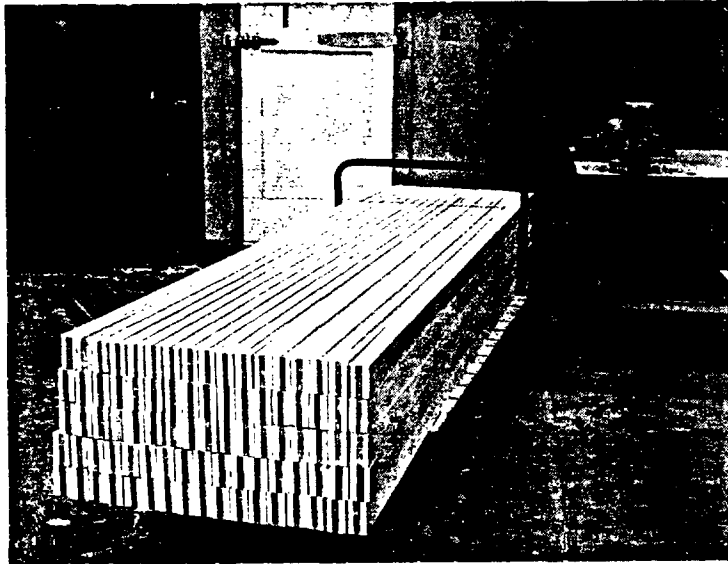
Objective:

Develop an improved type of stud for use in the Hummer System.

Investigation:

In one of our brainstorming sessions, a combination gypsum-plywood stud was suggested. This stud consists of a layer of plywood between two layers of wallboard. A few of these studs were made by laminating sheets of 5/8" wallboard, 1/2" plywood, and 1/2" wallboard together and sawing the composite into 3" widths. It was found that nail fasteners could be used to attach the face boards, and that a partition constructed with these studs would be sufficiently rigid. Over 100 studs were fabricated and will be used in a local field trial, to be arranged by the Sales Department. Some potential advantages of these studs are:

- a. They are lighter in weight than regular 6" wide gypsum studs.
- b. Nail fasteners can be used to attach face sheets to the studs.
- c. Electrical outlet boxes, baseboards, molding, etc., can be nailed to the studs.
- d. It may be possible that the adhesive normally required between the studs and the faceboards can be eliminated.



6. SYNTHETIC GYPSUM - R&D 221

Objectives:

1. To find a source of synthetic gypsum which is both useable and economical.
2. To revise and resubmit our patent application which covers our method of utilizing synthetic gypsum.

Investigation:

The sources of synthetic gypsum investigated to date include Coastal Chemical at Pascagoula, Miss.; Davison Chemical in Barton, Florida; Dominiguez Fertilizers in Compton, California; Best Fertilizers in Texas; and Olin-Mathieson in Joliet, Illinois. From these, we have had the most experience with the material from Coastal Chemical, since that was the synthetic used in the New Orleans plant trial last year. The Davison synthetic appears to be useable, but it isn't in a very satisfactory location. Olin-Mathieson has a sufficient supply of synthetic at a good location. but, as luck would have it, the hydration rate is very slow. We

are trying to find some way of improving the hydration. The Olin-Mathieson synthetic is a byproduct of the manufacture of sodium phosphate, rather than phosphoric acid, and this may account for the slow rate of hydration. Another sample of synthetic from National Phosphate Company at Marseilles, Illinois, has been requested and will be evaluated as soon as it is received.

The work on the synthetic gypsum patent application has been to develop information with which to convince the patent examiner that ground natural limestone will neutralize and therefore should be included in the scope of our patent claims. The Examiner is willing to allow precipitated chalk (synthetic calcium carbonate) but not the ground limestone. One of the problems has been to establish which limestones will be satisfactory. Although there is a difference in reaction rate, all of the ground limestone products tried seem to neutralize sufficiently. Another objective has been to establish limits for the use of both limestone and precipitated chalk. The revised application will be submitted shortly after the first of the year.

7. LIGHTWEIGHT WALLBOARD - R&D 255

Objective:

Evaluate fine grind stucco; the means of achieving finer grind; and the effect of fine grind stucco in producing a lighter weight wallboard.

Investigation:

Some preliminary work has indicated that finer grind stucco gives greater compressive strength at the same density. This information has been very meager however. With the Manufacturing Department starting a program of reduced weights in our plant operations, it was felt advisable to develop more information on the effect of fine grinding on wallboard core. A test program which will supplement the efforts of the Manufacturing Department is now in progress. There are two specific objectives:

- a. To evaluate various methods of reducing particle size.

A ton of Raymond grind stucco was furnished by Wilmington to use as the basic stucco (before subsequent grinding). Several hundred pound lots of this stucco (55% -325 mesh) were processed through the hammermill (76% -325), the Entolater (90% -325 mesh), Bauer Mill (100% -325), and Bauer Classifier (100% -325). A Coulter Counter analysis has been made on each of the above fractions, and this information has brought out some rather interesting facts. The Bauer Classified fraction is finer than the Entolater stucco, as determined by the screen test (100% -325 vs. 90% -325 mesh), but the Coulter Counter analysis shows that the

Bauer Classified stucco has a larger average particle size (13 microns vs. 10 microns). This is because the classified particles are of a more uniform size than the Entoleter grind, or any of the other ground materials for that matter. The different particle sizes can be seen rather clearly in the microphotographs shown below.

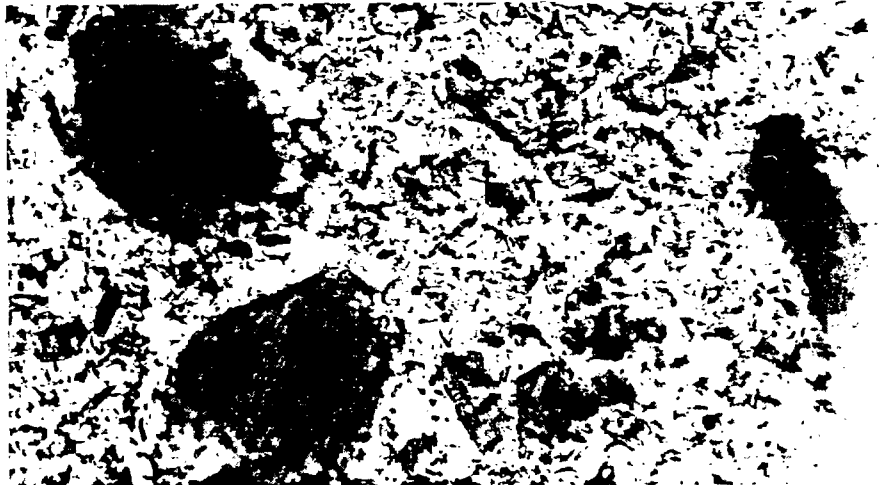
RAYMOND MILL GRIND

44 micron average
particle size



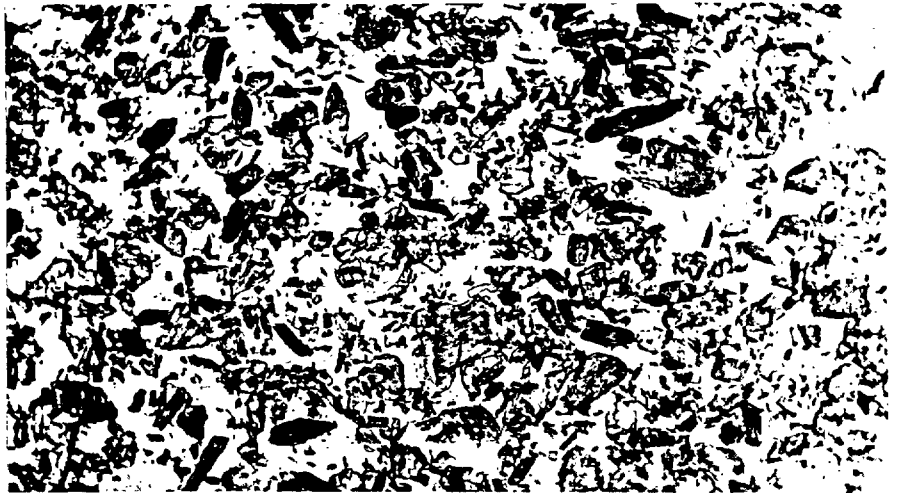
HAMMERMILL GRIND

21.5 micron average
particle size



BAUER CLASSIFIED

16 micron average
particle size



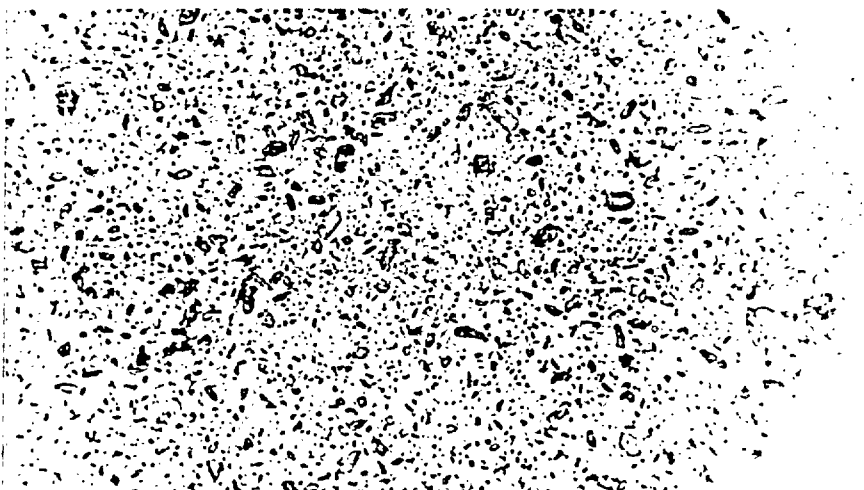
ENTOLETER GRIND

13 micron average
particle size



BAUER MILL GRIND

6.4 micron average
particle size



- b. The second specific aim is to relate fineness to wallboard weight. In other words, what fineness is optimum in producing the highest quality wallboard at the lowest possible weight? One criterion being used is compressive strength. Thus far, our figures show that the finer grind materials have greater compressive strengths. The Bauer Mill ground stucco (100% -325) is the lone exception. Perhaps this is an indication that the grind can be too fine. On the basis of these results it has been recommended and approved to install an Entoleter instead of a Hammermill at Blue Rapids.

The relation of fineness to other wallboard characteristics such as bond, core hardness, nailholding, etc., is currently being studied. It is expected that this work will bring out what needs to be achieved in the way of fineness to gain the maximum weight possible. We hope that it may reveal some approaches to even greater weight reductions than are presently contemplated.

8. NEW GRAINBOARD PRODUCTS - R&D 268

Objective:

To improve our present grainboard line.

Investigation:

Last year the project to striate or print and emboss black lines on our woodgrain products finished on rather a sour note when we were unable to print the lines on the vinyl covered fruitwood and cherry patterns. These patterns were subsequently discontinued, when there was no interest shown in them without the black lines.

A new approach is being made toward the problem of providing plank lined or striated grainboard items with abrasion resistant and washable surface. This approach is to apply a clear coating over grainboard on which the lines have already been printed. A clear coating material has been found, and the next step is to try some coating equipment. The application of a durable coating appears to be a very economical way of accomplishing our objective.

9. GYPSUM ACOUSTICAL TILE - R&D 274

Objective:

To develop a fire rated gypsum acoustical tile.

Investigation:

After a number of exploratory tests for sound absorption on our Standing Wave machine, a sufficient number of 2' x 4' x 3/4" thick tiles were cast, surface sanded, and painted for a full scale sound absorption test. The test was conducted at Kodaras Acoustical Laboratories in Long Island, New York. The NRC (Noise Reduction Coefficient) obtained was a very disappointing .50. While testing many different competitive tiles on the Standing Wave machine, and observing the results, it was observed that many of the competitive tiles were perforated. One of our tiles was also perforated, and the improvement in sound absorption was substantial. Based on this information, another set of tiles was cast, dried, painted, and this time perforated instead of surface sanded. The number and size of perforations was predetermined through a series of exploratory tests. This set of tiles gave an NRC of .60. Some Armstrong Fire-Guard acoustical tiles rated at .70 were tested at the same time, and they gave an NRC of .55. This proved two things: competitors' tiles do not necessarily conform to stated standards, and perforating is necessary to gain satisfactory sound absorption for our tile. Certain fiber tiles have enough natural surface openings and perforating is not necessary for good sound absorption.

Subsequent exploration brought out that the perforating was a difficult operation to perform with our limited facilities. The painting of the tile was another problem because the porous gypsum absorbed the paint like a sponge. Still another problem is the friability of the tile which causes the surfaces to wear off or dust, particularly at the edges. The latter of the two problems was overcome by finding a suitable tissue paper to use on the face of the tile. Indications are that the paper will give the tile a diaphragm effect and thereby also improve its sound absorption in the low frequency ranges. The next step is to form another set of 2' x 4' tiles with tissue paper facing, perforate them, and conduct another full scale sound absorption test. The perforating is quite tedious, so a small punch press is being fabricated to punch cleaner holes and punch them more quickly.

10. REDUCE WEIGHT OF 5/8" FIRESTOP - R&D 289

Objective:

To test a 2300 lb. /M 5/8" Firestop at Underwriters' in order to reduce the minimum weight to this level.

Investigation:

Our pilot fire tests indicated that we had a good chance of equaling the performance of our regular 5/8" Firestop, in either the 1 1/2 hour Design #13, or 2 hour Design #69. We also decided to reduce the glass

fiber content from 8 lbs. /M to 6 lbs. /M, since U. L. had reduced our minimum on 5/8" Firestop to 2415 lbs. /M by virtue of a previous test. The special Firestop failed to perform as well as we had hoped in the Underwriters' test and we did not achieve the lower weight. A study is currently being undertaken, as reported in R&D 76, page 19 , to improve the fire resistive characteristics of the board core. If this work is successful, another attempt will be made to reduce the weight by means of a U. L. test. A lightweight 5/8" Firestop with limited ratings has been discussed, but the decision was to develop one board to provide all of the present ratings rather than have two different fire rated products as some of our competitors do.

11. REDUCE FIBER CONTENT OF 5/8" FIRESTOP - R&D 290

Objective:

Conduct a fire test at Underwriters' to enable the glass fiber content to be reduced from 8 to 6 lbs. /M. The potential savings is \$25,000 annually.

Investigation:

The attempt to reduce glass fiber content was combined with the attempted weight reduction. As described under R&D 289, the performance of the board in Underwriters' test did not equal the performance of a previous test where the heavier board with more fiber was used. The results of the work to improve fire resistive qualities of Firestop will also be used to determine future possibilities of reductions in glass fiber content.

12. ONE HOUR FIRE RATED PARTITION WITH 1/2" FIRESTOP - R&D 292

Objective:

To find a means of obtaining a one hour rating for a wood stud partition faced with 1/2" Firestop.

Investigation:

It is now necessary to use 5/8" Firestop to get the one hour partition whereas one and two hour fire rated floor and ceiling assemblies with 1/2" Firestop are available. This often means having at least two different types of Firestop on the same job, so there would be considerable advantage to have the one hour rated partition with 1/2" Firestop. A few exploratory tests were conducted, based on some ideas that came out of a brainstorming session we had on this subject. The tests showed, however, that there is a wide difference between the performance at 1/2" and 5/8"

Firestop in fire rated partitions. Although no active investigation is being conducted at this time, the project has not been abandoned. It is possible that information developed in other areas of fire testing may shed some light on this problem.

13. MICROSCOPIC STUDIES - R&D 293

Objective:

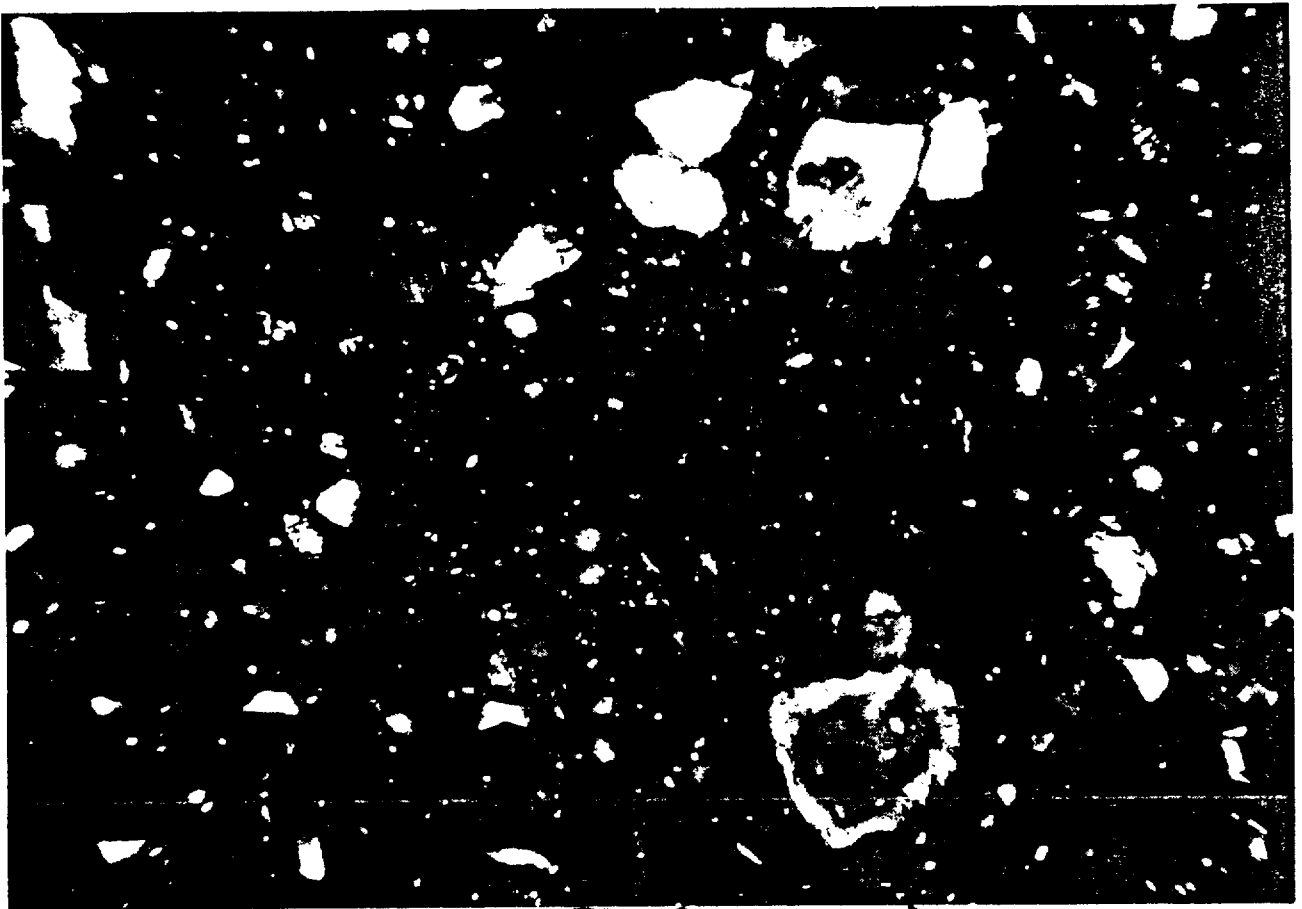
To investigate the uses to which we can put our polarizing microscope and to take maximum advantage of these uses.

Investigation:

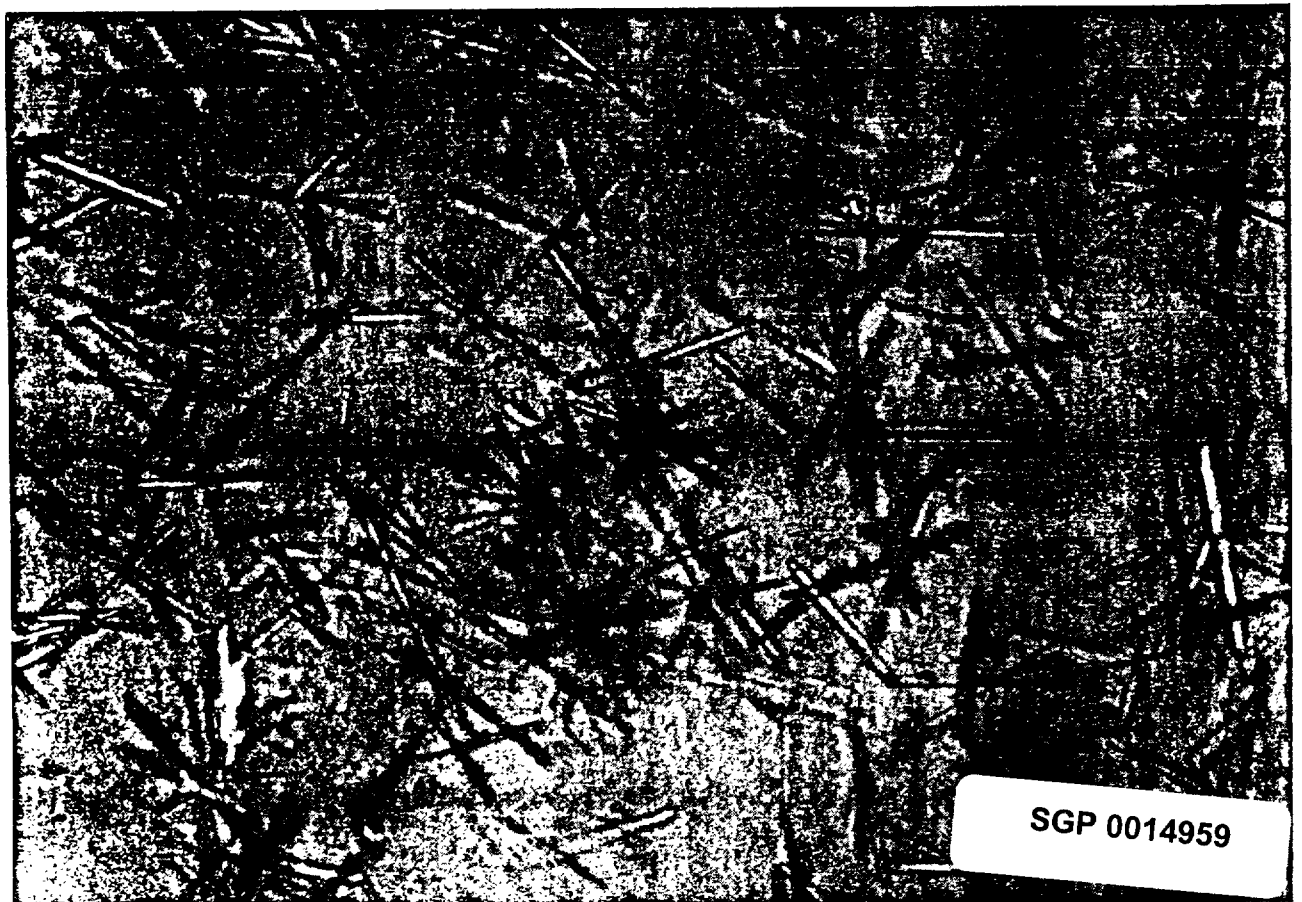
The Company has had a polarizing microscope for sometime, but it has not been used much in recent years, because we have not had anyone trained to use it. We received approval to have Mr. George Green attend a course offered by McCrone Institute in Chicago. McCrone is internationally known for their work in this field. It was found that we have a very good microscope, worth at least \$1500, but that certain auxilliary equipment would expand its use. The following accessories were purchased:

- A. Camera and Light Meter - This enables us to take pictures of microscopic observations. It is now possible to keep a record of important observations rather than trying to remember them.
- B. Additional Lenses & Objectives - These increase the magnifying power from 100X to 800X. It also permits very accurate measurements of fine particles and fiber diameters.
- C. Refractive Index Liquids - This set of liquids enables us to identify materials by their light refractive properties.
- D. Dispersion Staining Device - Two different materials in a mixture can be separated by each appearing as a different color through the use of this equipment.

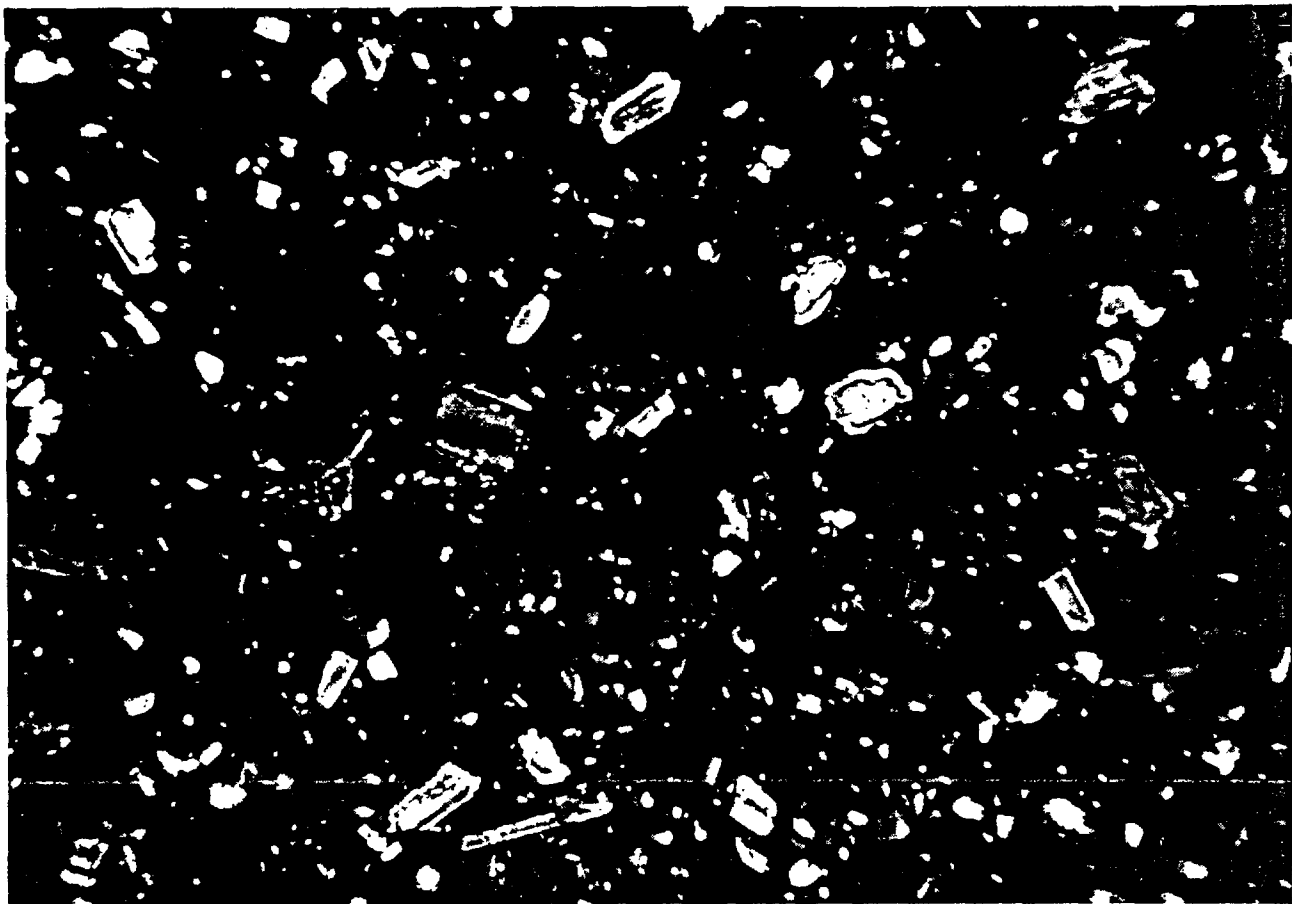
Further experiments are planned to study gypsum crystal growth during hydration, and the effect of various additives such as accelerators and retarders. At the present time the work will be rather general to study what can be done and the procedures which are necessary. This will guide future work which will probably be directed toward more specific objectives.



LAND PLASTER ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)



RE-HYDRATED GYPSUM CRYSTALS ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$)



DENSITE



SGP 0014960

NATURAL ANHYDRITE (CaSO_4)

14. STEEL ROOFDECK WITH LIGHTWEIGHT METRO MIX - R&D 294

Objective:

To evaluate a roofdeck consisting of Bethlehem Steel's slabform steel covered with 2 inches of perlited gypsum.

Investigation:

We have entered into a cooperative program to evaluate a steel deck system developed by Bethlehem Steel. Our interest is in furnishing the lightweight Metro Mix. We have volunteered to use our small section on the back side of the R&D building to install a trial deck. Bethlehem Steel will furnish the steel sheets, and we will furnish the lightweight Metro Mix which will consist of 3 cu. ft. of perlite/100 lbs. of tubed stucco. Small sample sections will be poured at the same time as the deck for later examination and testing. The steel slabform sheets are perforated to permit drying through the perforations. The perlited gypsum mixture we are using may be somewhat marginal strengthwise, but this is a good opportunity to see how this highly perlited deck will hold up. If it is found to be satisfactory, the insulating properties will be an advantage.

15. GYPSUM FIREDOOR FILLER - R&D 295

Objective:

To develop a lightweight precast gypsum product for use in fire rated doors

Investigation:

lbs. per

This requires a slab type product of 25/cubic foot density, good handling and sawing properties, 350 psi compressive strength, and sufficient fire resistance to give the same ratings that are presently obtained with calcium silicate. Some years ago, it was proposed that Tufcast be tried for this purpose, but it was approached on the basis that we would furnish the dry mix, and the firedoor manufacturer would have to cast his own slab material. The Tufcast approach was also questionable economical

Sales revived the project recently through some contact with General Plywood. The current approach is to attain the light weight with resin reinforced foam and to use glass fibers for flexural strength and fire resistance. Indications are that we can meet the weight and strength specifications. Our raw material cost estimate at this time is 10-12¢/sq. ft. There do not appear to be any unusual manufacturing problems, but we have no estimate on these costs. General Plywood has estimated that they would purchase 70,000 square feet of firedoor filler/month if the price is less than 30¢/sq. ft., and 40,000 square feet if the price is under 40¢/sq. ft.

They have estimated that about 1,000 wood firedoors per day are manufactured. This does not include metal firedoors which also use this filler. It looks as though there is a good potential volume for this product if we can meet the requirements at a competitive price.

SUMMARY

The last six months and full year gross sales resulting from products developed through research were \$1,038,600 and \$1,659,569 respectively. The corresponding gross profits were \$191,534 and \$347,766. Other annual sales increases which we believe have been favorably affected by research efforts were: 1/2" Firestop - up 157%; 5/8" Firestop - up 15.6%; Dry Joint System - up 5.1%; and Ready Mix - up 290%. The research projects completed during the past six months, that should result in more sales volume, are as follow:

1. The development of a vinyl binder joint compound called "Triple Duty". The formal release of this product will be announced at the G. D. C. I. Convention in March.
2. The improvement in quality and cost of our ready mix joint compound. This new formula has been adopted and we believe that it is a contributing factor to our increasing ready mix sales.
3. Successful fire tests have produced new fire rated assemblies and a 5/8" Firestop version of our Tile Backer board. This Firestop Tile backer has been added to our Underwriters' listed products and will be promoted for partitions where water resistance and fire protection are both required.
4. One new product was added to our Dens-Cote family and a new application for Dens-Cote was approved. The new product is "Dens-Cote Base plaster", which is the first coat material of a two coat system. The normal lime-putty guaging is used for the finish coat. Texture Finish Dens-Cote, developed in 1964, has been approved for use in radiant heated ceilings.
5. Sound transmission ratings were obtained for ten different partition assemblies. Most of these were tests mutually sponsored by Owens-Corning and Georgia-Pacific. These partitions consist of Fiberglas Noisestop and Firestop applied to metal studs. In addition to the financial assistance in conducting the tests, we will have the benefit of Owens-Corning's efforts to add to our own in promoting these partition systems.

Looking ahead, a 1966 research program has been planned which should protect our future, as well as providing for our immediate needs. Some of the objectives of this program are:

1. To provide a sound technical basis for producing a lighter weight wallboard.
2. To gain a better understanding of our products and processes through the use of the polarizing microscope.
3. To improve the fire endurance properties and the economics of our Firestop products.
4. To pursue the development of such new products as a fire rated gypsum acoustical tile, a combination gypsum/plywood stud, and a precast gypsum firedoor filler.
5. To improve our predecorated product line and our Industrial gypsum product line.

It is felt that we are currently making good progress in all areas with the exception of structural systems and components. This weakness will be overcome when we can hire and train a mechanical engineer. This addition has been incorporated into our 1966 budget. Some new Laboratory furniture and equipment have also been included in next year's budget. This will enhance our abilities and provide for more efficient use of our space. Research is primarily a long range approach to the profits of the company. This may be demonstrated by the fact that the original research on Firestop and Densite, two current mainstays, was conducted over ten years ago. By the same token, it may take a number of years before our present research work begins to pay off.