The Mineral Wool Industry of Indiana

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Introduction

Mineral wool is a substance composed of very fine interlaced threads, composed chiefly of calcium silicate, which are glass-like in character and similar in appearance to fibres of wool or cotton. Because of the high percentage of air space for a given volume of wool, it is used extensively for insulating purposes.

Mineral wool may be divided into three classes; rock wool, slag wool, and glass wool. This differentiation is upon the basis of the type of raw materials used in making the mineral wool. Rock wool is made, in most cases, from natural siliceous limestone or calcareous shales. In a few plants other raw materials are used for the manufacture of rock wool. Slag wool is made from blast furnace slags with or without the addition of limestone to temper the charge. Glass wool is made from commercial glass batches.

Early Manufacture of Mineral Wool

Information concerning the beginnings of the mineral wool industry is somewhat meager. Slag wool was made in Germany as early as 1870, according to Lang[1]. The first mineral wool made in the United States was probably made by the Salem Mineral Wool Company of Salem, Virginia. According to a brochure of the National Rock and Slag Wool Association, this company first manufactured mineral wool in 1887 at Salem, Virginia, but the plant was shut down in 1891 and did not operate again. Thus it appears that mineral wool is not a new product but was made in this country at least fifty years ago in much the same form as at present. Only the technique of its production and uses have been changed to meet modern demands.

Rock wool was first made in Indiana at Alexandria in 1897 by Mr. C. C. Hall[2]. Mr. Hall was a chemical engineer for a St. Louis firm which operated a steel plant at Alexandria. He discovered the peculiar qualities of the local rock in his search for a suitable rock for fluxing purposes in the steel plant. His first wool was produced on the premises of the steel company, but when the steel plant was absorbed by one of the steel trusts, he had to move the equipment which he had constructed for the production of rock wool. He then organized, with the aid of local friends, a company known as the Crystal Chemical Company for the purpose of producing rock wool. This plant operated until about 1901 when it was sold to a St. Louis company which was ultimately succeeded by the present General Insulating and Manufacturing Com-

[1] Lang, Herbert, 1923. Designing and Operating a Slag Wool Plant, Chem. and Met. Eng., pp. 365-367.

[2] Thoenen, J. R., 1929. Information Circular No. 6142, Dept. of Commerce, Bureau of Mines.

pany at Alexandria[3]. In 1906, Mr. Hall withdrew from this company and organized the Banner Rock Products Company, which was incorporated in September of 1906 and began operation in January of 1907. This plant, which has been in operation since 1907, is now owned and operated by the Johns-Manville Corporation. These two plants at Alexandria are still the largest producers in the state.

Present Status of Industry

The industry has grown in Indiana from two plants in 1907 to sixteen plants at present (1937). One of the sixteen plants is not producing at the present because of litigation over the ownership of the plant. The location of these sixteen plants is shown in Fig. 1. All of the plants except the one at East Chicago produce rock wool. The plant at East Chicago produces slag wool from lead slag. The plants vary in size from one to fifteen cupola installations. In all there are 61 cupolas installed in the state. Twenty-nine of the cupolas are in the two plants at Alexandria. There are fourteen cupolas in the three plants at Wabash. Thus Alexandria and Wabash have between them about three-fourths of the cupolas which are producing mineral wool in Indiana. The following table gives the name, location, date that plant began operation under present name, and the number of cupolas in each plant.

Name of Company	Location	Date	Cupolas
Banner Rock Products	Alexandria	1907	15
General Insulating and Manufacturing Co.	Alexandria	1912	14
Union Rock Wool Corp.	Wabash	1921	3
Weber Insulations Inc.	East Chicago	1927	2
Standard Rock Wool Inc.	Yorktown	1930	2
Salem Lime and Stone Co.	Salem	1931	1
Standard Lime and Stone Co.	Wabash	1931	5
Indiana State Farm	Putnamville	1932	1
American Rock Wool Corp.	Wabash	1934	6
Zier Products Co.	New Albany	1934	1
National Rock Wool Sales Co.	Lagro	1935	3
Western Rock Wool Co.	Huntington	1935	2
Mineral Felt Co.	Campbellsburg	1935	1
Ellis Fish Inc.	Bedford	1936	2
North Vernon Rock Wool Co.	North Vernon	1937	1
Superior Rock Wool Co.	Lagro	1937	2

The plant at Campbellsburg is not at present producing wool because the ownership of the plant is now in litigation. The cupola at the State Farm at Putnamville can hardly be considered a commercial plant because the output of this cupola is small and is limited to supplying the needs of the State Farm and other state institutions.

It will be noted from the table above that thirteen of the sixteen plants in Indiana have been organized within the last ten years. Several

[3] The writer wishes to acknowledge his appreciation of the courtesy shown by the General Insulating and Manufacturing Company in furnishing him with photographic material for this article and particularly to Messrs. D. W. Burnett and M. E. Mann for much very helpful information regarding details of plant procedure.

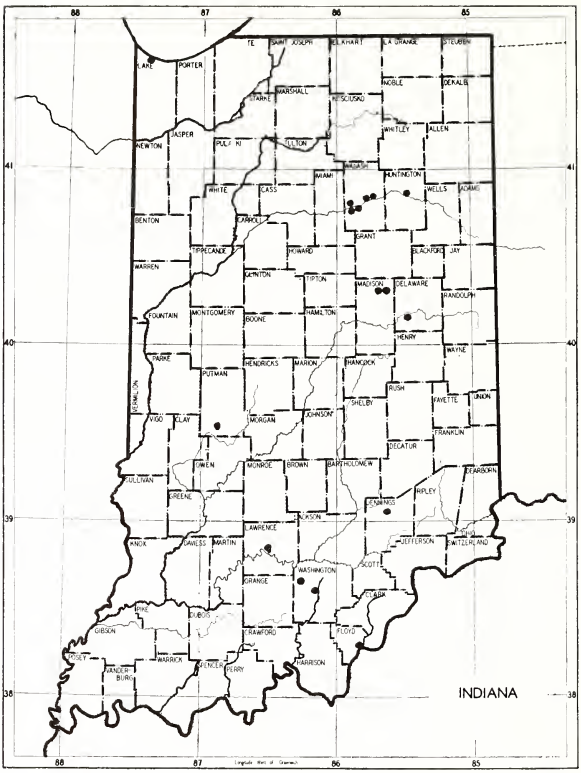

Fig. 1. Location of Mineral Wool plants in Indiana.

of the cupolas in the older plants have been installed within this decade also. The plants at Yorktown and Campbellsburg began operation at earlier dates than those given but have undergone reorganization at later dates.

This growth of the industry within the last ten years is typical of the industry nationally as well as within Indiana. In 1929, there were only eight producers of mineral wool in the United States. Two of these were in Indiana, and there was one each in California, Illinois, Michigan, New Jersey, Ohio, and Wisconsin. At the present time there are about fifty-six plants in the United States which manufacture mineral wool, and in addition there are nine companies which sell mineral wool products on the market but do not manufacture them themselves. The exact number of plants is difficult to ascertain because new plants are opening and some old ones closing down. The distribution of these fifty-six plants is shown in Fig. 2. Indiana ranks first in the list with sixteen plants, followed by Ohio with nine; Illinois and New Jersey with six each; Pennsylvania and California with three each; New York, Michigan, and Utah with two each; and Wisconsin, Virginia, Missouri, Texas, Tennessee, Iowa, and West Virginia with one plant each.

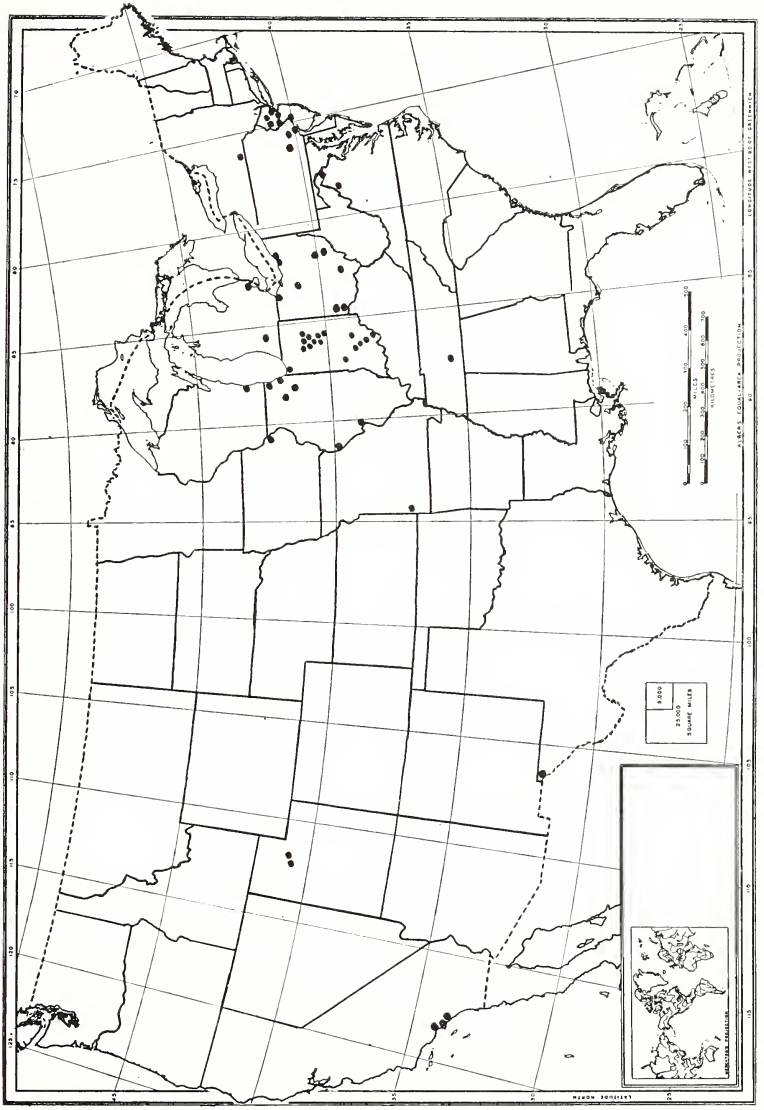

Fig. 2. Distribution of Mineral Wool plants in United States.

Indiana still holds first rank in the manufacture of mineral wool but is relatively slightly less important than it was ten years ago. There has been a rather noticeable tendency toward decentralization of the industry apparent within recent years. While Indiana, Ohio, and Illinois have more than half of the plants, there have been several new plants go up in the east and west within the last few years. This probably is due to the effect of freight costs upon the mineral wool. Mineral wool is a rather bulky product. A standard box car will accommodate only twelve tons of wool. This makes the freight costs high. The importance of freight costs is shown by the following table of freight costs of wool from Alexandria:

To Chicago	$ 4.80 per ton
To Cleveland	5.80 per ton
To Baltimore	9.00 per ton
To New York	10.00 per ton
To Birmingham	19.40 per ton
To Los Angeles	52.50 per ton

It is easy to see why three plants have gone up around Los Angeles within the last few years.

Another item that may have some effect upon the location of new plants is the nearness to fuel. Coke is the chief fuel used in the cupolas. Indiana does not have any good coking coal within the state, so the coke has to be shipped in at some considerable expense.

Raw Materials Used

Most of the mineral wool made in Indiana is rock wool. As stated above, fifteen of the sixteen plants manufacture rock wool. The plant at East Chicago used lead slag for the manufacture of wool. However, the type of raw materials used varies considerably throughout the state. The plants in northeastern Indiana all manufacture rock wool from a calcareous shale or argillaceous limestone known to the geologist as the *Mississinewa Shale*. Small amounts of local limestones are usually added as flux. This *Mississinewa Shale* is the so-called "fuzz rock" of the quarrymen. It has about the following analysis at South Wabash[4], which is fairly typical for northeastern Indiana.

SiO_2	30.89
Al_2O_3	13.21
Fe_2O_3	5.69
$CaCO_3$	28.03
$MgCO_3$	14.32
TiO_2	0.68
H_2O etc.	5.61

While analyses of the *Mississinewa Shale* show slight variations in the percentages of the various constituents, the formation is remarkably similar in composition over considerable areas. There seems to be then very little basis for the claims made by some manufacturers of rock wool in northeastern Indiana that their wool rock is unique in

[4] Cumings, E. R., and Shrock, R. R. The Geology of the Silurian Rocks of northern Indiana, Dept. of Conservation, Division of Geology, Publication No. 75, p. 57.

physical and chemical properties. There is a rather extensive area comprising parts of Wabash, Huntington, Grant, Madison, and Delaware counties, where the *Mississinewa Shale* may be found in outcrops or at no great depths beneath the surface. The mineral wool plants at Wabash, Huntington, Lagro, Yorktown, and Alexandria all use the *Mississinewa Shale* as their basic material. The flux rock used with it varies locally.

There are five strips of land in this area where the *Mississinewa Shale* outcrops. These are (1) along the Wabash River from a few miles above Huntington downstream to a point a few miles below Wabash, (2) along the Salamonie River from near Warren in southern Huntington County down the Salamonie to the point of its junction with the Wabash near Lagro, (3) along the Mississinewa River from Marion downstream to a point a short distance below Red Bridge, (4) along White River from a short distance above Yorktown downstream to about the western boundary of Madison County, and (5) along Pipe Creek from Alexandria southwestward nearly to its junction with White River. No doubt there are several other areas within this general region where the *Mississinewa Shale* is near enough the surface that the overburden could be removed without too great expense. Certainly there are enough possible locations for quarries within this area to take care of the needs of this industry for many years to come.

The rock wool plants in the southern part of the state use a variety of raw materials for the manufacture of their wool. The following table indicates the location of the plants and the raw materials used.

Ellis Fish Inc. (Bedford)	*Salem* ls. and *Borden* sh.
North Vernon Rock Wool Co. (North Vernon)	*Devonian* ls. and top soil
Mineral Felt Co. (Campbellsburg)	*Harrodsburg* ls., *Chester* ss.
Salem Lime and Stone Co. (Salem)	*Salem* ls. and clay
Zier Products Co. (New Albany)	River gravels and limestone
Indiana State Farm (Putnamville)	*Chester* (?) ls. and sh.

It thus appears that rock wool can be made from a great variety of raw materials. The *Mississinewa Shale* of northeastern Indiana has nearly the proper ratio of silica and lime, but almost any raw materials may be used provided they are combined in such proportions as to give the proper ratio between these two major constituents. That this mixture of materials can be done successfully is demonstrated by the plants in southern Indiana. The Bedford plant uses the waste limestone from the mills in Bedford and mixes it with shale trucked in from Rivervale, about twelve miles south of Bedford. The plant at North Vernon is a very interesting one because it uses a local limestone; which has been quarried north of town for many years for road metal, and mixes with it top soil from around the plant. The mixture makes a very nice looking rock wool. The plant at Campbellsburg uses local *Harrodsburg* limestone and a *Chester* sandstone trucked in from near Orleans. The plant at Salem uses some of the oolitic phase of the *Salem* limestone and mixes with it some of the so-called "bastard stone" from the *Salem* limestone and clay from the top soil. Perhaps

the most interesting plant from the standpoint of raw materials used is the one at New Albany, where Mr. Zier is making rock wool from a mixture of river gravels and local limestone. He is contemplating the construction of a new unit which would burn oil instead of coke and use top soil and limestone in the same manner as is being done at North Vernon.

When it is apparent that mineral wool can be made from such a variety of materials, including of course slag and glass wools, it seems rather obvious that no company is going to be able to get anything like a monopoly upon the raw materials from which mineral wool is made. The difference between success and failure seems to lie more in efficiency in manufacturing and marketing rather than in control of raw materials.

Quarrying Practice

In practically all of the plants the quarrying methods are the ordinary ones used in quarrying stone for use as road metal. In some of the smaller plants the loading is done by hand, but in the larger plants the steam shovel is used. In several of the plants part of the raw materials is trucked some distance to the plant. Probably the greatest distance that any material is trucked is at Bedford where shale is trucked twelve miles from Rivervale.

Manufacturing Methods

Both rock and slag wool are melted in cupolas. The ordinary rock wool cupola is a vertical steel cylinder which is generally water-jacketed. It is roughly 4 or 5 feet in diameter and 8 to 10 feet high. The charge in the cupola consists of alternate layers of coke and rock or slag in the ratio of about one part of coke to two to four parts of rock. Blowing tuyeres are placed about two feet above the bottom of the cupola. These average about eight in number. Air is blown through the tuyeres by a blower fan at low pressure. The fusion temperature in the cupola varies considerably, depending upon the material used. It ranges from about 2400° to 2800° Fahrenheit. The bottom of the cupola has drop doors to facilitate the cleaning of the cupola. This has to be done on the average about once weekly. The capacity of the cupola varies considerably with the individual plants. It ranges from 500 to 1500 pounds of wool per cupola per hour. The better installations average 800 to 1000 pounds per hour. In some plants the proportioning of the charge in the cupola is done by counting shovels of each type of material; in other plants the proportioning is done entirely by weight.

Blowing Wool

The molten material in the cupola issues in a small stream from a hole at the bottom of the cupola. As the molten slag falls from the hole at the bottom of the cupola, it is broken by a steam or air jet blow at pressures varying from 80 to 150 pounds and is broken into minute balls or shot which, while still molten, are propelled rapidly through the air. This comet-like propulsion through the air draws them

out into fibres or threads. Some of the material may not be drawn out into fine fibres, and this forms the so-called "shot" in the wool. The "shot" occurs as small globular beads of glass-like texture. The formation of shot seems to be related to the composition of the charge and the force of the air or steam. In general, it seems more practical to discard the "shot" after formation rather than to attempt to prevent its formation. The "shot" is separated from the wool fibres by passing the wool through a machine very similar to a grain separator.

Fig. 3. Blowing rock wool from cupola into wool room. (Courtesy of General Insulating & Manufacturing Co.)

Practice varies as to the form and shape of the steam or air jet blower. Much of the secrecy which is associated with the production of mineral wool relates to the methods of blowing the wool and of injecting certain materials into the wool to give it binding qualities. The person or concern contemplating entering the mineral wool industry runs into the patent problem at this point. This is one thing that may to some extent tend to prevent too rapid a spread of mineral wool production.

Not all slags will make wool. One too high in iron will blow into shot without any trace of fibres. Slags too rich in alkaline earths will

blow into short wool or even dust. To produce a long-fibred wool a slag is required that has a prolonged period of plasticity or viscosity. There should be a wide range of temperature between softening and complete fusion. Glass best illustrates this phenomenon, and this fact helps to explain why very excellent wool can be made from glass batches. Some slags will make light-colored wools and some make dark-colored wools. Tradition has rather required that the wool be light-colored, which necessitates the slag being nearly free of iron. However, since mineral wool is usually placed in covered places, it seems that color is of little moment. The wool may be black as far as its value for insulation is concerned. The insulational value of the wool depends upon dead air cells, not upon its color. Incidentally, the addition of binding material must diminish the efficiency of the wool for insulation purposes because the binding material eliminates air space. Insulation in the powdered form is thus inferior to the fibre form, although it is more easily shaped.

The wool is blown from the cupola by the steam or air jet into a so-called wool room. In the early days of the industry, the wool was collected and bagged by hand. Two rooms usually were used so that one could be emptied while the other was being filled. In the modern plants the wool from the cupola is carried on an endless conveyor and goes through a set of rollers from which it emerges in rolls. These rolls may then be worked upon into the various types of products made by the plant. The smaller plants generally make chiefly loose or granulated wool, while the larger plants make a variety of products.

Mineral Wool Products

In the early days of the industry most of the mineral wool produced was either what is known as loose or granulated wool. The term loose or bulk wool is applied to the direct product of the cupola. Mineral wool is still used in that form where a loose insulating material is needed. The loose wool may be run through a machine which separates the "shot" from the fibres. This results in a short fibre which is "shot-free" and which goes by the name of granulated wool. This is widely used where a loose insulating material is needed. It is packed in standard bags weighing 35 pounds. The granulated wool can be poured or blown into spaces.

Mineral wool may be fabricated in various forms to meet particular needs. Some of the more common forms are: (1) Blankets—Blankets are made by placing the wool between two wire nettings. They may be made in various sizes and thicknesses, and in newer buildings may be placed directly on or between the studding. Blankets are also used for boiler and oven insulation. (2) Rolls—The wool is made into rolls much like rolls of cotton or wool and can be used either for the same purposes as loose wool or as blanketing material. (3) Blocks—The wool is pressed into blocks of varying size. The thickness seldom exceeds 2½ inches. Blocks are used for oven insulation, heating and air conditioning ducts, hot air furnaces, and other light heated equipment. (4) Bats—Bats are similar in shape to blocks but are of greater thickness and are used where thicker insulation is needed than is provided by blocks.

Fig. 4. Mineral Wool products. Upper, loose wool; lower, granulated wool. (Courtesy of General Insulating & Manufacturing Co.)

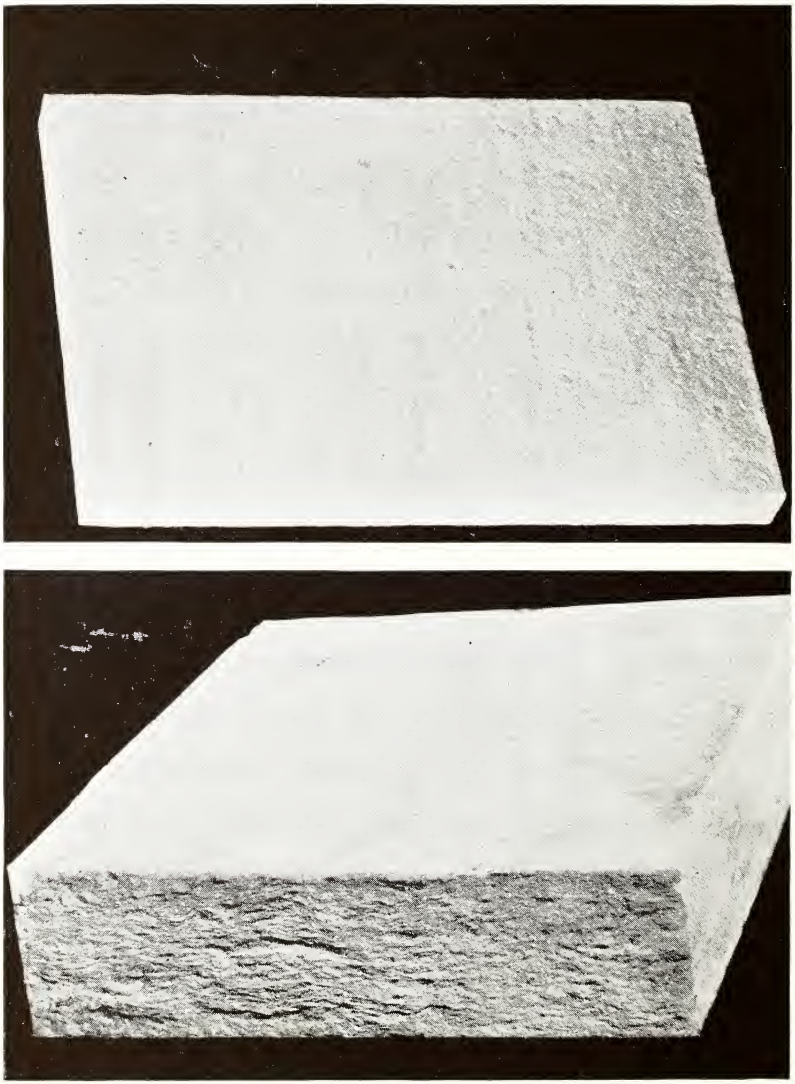

Fig. 5. Mineral Wool products. Upper, block; lower, bat. (Courtesy of General Insulating & Manufacturing Co.)

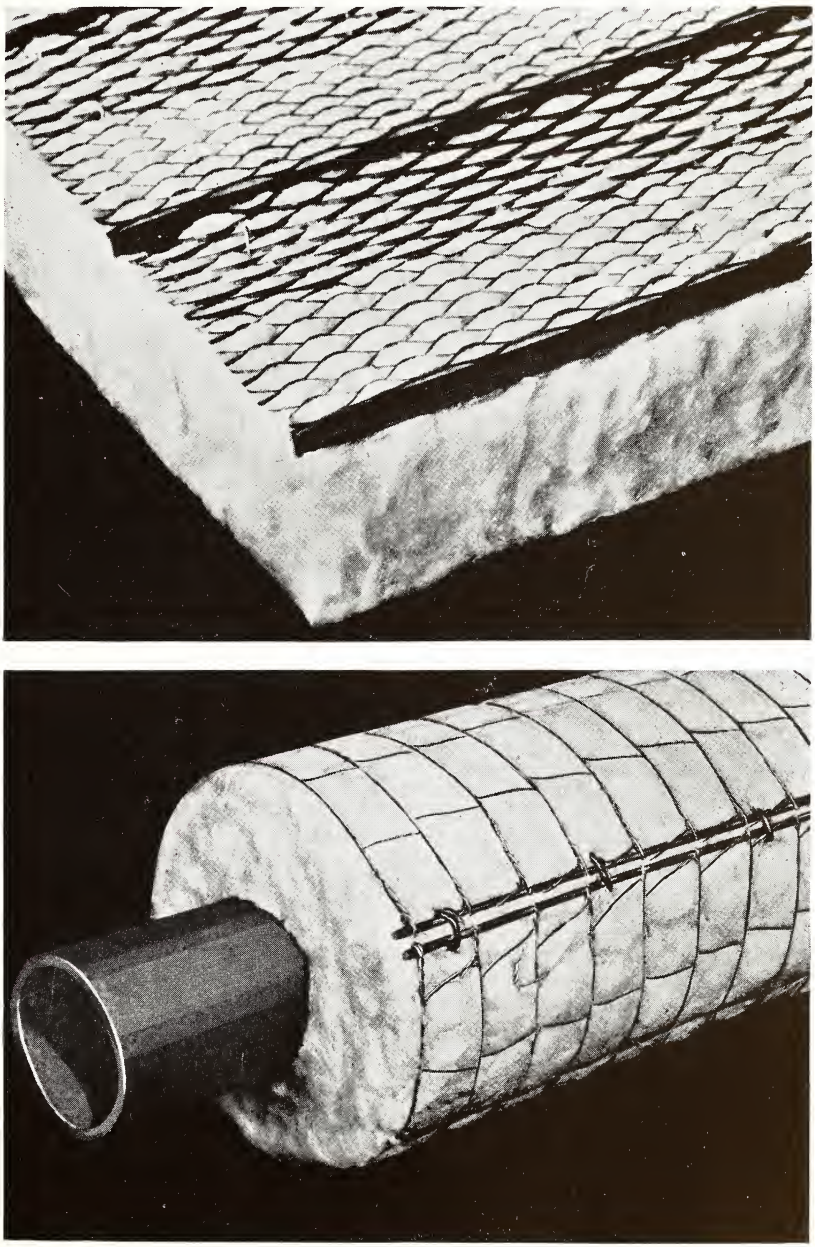

Fig. 6. Mineral Wool products. Upper, blanket; lower, pipe covering. (Courtesy General Insulating & Manufacturing Co.)

In addition to the above-mentioned common forms, mineral wool is also made into pipe covering, cork board, sound-absorbing blankets, pads, panels, felt, rock wool cement, plaster, and brick. Thus it is apparent that mineral wool has a great variety of forms and uses for both sound and heat insulation.

Value of Mineral Wool

Accurate data on the value of mineral wool produced in the state and nation are difficult to obtain because the producers of mineral wool are very secretive as to the amount of wool which they produce. This secretiveness is probably due in part to the fact that the industry is a relatively new one, which is expanding rapidly, and that each manufacturer is jealous of his rank in the industry. However, some information is available from the Biennial Census Reports. These reports estimate that the value of all mineral wool produced in the United States in 1900 was slightly over $60,000, about one-third of which was slag wool. No glass wool was produced in this country then. Since 1900, the value of mineral wool products has steadily increased, except for a few years during the worst of the depression, until in 1935 the value of the products of the industry was estimated at $7,672,096. Estimates for 1936 indicate a production value nearly double that for 1935. The following table indicates the rate of growth of the industry.

Year	Value of Products
1900	$ 60,320
1910	84,012
1929	2,377,324
1931	2,873,230
1933	1,714,171
1935	7,672,096
1936	14,000,000 (estimate)

Most of the rapid growth of the industry has been in the last ten years.

Statistics are not available on the value of the mineral wool produced by states. A rough approximation of the value of the mineral wool produced in Indiana may be obtained by comparing the number of plants in Indiana with the number in the entire country. There are sixteen plants in Indiana which are producing mineral wool. There are, according to the best information available, fifty-six plants in the United States which produce mineral wool. Indiana, therefore, has about 28-29% of the plants operating in the production of mineral wool. This would indicate for 1935 a value of wool produced of slightly over $2,000,000 dollars. If the estimates for 1936 are nearly correct, the value of wool produced in 1936 in Indiana should have been around $4,000,000.

Indiana is still the leading state in the production of mineral wool, but is relatively less important than in the early days of the industry. In 1929, four of the eight producers of mineral wool were in Indiana. In 1935, eleven of thirty-eight producing companies were in Indiana and in 1937, sixteen of fifty-six producing companies were in Indiana.

In 1931, "American Builder and Building Age" forecast that the

mineral wool industry would very likely in time become a $100,000,000 industry. The rapid growth of the industry within the last ten years seems to suggest that it bids fair to become one of our leading mineral industries. If Indiana can continue to hold its own in the production of mineral wool as well as it has for the last ten years, the value of the mineral wool produced in the state may reach $15,000,000 or $20,000,000 eventually. Even at the present status of production, the value of mineral wool produced in the state is as great as the value of the famous oolitic limestone which is so widely used as a building stone. The Minerals Yearbook gives the value of the limestone in the Indiana Oolitic district for 1935 at $1,854,245. This is about the same as the estimated value of the mineral wool produced in Indiana for that year. Indiana may then look forward with increased assurance toward contributing in a large measure toward the better homes of the future through her limestone and mineral wool.