PLAINTIFF'S EXHIBIT USM-175

Approved for Distribution

By ____________

NATIONAL GYPSUM COMPANY
RESEARCH LABORATORIES

Copies to:

File No. 1950-129

Report No. 665

Date February 13, 1950

REPORT TO THE DIRECTOR OF RESEARCH FROM Acoustical LABORATORY

TITLE: Thermacoustic Final Report.

REQUESTED BY: F. L. Marsh

WHAT IS WANTED: A final report on the development program of Thermacoustic.

WHY WANTED: To terminate the research phase of Thermacoustic and place the product under the Acoustical Commodity Department.

REPORT:

CONCLUSIONS

Thermacoustic is at present being periodically manufactured at the Alexandria plant in basically the same manner as is Mineral Wool Insulating Cement. The material contains mineral wool, asbestos, a binder, and a fungicide. The formula was developed to replace Limpet whose manufacture has been stopped. The material is applied with a spraying machine called the Thermablower. This machine is very similar to the Limpet unit, and is sold directly to the applicators by the manufacturer.

Thermacoustic is considerably more difficult to apply than Limpet, and consequently more skill is required to prevent the frequent drops. The material may be applied to most surfaces up to a thickness of two inches.

Thermacoustic received a fire rating of 3 hours and 55 minutes at the Mellon Institute, but the report issued contained results of two other competitive materials tested. A second test is now in progress in order to receive an independent report. Sales would like to see this material pass fire tests when applied directly to steel flooring.

Though Thermacoustic is difficult to apply and results with a rough finish, it seems satisfactory in the field as an acoustical material. When used

Stumpf Ex 49

M 00076

as an insulating or fire retardant material, it has its faults. The binder in the material at high temperatures will burn out and leave a mass that is very friable with little bonding action. This may result in a drop during the fire. As an insulating material, there is no protection against vapor condensation. Condensation may cause loss in bonding action with a probable drop resulting.

The recommendations herein are contingent on the demand of Sales for a better product to be developed, or that true quality control is needed. The effectiveness of quality control for this product is doubtful because the ability of this product to perform is dependent solely upon the applicator's methods of application.

Both the machine used, and the method of Thermacoustic application are very similar to the Dolbey Patents which expire in two years. As yet there has been no clear definition of non-infringement, and consequently it will have to be cleared up.

Mr. N. E. Whitlock is at present studying the patentability of the formula or some of the application phases.

Sound absorption results from the Riverbank Acoustical Laboratories are as follows:

	N.R. Coefficient
1/2" thick on metal lath	0.80
3/4" thick on metal lath	0.75
3/4" thick on metal lath (painted)	0.75
3/4" thick on solid backing	0.65

These results are not as good as those for competitive sprayed acoustical products, but are classified by Sales as livable.

A thermal conductivity coefficient received from the Pittsburgh Testing Laboratories was 0.27. This value is considered exceptionally good.

RECOMMENDATIONS

The recommendations herein as stated in the conclusions are contingent on the demand for new spraying products, closer quality control and more performance data.

1. Purchase of a Thermacoustic machine by the Alexandria plant. The machine will be used by the plant for quality control and by Research for further development of spraying products.

2. Development of best testing methods for coverage, density, bonding, texture and surface, etc.

3. Study of Thermacoustic limits such as maximum application rates, maximum thickness, density and thickness vs. sound absorption and thermal conductivity, etc.

4. Future research:

   A. Development of an inorganic binder to wholly or partially replace the present organic binder.

   B. Finding substitute fibers comparable to Amosite asbestos.

   C. Development of a spraying wool containing mineral wool as the only fiber.

   D. Future testing for:

      1. Improved sound absorption coefficients.

      2. Underwriter's Laboratory fire rating.

Clarification of the possibility of infringement on the Dolbey Patents.

DISCUSSION

The Thermacoustic problem No. 1950-129 (previously No. 6004), is covered under the following research reports Nos. 356, 377, 391, 437, 468, 470, 495, 595, 596, and 656.

The development commenced with a literature study, and a visit to the Limpet applicator in New York City to study the principles of Limpet application, and the machinery used. Following this was a search for a suitable type of binder and asbestos fiber.

The development of the formula involved the evaluation of various mixes using different types and percentages of asbestos and binders, the use of mineral wool as the sole fiber, and one test using mineral wool insulating cement.

The final formula selected is as follows:

Mineral Wool (type X)	80 lbs.
Asbestos (Amosite)	12 lbs.
Binder (Perfection Paste Powder)	8 lbs.
Fungicide (Shirlan D)	2/10 lbs.

Mineral wool does not have a tendency to readily become wet, and consequently it will not easily felt together and stick to the surface applied. This is especially true when applied to metal lath. The characteristic of felting and sticking when wet is of utmost importance since the binder used does not display adhesive qualities until drying has started. The ability for the material to support itself and be wetted is therefore, dependent upon the wetting and felting action. Amosite asbestos will readily become wet and will do a fair job of sticking to most surfaces. Furthermore, it does not have the tendency to remain in a nodular state when blown through a machine as does mineral wool. The combination of mineral wool and asbestos blend and felt together, and satisfactorily adhere when applied wet to most surfaces. It is therefore used in the formula.

The binder used is a starch which may become putrid or support mold growth when maintained at high humidities and temperatures for extended periods of time. For this reason the starch is inhibited with a fungicide. The present fungicide used is Shirlan D and was selected after testing a variety of fungicides at varied concentrations. It is non toxic, non irritating and is added to Thermacoustic at the time of manufacture.

Previous to Shirlan D, Santibrite briquettes were used. These briquettes had to be dissolved in the spraying water as they were too irritating to be added to the product in the dry form. Even when dissolved in water, the fungicide was extremely irritating. For fungicidal study, see research reports 494 and 596.

Thermacoustic is manufactured at the Alexandria plant using the mineral wool cement facilities. The manufacturing procedure is basically the same as used in the manufacture of mineral wool cement. Two bags of type X wool and weighed amounts of asbestos, binder and cut fungicide are mixed for 30 seconds and then bagged to weigh 50 lbs. net.

Specifications covering this product are as follows:

Product	-	60-60
Product Mfg. Procedure	-	61-60
Raw Materials		
Asbestos	-	68-60-1
Binder	-	68-60-2
Fungicide	-	68-60-3

The Malloy Machine Company, Chicago, Illinois is manufacturing the Thermablower (Thermacoustic machine) and accessories. This equipment is sold directly to the applicators.

The machine is a duplication of the Limpet machine with modifications. It produces higher air velocities, is capable of greater feed, and is twenty per cent lighter in weight than the Limpet unit. Rearranging the brush off roller of the conveyor has stopped balling up the wool, a condition previously experienced. The balling action caused loss of wool at the end of the conveyor belt, and contributed to a rough textured finish of the product. The new machine fluffs the material very well, resulting in no loss at the bottom, and a finer textured surface.

M 00079

Thermacoustic, because its formula consists mostly of mineral wool, is considerably more difficult to apply than Limpet which is all asbestos. Frequent drops occur because of poor felting, and considerably more skill in application is required.

At a density of 12 lbs., Thermacoustic has a minimum coverage of 2400 sq. ft./ton at 3/4" thick. This figure allows for an 11% loss through drops, fly, material left in bags, etc.

Approximately 3/4 lbs. of water is used per lb. of Thermacoustic. A low water ratio results in a soft finish, increasing the amount of water results in a harder finish. The degree of drying also effects the hardness, good ventilation (quick drying) increases hardness.

Thermacoustic may be applied to solid backings such as wallboard, plaster, gypsum lath, concrete, masonry, metal or to metal rib lath. Diamond mesh lath is not recommended since it has insufficient integral strength and if used must be on centers of approximately 8".

All surfaces other than metal lath are first primed with asphalt emulsion. The priming cuts surface water absorption, and also aids in initial bonding.

The maximum wet application on solid backing is 1-1/2" thick, and on metal lath it is 1-1/4" thick. This material may be applied up to 2" thick if it is put on in two applications, the first being allowed to completely dry before applying the second. Indications are that Thermacoustic may be applied to ceilings in excess of 2", but since no actual job or experimentation has been carried out, a figure above 2" can not be recommended.

Three sets of panels each totaling 72 sq. ft. were sent to the Riverbank Acoustical Laboratories for acoustical ratings. Each set consisted of 6 panels, each panel being 3' x 4'. They were prepared at the Clarence Center plant, and sprayed by the Fischer Busse Co. in Chicago. The thickness, backing and results of the test are as follows:

Type and Thickness	Coefficients						
	128	256	512	1024	2048	4096	N.R.
1/2" thick on metal lath	.61	.64	.78	.85	.86	.87	.80
3/4" thick on metal lath	.57	.64	.71	.85	.88	.86	.75
3/4" thick on metal lath (above sample with 2 spray coats of water base paint)	.59	.58	.70	.86	.86	.90	.75
3/4" thick on solid backing	.08	.25	.67	.87	.84	.78	.65

Thermacoustic on solid backing when evaluated in the laboratory resulted in N.R. coefficients of .75 to .80. A portion of one of the solid backed panels returned from the Riverbank Laboratories gave a N.R. coefficient of .80. The reason for the discrepancy is not known.

M 00080

Two blocks of Thermacoustic 1" x 12" x 12" at 10.8 lbs. average density received a K value of 0.27 at a mean temperature of 75°F. The test was performed by the Pittsburgh Testing Laboratories.

Thermal conductivity results are considered exceptionally good, but acoustical results are classified by Sales as only livable. The N.R. coefficients of Thermacoustic 3/4" thick on metal lath are not being used for advertising purposes because they are considerably lower than competitive sprayed test results.

For the first fire rating test at the Mellon Institute, Thermacoustic was sprayed 1" thick on to a suspended ceiling consisting of diamond mesh metal lath on 12" centers. Due to application trouble caused by weaving lath, the material was only applied at a 9 lb. density. The material received a 3 hour and 55 minute fire rating but was considered not conductive to confidence because the Thermacoustic readily separated from the lath when lightly probed after the fire.

The average temperatures were 110° to 160°F. higher than the temperatures of competitive materials previously tested in the same furnace. These high values were attributed to the low density since the competitive tests were run at densities in the vicinity of 18 lbs./cu. ft. The separation of Thermacoustic by slight probing occurred because the organic binder had burned out, and only the felting action of the fibers held the material in place.

A second fire test at the institute is now in progress. Thermacoustic has been applied to a more rigid suspended ceiling consisting of 3.4 lbs. metal rib lath and applied at an estimated density of 15 lbs./cu. ft. The increased density will undoubtedly give a greater time rating, but no relief is seen to prevent the material from separating when lightly probed since an organic binder was used.

The prime reason for this second test is to receive an independent report. The report of the first test contained the results of Thermacoustic and two other competitive spraying materials previously tested. A fire rating of 4 hours or greater is also strived for in this test.

The Sales Department would like to see a material developed that could be applied directly to the surface being protected without the use of a false ceiling. The H. H. Robertson Co. of Pittsburgh, who manufacture prefabricated steel flooring, are very willing to aid this organization with the development of this type material.

The following is a list of patents dealing with spraying of fiberous materials:

No. 1	1,718,507	No. 6.	1,990,584
No. 2	1,837,422	No. 7	1,990,585
No. 3	1,881,345	No. 8	2,179,678
No. 4	1,888,841	No. 9	2,303,280
No. 5	1,978,125	No. 10	2,433,463

M 00081

Patents numbered 1 through 5 have expired while patents numbered 8 through 10 have specific types of equipment not similar to the Thermacoustic process. Nos. 6 and 7 are the Dolbey patents expiring in two years and were the patents used by Keasbey Mattison Co. in the Limpet process.

Since the Thermablower is essentially a copy of the machine described in the Dolbey patent [illegible], and the method of application is very similar to the Dolbey patent No. [illegible], the status of infringement should be clarified by the company's Patent Department.

There is on record in this office, a memorandum showing a settlement out of court between the Keasbey Mattison Co. and George W. Luhrman regarding the infringement of the Dolbey patents.

DISCUSSION OF RECOMMENDATIONS

At present there is no quality control testing of Thermacoustic similar to job applications, and there are no such tests specified. The practicality of these tests is doubtful since the application of this material is entirely dependent upon the judgement of the applicator (coverage may be varied from 1600 to 3500 sq. ft./ton, and density may be varied from 8 to 18 lbs. are examples). If, however, the demand for this product requires quality control similar to job applications, the following are recommended:

1. Purchase of a Thermablower by the Alexandria plant. The plant will periodically check Thermacoustic for coverage, density, bonding, texture and surface.

2. The Research Department will have to develop suitable methods for the above tests.

Due to the lack of facilities during previous research, the following were only partially or not at all evaluated, and only a limited amount of performance data is available. This work as above is only recommended if the sale of Thermacoustic warrants the study.

1. Optimum means of spraying (rates, applications, angles, etc.).

2. Best methods to produce desired texture.

3. Maximum permissible thickness.

4. Density and/or thickness vs. sound absorption and/or thermal conductivity.

M 00082

Proposed Future Research

1. The present organic binder is costly, it will deteriorate at high temperatures, is susceptible to putrefaction, and requires an expensive fungicide. Substitution of a suitable inorganic binder may eliminate all of the undesirable properties encountered with the organic binder.

2. The imported Amosite asbestos presently being used is costly, furthermore, no assurance of its supply is guaranteed. Organic fibers such as cotton, manila, sisal, wood, etc. in sufficiently small quantities may pass the fire tests and be suitable. Inorganic fibers such as fiberglass have displayed possibilities.

3. Though mineral wool and a binder do not adhere well to metal lath on ceilings, it does hold fairly well on metal lath walls, and very well on solid walls. The development of a spraying wool containing only mineral wool fibers is entirely possible.

4. The noise reduction coefficients from the Riverbank Laboratories are passable but not good. One of the samples was rechecked in this laboratory and found to be higher than reported. This discrepancy along with a thorough study of Thermacoustic sound absorption characteristics will result in optimum acoustical coefficients.

F. M. Stumpf

F. M. Stumpf
Research Department

FMS/mjh