

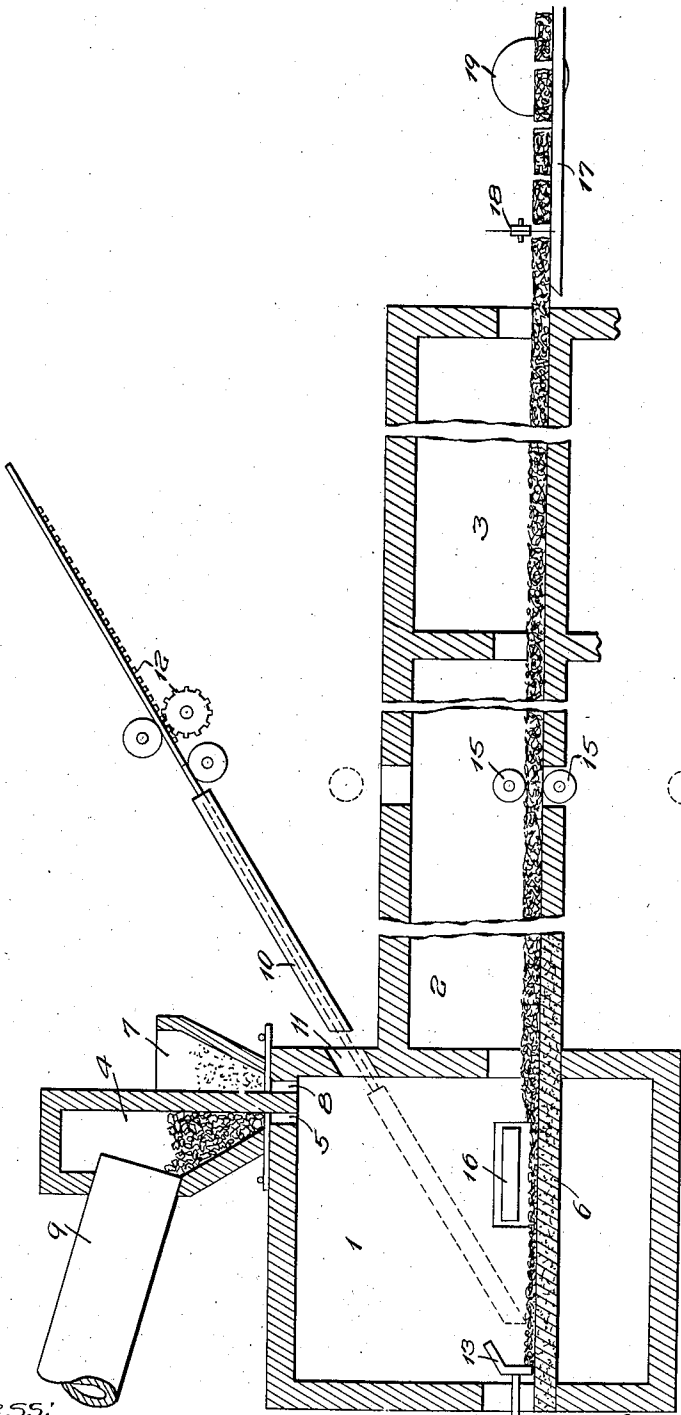
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PROCESS OF BLOATING AND ANNEALING CELLULAR BLOCKS

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SHERMAN Q. LEE AND WARNER HATHAWAY, OF MADISON, WISCONSIN, SAID LEE ASSIGNOR, BY MESNE ASSIGNMENTS, OF HIS ENTIRE RIGHT TO AMERICAN FACE BRICK RESEARCH CORPORATION, A CORPORATION OF ILLINOIS

PROCESS OF BLOATING AND ANNEALING CELLULAR BLOCKS

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This invention relates to process of bloating and annealing cellular blocks.

This invention is directed to a process of treating argillaceous or similar earthy material while in granular form, to a heating and annealing treatment for the purpose of producing building blocks and units or other articles of manufacture.

The product produced by the process of the present invention possesses high insulating qualities and is entirely impervious to moisture, and at the same time possesses sufficient strength to easily meet building requirements.

The material is of a cellular or vesiculated character throughout, having a structure very similar to that of baked bread, and is of such light weight that it readily floats in water and is otherwise well adapted for building purposes.

The process of the present invention includes a preheating step which is preferably formed under agitation in a rotary kiln, a bloating step which is performed in a furnace or kiln affording a heat zone which will ordinarily be held at a temperature of approximately 2200° F., and an annealing step, to which latter in particular the present invention relates.

It has been ascertained that after the granular material has been fused and bloated by the formation throughout of minute cells or cavities, and after it has assumed its ultimate dimensions, great care must be exercised in the annealing of the bloated product in order to prevent it from becoming fractured or shattered by the internal stresses incident to the cooling of the product down to room temperature.

While the material is in the bloating stage, it is in a fused condition and somewhat plastic or pliable, but it has been found that when the temperature is lowered by a comparatively small amount below the temperature of the bloating zone, a critical stage is reached at which the material congeals or solidifies, so that immediately thereafter it becomes brittle and incapable of deformation, and unless it is handled with care during the annealing

period it will develop cracks or fractures which render it unfit for the intended purpose. In order, therefore, to properly anneal the material, it is necessary to divide the annealing period into two stages, which may be referred to as the soaking stage and the cooling stage. During the soaking stage, the material, after its emergence from the bloating zone, is maintained at a temperature below that of the bloating zone, and which in practice has been found to approximate from 2000° F. to 2050° F. The bloated material should be maintained in the soaking temperature from one and a half to two hours under ordinary conditions, although both the bloating temperature and the soaking temperature may vary somewhat, depending upon the nature of the materials employed and the dimensions of the product subjected to treatment, the temperatures and times given being those appropriate to the production of a four inch thick slab bloated from certain clays from central and eastern Illinois, and serving for purposes of illustration only.

In all cases, the material should be held at a soaking temperature, which is intermediate between the bloating temperature at which the material continues actively to expand and the critical temperature at which the material congeals. Within the soaking zone, therefore, the bloating will be arrested, but the material will be maintained in a slightly plastic or fluid condition during a sufficient period of time to permit all of the internal strains or stresses to be disseminated throughout the mass and thus dissipated by the complete equalization of the temperature throughout, so that these strains or stresses will be eliminated before the material is introduced into the cooling zone and subjected to a progressively diminishing temperature.

It is important, however, during the cooling stage of the process to subject the material to a gradual decreasing temperature, partly in view of the fact that the bloated cellular material possesses high heat insulating properties, so that any sudden diminution in temperature will tend to cool the surface much more quickly than the interior, with a consequent tendency to shatter, due to in-

equalities in the rate of contraction throughout the mass.

By properly regulating the period of time devoted to the soaking stage, and by properly regulating the heat gradient during the cooling stage, the bloated material will be properly annealed, so that when ultimately discharged from the annealing chamber it will be free from cracks or fissures, and from internal strains which might tend later to develop cracks when the material is employed for building purposes.

In order to describe more in detail the technique observed in carrying out the present process, the various steps will be described as performed in a kiln, which illustrates diagrammatically a suitable apparatus for the performance of the process, although it will, of course, be understood that the apparatus shown serves merely for purposes of illustration.

The drawing illustrates a longitudinal sectional view of a kiln comprising a bloating chamber 1, a soaking chamber 2, and a cooling chamber 3. As shown, the bloating chamber is of boxlike formation, and the soaking chamber and the cooling chamber are separately formed in an elongated extension, to which the material is fed either by continuous or intermediate movement from the bloating chamber to the point of discharge.

The bloating chamber is provided on its roof with a hopper 4 which discharges granular earthy material through an orifice 5 onto the bed or hearth 6 of the bloating chamber. Adjacent to the hopper 4 is a hopper 7 which is adapted to discharge a lubricating material, such as sand, graphite or the like, through an orifice 8.

A preheater, in the form of a rotary kiln 9, is obliquely mounted, and has its discharge end entered into the hopper 4. Within the preheater, the granular material is heated to a temperature which will ordinarily be in the neighborhood of from 1500° F. to 1800° F., the desire being to preheat the material to a point but slightly below that at which the particles begin to fuse or adhere together, so that the material will be delivered to the hopper 4 from the preheater while still in a granular condition.

The preheated material is spread out in the form of a layer by the use of a suitable charging device, and for purposes of illustration a charger 10 is shown, which is in the form of an obliquely mounted plate having side walls or flanges, which plate is positioned to descend in an oblique direction through an opening 11 in the wall of the bloating chamber and is adapted to be actuated by suitable mechanism, such, for instance, as a rack and pinion 12, operable from a point outside of the bloating chamber.

In charging the material onto the floor or hearth of the furnace, the charging plate is

moved inwarding at a proper rate of speed to receive a thin layer of sand or other lubricating material from the hopper 7, and as the charging plate is withdrawn, the sand will be uniformly distributed in the form of a thin layer over the hearth of the bloating chamber. Thereafter the charging plate is again introduced into the bloating chamber and receives a charge of granular material which is uniformly distributed and laid upon a sand bed, which bed is utilized for the purpose of preventing adherence of the bloating material to the hearth of the furnace.

The bloating chamber will under ordinary circumstances be maintained at a temperature of approximately 2200° F., and the preheated granular material is allowed to remain in a quiescent or undisturbed state for a period sufficient to cause fusion or coalescence of the granular particles into a mass which while in plastic state will be bloated by the formation of cells occasioned by the expansion of gases contained in the material.

The bloating stage will continue until the mass has been thoroughly bloated, which will ordinarily occupy a period of from one-half to three-quarters of an hour, although the period may vary considerably, depending upon the nature of the materials employed, the thickness of the layer deposited upon the hearth of the bloating chamber, and the amount of gas-forming constituents present within the mass. Also, the bloating period may be increased or diminished to the degree required to secure the intended density. In all cases, the bloating will continue until the mass has been thoroughly fused, and the granular particles have completely coalesced together in the formation of a cellular block having the cells formed of vitrified material.

After the bloating stage has been completed, the material is discharged from the bloating chamber by any suitable means, such, for instance, as a pusher 13 operated by rollers 14, and where a continuous slab or column of material is being formed, the feeding movement can be assisted by the provision of draw rollers 15 located as shown in the cooling chamber 3. Furthermore, if desired, the bloated material can be subjected to a rolling process while still within the bloating chamber, by the provision of a roll 16, which is suitably manipulated to roll across the surface of the bloated slab and press down or even out any inequalities in the surface of the slab. The mechanisms shown, however, serve merely for purposes of illustration, since numerous variations in the form and arrangement in the various mechanisms can be introduced without departing from the spirit of the invention.

The bloated material is discharged into the soaking chamber 2 wherein the temperature is maintained at a point intermediate

the soaking temperature and the congealing temperature, and in the bloating chamber it is allowed to remain for a considerable period of time, which according to the present practice may be from an hour and a half to two hours, although of course the soaking time will depend on various factors, such for instance as the nature of the ingredients employed, and the thickness and density of the bloated slab.

Where the material is fed forward in the form of a continuous slab or column, the soaking chamber will be given an adequate length to permit the material to remain within the soaking zone for the required length of time, but where individual sections or disconnected units are bloated, the soaking chamber can be of suitable dimensions to permit an accumulation of such sections or units and they can be individually withdrawn from the soaking chamber after the soaking stage has been completed.

During the soaking stage, the bloated slab or slabs will be maintained while in a semi-plastic condition until the temperature of the slab has been equalized throughout and until all internal strains or stresses have been properly distributed and equalized, and thereafter the slab or slabs will be introduced into the cooling chamber, which is preferably constructed to provide for a variably decreasing temperature, so that as the slabs are advanced through the cooling chamber they will be gradually cooled, without, however, permitting violent temperature changes, so that throughout the temperatures at the surface and within the interior of the mass will be maintained substantially equal, with the result that violent strains or stresses are avoided.

After the slabs have been cooled down to room temperature, they are delivered onto a platform or table 17 where they may be sawed into blocks or units by the action of saws 18 and 19, or otherwise manipulated for subsequent use.

The slabs or blocks of material produced in the manner above described possess a substantially uniform cellular structure throughout without inter-communicating pores, interstices or crevices, and when properly treated the material will have a clear metallic ring, which in conjunction with its ability to withstand severe blows indicates its freedom from fractures or internal strains.

The material can be produced in the form of a continuous slab or column by feeding the successive charges of material in such a way that a newly deposited charge will overlap the terminus of a previously bloated charge, so that the bloating of the last deposited charge will cause a fusion and adherence of the materials, with the result that a continuous slab or layer may be produced

without discernable joints or points of juncture. However, the invention is not limited to the formation of the sections in the form of units thus bloated and fused together, since the process may, by constant accretions or small amounts of material, be deposited at the terminus of the bloating mass, or if desired the material may be spread in the form of superposed layers and bloated in this manner.

The present invention is therefore directed mainly to the treatment of the block, slab or continuous column, after it has been bloated in any suitable or desirable manner and during the annealing period, which as before stated is divided into the soaking stage and cooling stage.

For purposes of adequate illustration, the soaking chamber and the cooling chamber are shown as separate and distinct portions of the structure, but it will be understood that these chambers might under some conditions be merged together, provided only that the material is maintained at a substantially uniform soaking temperature for the required length of time, and before it is carried forward into a cooling region and subjected to a diminishing temperature during the cooling period. It will thus be understood that where such expressions are employed as the bloating zone, the soaking zone, and the cooling zone, these expressions have reference rather to the degrees of temperature maintained in the respective region than to any particular physical structure which is provided for affording or maintaining the zones in question.

It will also be understood that the material may be textured or colored in various ways during its period of treatment, but these details form no portion of the present invention, and need not be described herein.

We claim:

1. The process of treating earthy material in the production of a cellular mass, which consists in subjecting the material while under agitation to a temperature not exceeding that at which the particles retain their granular condition, continuing the heating at a higher temperature and with the material in a non-agitated condition to produce bloating to the desired dimensions, and continuing the heating at a soaking temperature intermediate the temperature at which active bloating occurs and the congealing temperature, for a sufficient period of time to eliminate internal strains, and finally in gradually cooling the material.

2. The process of treating broken up earthy material in granular form, which consists in subjecting a layer of such material to a bloating temperature sufficient in degree to cause fusion of the mass and bloating by liberation of internal gases, thereafter subjecting the bloated mass to a soaking temper-

ature intermediate the bloating temperature and the congealing temperature to permit the dissipation of strains and stresses throughout the mass, and thereafter gradually cooling the mass.

3. The process of treating broken up earthy material in granular form, which consists in subjecting a layer of such material to a bloating temperature sufficient in degree to cause fusion of the mass and bloating by the liberation of internal gases, thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to permit the dissipation of strains and stresses throughout the mass, and thereafter cooling the mass at a rate sufficiently gradual to maintain substantial uniformity of temperatures at the surface and in the interior of the mass to prevent shattering due to excessive inequality in the distribution of temperatures.

4. The process of treating broken up earthy material in granular form, which consists in first preheating the material under agitation to a temperature not exceeding that at which the particles retain their granular condition, then in subjecting a layer of such material to a bloating temperature sufficient in degree to cause fusion of the mass and bloating by the liberation of internal gases, thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to permit the dissipation of strains and stresses throughout the mass, and thereafter gradually cooling the mass.

5. The process of treating broken up earthy material in granular form, which consists in first preheating the material under agitation to a temperature not exceeding that at which the particles retain their granular condition, then in subjecting a layer of such material to a bloating temperature sufficient in degree to cause fusion of the mass and bloating by the liberation of internal gases; thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to permit the dissipation of strains and stresses throughout the mass, and thereafter cooling the mass at a rate sufficiently gradual to maintain substantial uniformity of temperatures at the surface and in the interior of the mass to prevent shattering due to excessive inequality in the distribution of temperatures.

6. The process of producing cellular bloated units of exact dimensions from earthy material, which consists in introducing successive charges of the material into a bloating zone at a temperature adapted to fuse the particles of each charge and produce a bloated mass, each succeeding charge being fused and bonded to the preceding bloated

mass to produce a continuous column, subjecting the bloated material to a soaking temperature intermediate the bloating temperature and the congealing temperature to eliminate internal stresses, and thereafter subjecting the material to gradual cooling to prevent shattering from temperature shock.

7. The process of producing cellular building units of exact dimensions from earthy material, which consists in preheating the material in granular form, introducing successive charges of the preheated material into a bloating zone at a temperature adapted to fuse the particles of each charge and produce a bloated mass, each succeeding charge being fused and bonded to the preceding bloated mass to produce a continuous column, subjecting the bloated material to a soaking temperature intermediate the bloating temperature and the congealing temperature to eliminate internal stresses, and thereafter subjecting the material to gradual cooling to prevent shattering from temperature shock.

8. The process of producing a cellular mass adapted for building purposes, from earthy material, which consists in introducing layers of substantially uniform thickness of the material into a bloating zone at a temperature adapted to fuse the particles and produce a bloated mass of cellular material, discharging the material from the bloating zone into a soaking zone maintained at a temperature intermediate the bloating temperature and the congealing temperature, and retaining the material in the soaking zone for a sufficient length of time to eliminate internal stresses, and thereafter discharging the material from the bloating zone to a cooling zone and subjecting the material to gradual cooling at a rate sufficient to prevent shattering from temperature shock.

9. The process of producing a cellular mass adapted for building purposes, from earthy material, which consists in preheating the material in granular form, introducing layers of substantially uniform thickness of the preheated material into a bloating zone at a temperature adapted to fuse the particles and produce a bloated mass of cellular material, discharging the material from the bloating zone into a soaking zone maintained at a temperature slightly below the bloating temperature and slightly above the congealing temperature, and retaining the material in the soaking zone for a sufficient length of time to eliminate internal stresses, and thereafter discharging the material from the bloating zone to a cooling zone, and subjecting the material to gradual cooling at a rate sufficient to prevent shattering from temperature shock.

10. The process of producing a cellular granular product from earthy material, which consists in preheating the material in granular form at a temperature of from 1500° F. to 1800° F., introducing charges of

said preheated material into a bloating zone maintained at a temperature of substantially 2200° F., and retaining the material therein for a sufficient period of time to fuse the particles of each charge and produce a bloated cellular mass, introducing the mass into a soaking zone maintained at a temperature of approximately 2000° F. for a sufficient period of time to eliminate internal stresses, and thereafter gradually cooling the material to room temperature.

11. The process of producing a cellular mass which consists in introducing a charge of earthy material into a bloating zone at a temperature adapted to cause fusion of the earthy material and expansion due to the formation of cells throughout the mass, and in thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to eliminate internal stresses, and thereafter cooling the mass.

12. The process of producing a cellular mass which consists in introducing a charge of earthy material into a bloating zone at a temperature adapted to cause fusion of the earthy material and expansion due to the formation of cells throughout the mass, and in thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to eliminate internal stresses, and thereafter cooling the mass at a sufficiently gradual rate to prevent shattering due to variations in contraction occasioned by abrupt surface cooling.

13. The process of treating earthy material in the production of a cellular mass, which consists in subjecting the material to a temperature not exceeding that at which the particles retain their granular condition, continuing the heating at a higher temperature and with the material in a non-agitated condition to produce bloating to the desired dimensions, and continuing the heating at a soaking temperature intermediate the temperature at which active bloating occurs and the congealing temperature, for a sufficient period of time to eliminate internal strains, and finally in gradually cooling the material.

14. The process of treating broken up earthy material in granular form, which consists in first preheating the material to a temperature not exceeding that at which the particles retain their granular condition, then in subjecting a layer of such material to a bloating temperature sufficient in degree to cause fusion of the mass and bloating by the liberation of internal gases, thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to permit the dissipation of strains and stresses throughout the mass, and thereafter gradually cooling the mass.

15. The process of treating broken up earthy material in granular form, which consists in first preheating the material to a temperature not exceeding that at which the particles retain their granular condition, then in subjecting a layer of such material to a bloating temperature sufficient in degree to cause fusion of the mass and bloating by the liberation of internal gases, thereafter subjecting the bloated mass to a soaking temperature intermediate the bloating temperature and the congealing temperature to permit the dissipation of strains and stresses throughout the mass, and thereafter cooling the mass at a rate sufficiently gradual to maintain substantial uniformity of temperatures at the surface and in the interior of the mass to prevent shattering due to excessive inequality in the distribution of temperatures.

In witness that we claim the foregoing we have hereunto subscribed our names this 27th day of June, 1930.

SHERMAN Q. LEE.
WARNER HATHAWAY.