PLAINTIFF'S
EXHIBIT
K-1521

January 16, 1956

HISTORY OF

MAGNESIA-TYPE INSULATIONS

by J. C. Rademaker

Early History

When a practical steam engine was invented about 1790, boilers and steam lines were insulated with wood boards, sawdust, and similar materials. As pressures and temperatures were raised, a material was needed which would not burn out above 300 degrees. Insulations were made of mixtures like cattle hair and clay or plaster of paris which were applied in plastic form. In 1865 a typical covering consisted of a layer of plaster of paris covered with wire mesh, then a layer of fire clay held in place with more wire, and finished with sand and plaster of paris.

In 1866 Robert Tocpe of New York City marketed an insulation consisting of asbestos fiber and sodium silicate. Later on he sold his business to the H. W. Johns Company.

In 1868 Henry W. Johns obtained a patent for an asbestos sheet felted with wool flock and plied with cement or oleaginous matter (1) designed for covering steam pipes and boilers.

In 1870 Washington Harris of Philadelphia obtained a patent for "shells or tiles constructed and applied to steam pipes, drums, or other heated vessels, so as to produce a non-conducting covering either with or without a confined air space between the said shells and the vessel covered". (2) Harris suggested that his "shells" could be made of plaster of paris "or any other suitable poor conductor of heat".

In 1875 the Chalmers-Spence Non-Conductor Company of New York advertised and were marketing the Harris air space method of applying insulation. This organization and its products were taken over later by the H. W. Johns Company.

In 1875 Isaac Merrell of San Francisco obtained a patent for a boiler covering composition consisting of steatite, charcoal, magnesia, bittern water, plaster of paris and clay. (3) However, his compound included less than two per cent magnesia and was used only as a cement or hard outer layer over insulation.

The discovery of the heat insulating properties of magnesium basic carbonate is credited to Hiram M. Hanmore of Philadelphia who had been in the insulation contract business for some years, mixing plaster of paris, shredded rope and similar materials to a compound for application to boilers. The story is that about 1882 Hanmore purchased some magnesium basic carbonate for a stomach ailment and recognized that the light weight and heat resistance of the magnesia should make an excellent insulation.

(1) Johns U. S. P. No. 81,641 granted September 1, 1868
(2) Harris " " 98,865 " January 18, 1870
(3) Merrell " " 170,099 " November 16, 1875

FILE COPY
File 432

DEFENDANT'S
EXHIBIT
DF-92

Hanmore first tried a covering made of magnesium basic carbonate and shredded rope. He found it difficult and slow to chop up the rope but his business did not warrant the purchase of machinery for shredding. He next tried silk noils and found that these gave the mixtures more strength. His business prospered and he obtained contracts for covering the boilers and steam lines of Navy vessels in the Philadelphia Navy Yard and similar equipment in the plant of the Franklin Sugar Refinery.

Hanmore was buying his magnesia requirements from the partnership of Richard Mattison, a medical student, and Henry Keasbey, a pharmacist, two Philadelphia young men who in 1873 had started to manufacture pharmaceuticals. Among other chemicals, they were producing magnesium basic carbonate by reacting imported Kieserite with an alkali carbonate. In 1882 they had erected a plant at Ambler, Pennsylvania, and were manufacturing the magnesia from dolomite.

Mattison was told of the large orders for magnesia coming from Hanmore and of his use for it. Hanmore the inventor and Mattison the manufacturer came to an understanding whereby the new magnesia insulation was to be produced.

Magnesia Pipe Covering and Blocks

In 1885 Hanmore, Keasbey, and Mattison formed the Magnesia Sectional Covering Company to make and sell the insulation. Pan molds were built for casting preformed sections or blocks, which were then dried, trimmed to size and sold as blocks or sectional insulation.

On January 19, 1886 Hanmore applied for a patent for "blocks and pipe covering sections consisting substantially of carbonate of or calcined magnesia"(4) either alone or including fibrous material like asbestos fiber, animal hair, or wool. Half of the patent was assigned to Mattison and Keasbey.

Hanmore later became dissatisfied with his arrangement and moved to Santa Cruz, California, where in 1890 he applied for a patent for "A covering for pipes, boilers, and similar articles, made of fossil-meal, carbonate of magnesia, and fiber", (5) a pan cast insulation which foretold Superex-type insulations. Soon after Hanmore became a founder of the Magne Silica Company, which later became the Kieselguhr Company of America, and still later the Celite Company.

Others were entering the magnesia insulation business. Philip Carey of Cincinnati dipped the finished insulation in sodium silicate and then redried it for added strength.(6) Mattison covered a mixture of magnesia, gypsum, and wood pulp, (7) and a dolomitic composition with wood pulp.(8) John Lumley and William Borrowe of the California Anti-Caloric Company of San Francisco were granted patents involving infusorial earth bonded with the fiber of cattails,(9) and equipment to shape magnesia or diatomaceous earth insulations.(10) William Zitt of Chicago assigned a patent involving an ammonia reaction for an insulation consisting of magnesium hydrate, or of magnesium hydrate and magnesium carbonate(11) to the McConnell Asbestos Company of Pittsburgh.

(4) Hanmore	U. S. P. No.	345,843	granted	July 20, 1886
(5) Hanmore	" "	432,162	"	July 15, 1890
(6) Carey	" "	506,870	"	Oct. 17, 1893
(7) Mattison	" "	492,093	"	Feb. 21, 1893
(8) Mattison	" "	492,094	"	Feb. 21, 1893
(9) Lumley	" "	591,409	"	Oct. 12, 1897
(10) Borrowe	" "	629,102	"	July 18, 1899
(11) Zitt	" "	723,970	"	Mar. 31, 1903

Filter Molded Magnesia

In 1900 the Manville Covering Company of Milwaukee built a magnesia insulation plant which was completed in 1901. There is a story that a lawsuit was brought to stop the plant from operating but this has not been confirmed. The Milwaukee plant had two small kilns for calcining dolomite, and carbonated the slaked dolime in two sets of small saturators. The precipitated calcium carbonate was removed from the magnesium bicarbonate solution in plate and frame filter presses.

More important, the magnesia slurry was not pan cast, but was put under pressure with a piston pump, and filter molded to blocks and pipe covering in plate and frame filter presses. This was evidently the first filter molding of magnesia insulation.

The magnesia product was strong for handling, laminated in structure for lower conductivity, but still shrank upon being dried, as did the pan cast insulation of the competitors, and had to be trimmed to size.

The new technique of filter molding was adopted by others. In 1907 Luttgen of Keasbey & Mattison patented an air tank arrangement for blowing the magnesia slurry to the filter molding presses.(12) In 1920 Pike of San Francisco patented the technique of filling a mold, closing it, and filtering.(13)

Magnesium Normal Carbonate

In 1906 a reaction was proposed for a magnesium normal carbonate which many years later was to be used in the magnesia insulation business. George Sisson of Newcastle-on-Tyne took out an American patent (14) in 1910 for a method disclosed in England in 1906 (15) of reacting seawater and lime to produce magnesium hydroxide which was then reacted with carbon dioxide to produce magnesium bicarbonate which was reacted with additional magnesium hydroxide to produce magnesium normal carbonate.

Magnesia Insulation Producers

In 1908 the H. W. Johns-Manville Company issued a catalog offering blocks, and pipe covering through 14-in. size, in three compositions:

"Magno" containing 35% Magnesia "and other fireproof materials"
"Equality" containing 50% Magnesia "for government work only"
"85% Magnesia".

Fabricated tees, ells, and flange covers were offered. Pipe covering sections were shiplap finished on the ends. Blocks were 18 lbs per cu ft density.

The Manville, New Jersey, magnesia plant, which was a larger copy of the Milwaukee plant, was built in 1912, and the Waukegan, Illinois plant in 1922. The Milwaukee plant was shut down and the buildings were sold in 1924.

---

(12) Luttgen U. S. P. No. 1,356,309 granted Oct. 19, 1920
(13) Pike " " 845,365 " Feb. 26, 1907
(14) Sisson " " 935,418 " Sept. 28, 1910
(15) Sisson Brit. " 24,134 " Oct. 30, 1906

In 1920 a list of manufacturers of magnesia insulations included:

Philip Carey Co.	Plymouth Meeting, Pa.
Ehret Magnesia Mfg. Co.	Valley Forge, Pa.
General Magnesite and Magnesia Co.	Norristown, Pa.
H. W. Johns-Manville Co.	Manville and Milwaukee
Keasbey & Mattison Co.	Ambler, Pa.
Merele Magnesia Co.	Redwood City, Calif.
National Magnesia Mfg. Co.	Redwood City, Calif.
Norristown Magnesia & Asbestos Co.	Norristown, Pa.

Franklin Mfg. Co.
Mineral Products Co.
Mount Joy Magnesia Mfg. Co.

From patent assignments it appears that A. J. Merele, who had sold National Magnesia Mfg. Company to the Celite Company about May, 1918, then formed the Merele Magnesia Company, also of Redwood City, Calif. It may be that the Merele plant later became the Redwood City plant of the Plant Rubber & Asbestos Company.

It also appears that Western Industries, which operated across the Bay, at Agnew, California in 1926, was succeeded by American Solvents & Chemical Corporation of the same place before 1933.

In 1928 Johns-Manville purchased the Celite Company, and with it acquired the plant of National Magnesia at Redwood City.

Trim and Tailing Recovery

Efforts were made by some of the manufacturers to lighten the density of the magnesia insulation and to improve the yield of magnesia from the raw materials. At the J-M Waukegan plant, Dorr thickeners had been installed instead of filter presses for removal of calcium carbonate from the magnesium bicarbonate solution.

In 1929 Grieder of Philip Carey applied for a patent to react the magnesium bicarbonate waste liquors with hydrated lime to make magnesium hydroxide as an additional raw material.(16)

Crowell of American Solvents obtained a patent for dissolving the magnesia trim with 75% carbon dioxide to magnesium bicarbonate.(17) Perry of Johns-Manville slurried the trim with water, separated the fiber, gassed the magnesia to magnesium bicarbonate and then boiled to magnesium basic carbonate.(18) Viewig of Johns-Manville reacted the trim with water and hydrated lime and gassed the result to magnesium bicarbonate.(19) Atchison of Johns-Manville gassed a weak suspension of trim and/or tailings and then reacted the result with lime.(20)

---

(16) Greider	U.S.P.	No.	1,864,063	granted	June 21, 1932
(17) Crowell	"	"	1,927,602	"	Sept.19, 1933
(18) Perry	"	"	2,299,721	"	Oct. 20, 1942
(19) Viewig	"	"	2,338,886	"	Jan. 11, 1944
(20) Atchison	"	"	2,373,528	"	Apr. 10, 1945

Soap Addition

Profit-wise an important development was the soluble soap addition patent[21] for lighter density for which Seigle of Johns-Manville applied on June 1, 1915. This or a similar patent was cross-licensed to the magnesia producers.

Greider of Carey followed by adding soap bubbles[22], by adding soap and calcium carbide[23], and by adding soap to the magnesium bicarbonate before boiling.[24] In this latter patent Greider claimed the soap retarded crystallization and produced small size crystals.

Williams of Johns-Manville claimed adding soap to magnesium normal carbonate[25] which was then pan cast, heated to set, and dried to finished insulation.

McGarvey of Armstrong claimed the addition of 5-30% soap [26], 5-30% asphalt and/or wax[27], and 5-30% stearic acid, as well as a mix of asphalt and clay[28]. The McGarvey patents claimed water-resistant magnesia and that the soap accelerated the pan cast set of magnesium normal carbonate.

Earlier water-resistant patents had been Norton of Asbestos Wood Company, who claimed a magnesium hydroxide insulation impregnated with liquid, oxidizable hydrocarbon like asphalt or wax[29], Wallace of Keasbey & Mattison for the incorporation of grease[30], and Hurrell of Johns-Manville for an outer, water-resistant covering over the insulation[31].

Dolomitic Insulations

Since recovery of magnesia from dolomite leaves a precipitated calcium carbonate which usually must be wasted, several inventors obtained patents on insulations made of mixtures of magnesia and calcium carbonate. Carlton Miller of Redwood City, under a Superex-type patent filed in 1924, claimed dolomitic magnesia as an insulation[32]. Greider of Carey obtained a patent with 33 claims to cover amphibole fiber and all mixes of magnesium basic carbonate and calcium carbonate[33], Grunwald (not assigned) covered a dolomitic pan cast self-set insulation[34], and Greider covered adding lime to magnesium bicarbonate which thus precipitated calcium carbonate and magnesium normal carbonate which was then pan cast and heated for self-set[35].

---

(21)	Seigle	U. S. P.	No.	1,228,485	granted	June 5, 1917
(22)	Greider	"	"	1,782,383	"	Nov.18, 1930
(23)	"	"	"	1,782,384	"	Nov.18, 1930
(24)	"	"	"	1,900,235	"	Mar. 7, 1933
(25)	Williams	"	"	2,172,861	"	Sept12, 1939
(26)	McGarvey	"	"	2,423,839	"	July15, 1947
(27)	"	"	"	2,423,840	"	July15, 1947
(28)	"	"	"	2,423,841	"	July15, 1947
(29)	Norton	"	"	865,606	"	Sept10, 1907
(30)	Wallace	"	"	1,678,659	"	July31, 1928
(31)	Hurrell	"	"	2,016,039	"	Oct. 1, 1935
(32)	Miller	"	"	1,811,516	"	June23, 1931
(33)	Greider	"	"	2,042,096	"	May 26, 1936
(34)	Grunwald	"	"	2,131,374	"	Sept27, 1938
(35)	Greider	"	"	2,262,953	"	Nov.18, 1941

Miscellaneous

Several patents which apparently were not commercialized were those of Ehret assigned to Ehret Magnesia for dipping magnesia insulation in magnesium bicarbonate and re-drying[36], Steffens of Carey for impregnating insulation with sodium silicate[37], MacIntire of American Zinc for a light, fluffy precipitate of calcium-magnesium carbonate by reacting slaked dolime with ammonia and carbon dioxide[38]. Seigle of Johns-Manville patented soaking asbestos fiber in magnesium bicarbonate before it was boiled[39]. This was tried for a while but then dropped. Miller of Keasbey & Mattison had an idea for the mechanical separation of calcium carbonate and magnesium normal carbonate[40].

Reactions with Magnesium Oxide

The eastern manufacturers were using dolomite as their source of magnesia but the West Coast producers used magnesite which they calcined and then carbonated to magnesium bicarbonate.

Grunwald of National Magnesia patented the removal of dead-burned magnesium oxide from the calcined magnesite before the remaining active material was carbonated[41]. On March 18, 1918, Grunwald applied for a patent for reacting magnesium bicarbonate with magnesium oxide to produce magnesium normal carbonate, which was then boiled to magnesium basic carbonate[42], and an apparatus for accomplishing this[43]. Much later Miller of Keasbey & Mattison covered the incomplete reaction of magnesium bicarbonate with magnesium oxide powder and the separation of the normal carbonate crystals[44].

At the turn of the century, Emil Rueff had been granted two patents[45] [46] for compounds which contained at least two molecules of magnesium oxide for one of carbon dioxide, together with water. Crowell of Western Industries at Agnew, California covered the undercarbonation of magnesium oxide[47].

Reactions with Alkali

The Germans had been processing magnesium chloride brines with alkali. Thus Silberman covered the reaction of magnesium chloride with ammonium carbonate[48].

---

(36)	Ehret	U. S. P. No.	1,559,564	granted	Nov. 3,	1925
(37)	Steffens	" "	1,765,312	"	June 17,	1930
(38)	MacIntire	" "	1,975,213	"	Oct. 2,	1934
(39)	Seigle	" "	1,982,542	"	Nov. 27,	1934
(40)	Miller	" "	2,358,818	"	Sept.26,	1944
(41)	Grunwald	" "	1,285,683	"	Nov. 26,	1918
(42)	"	" "	1,361,324	"	Dec. 7,	1920
(43)	"	" "	1,361,325	"	Dec. 7,	1920
(44)	Miller	" "	2,574,652	"	Nov. 13,	1951
(45)	Rueff	" "	630,115	"	Aug. 1,	1899
(46)	"	" "	694,424	"	Mar. 4,	1902
(47)	Crowell	" "	1,573,632	"	Feb. 16,	1926
(48)	Silberman	" "	1,163,475	"	Dec. 7,	1915

Anton Hamtloch produced a double salt of magnesium bicarbonate-sodium from dolomite and heated it to magnesium-sodium bicarbonate(49) and later heated the double salt under vacuum to magnesium normal carbonate(50).

Grunwald, who had left National Magnesia, applied on July 5, 1918, for a patent which was assigned to A. J. Merele for the reaction of bitterns containing magnesium chloride and magnesium sulfate with Trona (which is a naturally occuring salt of sodium carbonate and sodium bicarbonate)(51). Later, Abrahams of Plant Rubber applied on November 24, 1931 for a patent for the reaction of bitterns with artificial mixtures of sodium carbonate and sodium bicarbonate(52).

Pan Cast Self-Set Magnesia

On June 30, 1924, Bertram Grunwald, who had left both National Magnesia and Merele, applied for two patents which were to have a profound influence on the magnesia insulation industry. He had learned that if magnesium normal carbonate slurry was pan cast, heated for a time between 150-250F, and then dried, that the insulation did not shrink upon drying(53). He had also learned that if before being pan cast, the magnesium normal carbonate slurry was heated between 140-180F, it would expand in volume, and then could be pan cast to a lighter density, and dried without shrinkage(54).

In 1928 he approached Johns-Manville with his "Grunwald Process". His demonstrations were erratic and Johns-Manville turned him down. Grunwald then approached Commercial Alcohols of Montreal who paid him a fee and took a license.

Grunwald could not solve manufacturing difficulties at Commercial Alcohols, particularly those of slurry sticking to the pans, and of gas blow-holes in the product, and finally returned the fee. Commercial Alcohols worked on the process and finally made a product which Johns-Manville bought and sold in Canada for years.

Grunwald returned to California and interested Plant Rubber & Asbestos, who after development built a new plant for pan cast magnesia insulations at Emeryville, California.

Abrahams of Plant first applied for two patents, the first covering a pan cast self-set magnesia made from magnesium normal carbonate obtained from magnesium bicarbonate(55), and the second covering a pan cast self-set magnesia made from magnesium normal carbonate obtained by reacting bitterns and sodium carbonate(56). A few years later Abrahams covered the idea of adding bentonite to the magnesium bicarbonate before the production of magnesium normal carbonate, in order to make small crystals(57).

Of more importance was Abraham's patent for which he applied on March 8, 1939, in which he added a small amount of alkali (magnesium oxide) to the magnesium normal carbonate slurry before being pan cast to consume the carbon dioxide liberated during

(49)	Hamtloch	U. S. P. No.	1,540,391	granted	June 2, 1925
(50)	"	"	1,512,924	"	Oct. 28, 1924
(51)	Grunwald	"	1,298,932	"	Apr. 1, 1919
(52)	Abrahams	"	2,027,714	"	Jan. 14, 1936
(53)	Grunwald	"	1,573,603	"	Feb. 16, 1926
(54)	"	"	1,573,604	"	Feb. 16, 1926
(55)	Abrahams	"	2,209,752	"	July 30, 1940
(56)	"	"	2,209,753	"	July 30, 1940
(57)	"	"	2,339,041	"	Jan. 11, 1944

the self-set step and which had been the cause of the large blow-holes appearing in Grunwald's product(58). Unfortunately the oxide addition lowered the temperature limit of the Plant magnesia to 500F.

Plant Rubber also realized that the prolonged heating or setting of Grunwald's pan cast slurry could be shortened to as little as fifteen minutes by preheating the slurry and casting it in heated, jacketed pans. This permitted the designing of automatic machinery and precision machined molds.

In 1941 Plant Rubber offered to license their improved Grunwald process to the other magnesia manufacturers, including Johns-Manville. The advantages were lighter density (10 lbs compared to 14 lbs per cu ft), much less trim, automatic operation, and precision-molded magnesia. All turned it down at the time, probably for the usual reason of not wanting to make a product improvement when business was good (as in 1929) or because business was bad (as in 1935).

Variations on Self-Set

However, for some years a few of the magnesia producers had been carrying out research programs aimed at developing an improved magnesia. In 1935 Miller of Johns-Manville applied for a patent for heating magnesium bicarbonate below 200F(59) to produce a special type of magnesium basic carbonate, and in 1940 the same Miller who then worked for Keasbey & Mattison applied for a patent for magnesia made in a two-stage boil kettle(60).

Greider of Carey took out a series of patents, for magnesium normal carbonate made under special heat conditions(61), for adding magnesium normal carbonate to magnesium basic carbonate or to magnesium bicarbonate and then heating(62), for grinding the magnesium normal carbonate crystals before pan casting according to the Grunwald process(63), and for molding a mixture of magnesium normal and magnesium basic carbonates(64).

Gloss of Marine Magnesium Products which made magnesium chemicals at South San Francisco covered the aeration of magnesium bicarbonate to magnesium normal carbonate with a crystal feed back(65).

McGarvey of Armstrong carbonated a 7% MgO suspension to a thick slurry of magnesium normal carbonate which was then to be pan cast(66).

Greider of Carey claimed a heavy wall made of self-set magnesium normal carbonate(67) and Dinkfeld of Johns-Manville claimed heavy boards of self-set magnesium normal carbonate(68).

---

(58)	Abrahams	U. S. P.	No.	2,209,754	granted	July 30, 1940
(59)	Miller	"	"	2,084,588	"	June 22, 1937
(60)	"	"	"	2,330,836	"	Oct. 5, 1943
(61)	Greider	"	"	2,396,915	"	Mar. 19, 1946
(62)	"	"	"	2,275,032	"	Mar. 3, 1942
(63)	"	"	"	2,335,242	"	Nov. 30, 1943
(64)	"	"	"	2,348,898	"	May 16, 1944
(65)	Gloss	"	"	2,390,095	"	Dec. 4, 1945
(66)	McGarvey	"	"	2,409,297	"	Oct. 15, 1946
(67)	Greider	"	"	2,415,647	"	Feb. 11, 1947
(68)	Dinkfeld	"	"	2,348,614	"	May 9, 1944

Johns-Manville Process

On June 30, 1942, Dinkfeld of Johns-Manville applied for a patent involving magnesium normal carbonate slurry cast in a pan made of screen, which was submerged in hot water to set the slurry(69). On March 27, 1943, Cummins of Johns-Manville covered the extrusion of magnesium normal carbonate slurry of 15-18% concentration between moving belts submerged in hot water(70).

On September 10, 1945, Dinkfeld and Viewig applied for a patent involving pouring a thin slurry of magnesium normal carbonate into a screen filter mold which was submerged in hot water, to concentrate and to set the slurry(71). One claim of this patent called for preheating the slurry to above 130F before pouring it into the submerged filter mold.

On April 19, 1943, the Johns-Manville Officer's Board received a commercialization request for a new process for magnesia insulation which involved the gelling or flocculating of magnesium normal carbonate in several volumes of hot water for a number of minutes in a mold with a filter screen base immersed in hot water, then concentrating the expanded slurry with a filter ram, then replacing the ram with a crown ram, then curing the partly formed piece (still in the screen mold) for several minutes in hot water, and then final shaping of the filter molded piece with the crown ram.

The required magnesium normal carbonate was to be prepared by aeration of magnesium bicarbonate in a series of pools, and the carbon dioxide lost by the aeration was to be replaced by partial carbonation of the dolime with stack gas.

By October 26, 1945 the process had been simplified so that the magnesia slurry was expanded in hot water in separate "cluster" tanks, then poured into a mold box, filter molded under water, removed immediately from the mold, and cured under filter plates immersed in hot water(72).

In 1946 a "straight-line" commercial molder for block insulation was completed and demonstrated the process.

In 1947, a method of preparing the required magnesium normal carbonate crystals by vacuum decomposition of magnesium bicarbonate (which recovered the carbon dioxide and eliminated the need for stack gas carbonation) was developed and demonstrated.

In 1948 the straight-line molder for blocks was moved to Manville magnesia building and a year-long demonstration was started. The need for hold-down filter plates during hot water curing was eliminated. During the same year a "rotary" molder for pipe covering and block insulation was built and operated at the Research Center(73).

In 1949 the rotary molder was moved and started operation at Manville.

---

(69) Dinkfeld	U. S. P. No.	2,368,975	granted	Feb.	6, 1945
(70) Cummins	" "	2,428,555	"	Oct.	7, 1947
(71) Dinkfeld	" "	2,368,975	"	Feb.	6, 1945
(72) Honnig	" "	2,609,733	"	Sept.	9, 1952
(73) Hawthorne	" "	2,588,838	"	Mar.	11, 1952

Commercial Alcohols

The Montreal magnesia plant of Commercial Alcohols had burned in 1948. Commercial contracted with Johns-Manville for a license for New Process Magnesia and invested $500,000 in a plant at Gatineau, Quebec, which started in January, 1950, using carbon dioxide from an alcohol process and purchased magnesium hydroxide to make magnesium normal carbonate crystals in a carbonation-reaction continuous process developed by Johns-Manville. Two rotary molders were installed for production of blocks and of pipe covering up to 6 x 1 size. Commercial is still using their original molders, rams and cores.

Competitors

In 1948 Philip Carey, Ehret, and Mundet took licenses from Plant Rubber and built plants for the production of precision molded magnesia using the Grunwald-Plant Rubber process. The Plant Rubber men, Abrahams and Collonge went with Carey and Mundet respectively. The Keasbey & Mattison concern stayed with their old process magnesia.

Johns-Manville

In April, 1950, the Johns-Manville Board of Directors approved an appropriation for the purchase and installation of equipment for the complete conversion of Manville plant to New Process Magnesia.

At about the same time, the J-M process was still further simplified by eliminating the hot water cure of the magnesia after molding. Less complicated "reciprocating molders with only two flights and no water bath were designed and built for Manville.

Installation went slowly. It was decided that the flexible filter rams and cores which shaped the insulation were not sufficiently accurate and they were replaced partly with cast steel filter rams. The molders were made automatic.

By the summer of 1955, the production of New Process Magnesia exceeded old style magnesia at Manville.

In May, 1952, the Board of Directors approved an appropriation for a completely new plant for New Process Magnesia, Superex, and Thermobestos at Watson, California, to take the place of the old Redwood City plant. Thermobestos production started in July, 1954. The first New Process Magnesia at Watson was molded in January, 1955, and construction of the plant was completed in December, 1955.

Experience in production of New Process Magnesia has shown that the two problems of variation in density and fouling of molder filter screens have yet to be solved. Variation in density is caused by inadequate mixing tanks for the magnesia slurry and by measurement variation at the molders.

Fouling of molder filter screens is caused by magnesia which dissolves in the cluster tank water and then precipitates as a hard scale on the screens. The acid which must be used to dissolve the scale is expensive, time-consuming, and corrosive to the equipment.

Superex-Type Insulations

Insulations composed principally of diatomaceous earth have been referred to earlier in the Hanmore patent(5) for a covering of "fossil-meal, carbonate of magnesia, and fiber", in the Lumley patent(9) for an insulation of infusorial earth bonded with the fiber of cattails, and in the Borrowe patent(10) for equipment to shape magnesia or diatomaceous earth insulations.

Later patents deal mostly with various bonding agents for the diatomaceous earth and fiber. Thus Krieger of Los Angeles used gypsum(74), and sugar residue(75). Boeck of New York and Jordon of Glendale claimed that a mix of magnesium basic carbonate with diatomaceous earth would contain some magnesium silicate, especially if a small amount of alkali hydroxide was added(76). Winkley of Los Angeles used sodium carbonate, hydrated lime, and starch to bond the diatomaceous earth(77). Ottman of New Jersey used insoluble phosphate(78), and Siegle of Johns-Manville used water dispersed Bentonite(79).

C. E. Miller of Redwood City claimed dolomitic magnesia or calcium carbonate and magnesium basic carbonate as a bond, as well as dolomitic magnesia by itself as an insulation(32). He discussed the use of calcined earth but did not claim it.

Cummins of Johns-Manville in 7 method and 17 product claims covered the use of straight-calcined and flux-calcined diatomaceous earth in Superex-type insulations(80).

A British patent assigned to Turner-Newall covered diatomaceous earth bonded with calcium carbonate and magnesium carbonate together with sodium stearate which has been rendered insoluble with alum(81).

Greider of Carey patented separate magnesia and Superex-type insulations fastened together(82) as well as first molding Superex-type and then adding magnesia in the same mold(83).

Williams of Johns-Manville covered pan cast diatomaceous earth bonded with magnesium normal carbonate(84).

Present Superex-Type Insulations

Present Superex-type insulations with temperature limits from 1500F to 1900F and density range from 19 lbs to 27 lbs per cu ft consist essentially of calcined diatomaceous earth bonded with fiber, bentonite clay, and magnesia. In manufacturing, the bentonite causes slow filtration but adds strength after heat soak. The temperature limit and density depends essentially on the magnesia content which ranges from 5 per cent to 30 per cent.

---

(74)	Krieger	U. S. P.	No.	1,184,184	granted	1916
(75)	"	"	"	1,393,225	"	1921
(76)	Boeck	"	"	1,279,975	"	1918
(77)	Winkley	"	"	1,332,370	"	1920
(78)	Ottman	"	"	1,435,416	"	1922
(79)	Seigle	"	"	1,613,137	"	1927
(80)	Cummins	"	"	2,033,106	"	1936
(81)	Turner-N	Brit.	"	533,205	"	1941
(82)	Greider	"	"	2,284,439	"	1942
(83)	"	"	"	2,348,829	"	1944
(84)	Williams	"	"	2,388,549	"	1945

The advent of pan case precision molded, and filter cast precision molded magnesia placed Superex-type insulations at a manufacturing and product disadvantage. Superex-type insulations, due to the great proportion of diatomaceous earth, tend to be plastic when wet. In pan cast Superex-type, this has resulted in a weak final product. In the Johns-Manville filter molded process it at first resulted in slow filtretion and in a heavier density product.

The problem of slow filtration and heavy density in the Johns-Manville product was solved by thickening a water suspension of the diatomaceous earth with a small amount of lime, and by flocculating the bentonite with lime before adding them to the expanded magnesia in the cluster tanks at the molders.

While the addition of lime speeded filtration and lowered density, and also reduced after fired shrinkage, it had an adverse effect on the after fired hardness.

Research toward improvement in New Process Superex is directed toward finding a free filtering substitute for the bentonite clay. All the sodium compounds react to form slow filtering sodium silicates. Any calcium compound which reacts has the same effect as lime. Organic compounds like starch also form slow filtering complexes.

Recently Philip Carey has marketed an "All-Temp" insulation of 14 lb density for 1500F service which is made by mixing two-thirds of old process Superex-type and one-third of expanded Perlite, and filter molding in an old process press.

The problem of Superex is essentially one of costs. The heavier density material, compared to magnesia means that the raw material costs are higher. All the Superex pipe covering and most of the blocks are sold at magnesia prices.

The use of expanded Perlite in New Process Superex has been hindered because the temperature limit is lowered, the broken particles of Perlite tend to stick in the filter screens, foul them, and pull the molded insulation apart.

COPY FORM	INITIALS	DATE

BOX NUMBER	SEGMENT NO.	REQUESTING PARTY
P-163		Burns

NOTES