UNITED STATES PATENT OFFICE

2,372,230

PROCESS OF PREPARING BUILDING COMPOSITIONS

Albert Sommer, Riverdale, N. Y.

No Drawing. Application June 12, 1940, Serial No. 340,055

11 Claims. (Cl. 106—281)

The invention relates to new processes of preparing building compositions which remain non-coalescent, on the basis of a pulverulent inert and under the conditions of the process non-liquifiable solid and an organic binding agent of the group which consists of the soluble and fusible bitumens, the thermoplastic resins, and the drying fatty oils and to products resulting therefrom.

It is an object of this invention to bring, by means of a dispersion process in air or another gaseous medium the corpuscles of which the composition consists or which the composition contains into a condition in which the cohesiveness of the binder particles is excited which, however, permits the composition to be stored and manipulated while the cohesiveness of the corpuscles is suspended; and ultimately, to bring the composition into the form of the desired structure, the cohesiveness of the particles or corpuscles being revived, and the structure compacted and solidified without the application of heat.

It is thus an object of the invention to maintain the composition in its loose or corpuscular non-coalescent condition up to the time when it is formed into the definite shape of the structure, and it may be so shaped, compacted and solidified immediately from the loose condition without the complication of melting, emulsifying or other conversion processes which require skilled personnel or special equipment.

This object is achieved in accordance with the invention by binding together particles of the pulverulent inert solid and of the organic binding agent by dispersion in air or another gaseous medium to corpuscles in which the solid forms the exterior phase or covers the particles of the binding agent.

Thereupon, whilst the corpuscles are kept apart from one another, again or still, by suspension in air or another gaseous medium, the phases are inverted so that the binder is the exterior phase and covers or coats the particles of the solid, and is rendered cohesive, its cohesiveness however being suspended by applying a protective layer of a liquid immiscible with said binding agent to the corpuscles whilst they are still in gas suspended state.

In this way the cohesiveness of the corpuscles is suspended and the coalescence of the cohesive corpuscles temporarily suspended up to the time when the mass is given the definite form or shape of the structure to be produced.

New building compositions may thus be obtained in the form of loose masses of corpuscles, the surfaces of which whilst being cohesive, are prevented from coalescing by protective layers, which masses may therefore be handled, stored, shipped in the same way as any other inert loose material without any risk of deterioration or changes by atmospheric conditions and, at the place of application, may be brought into the desired form, the protective layers may be eliminated and thus the cohesiveness of the corpuscles liberated and utilized for conglomerating, compacting, or solidifying the desired structure.

A pre-eminent feature of the invention resides in the fact that the binding process of the new building material is carried out in three stages.

(1) A first stage in which both materials, pulverulent solid and binding agent, are contacted to form corpuscles, the solid forming the exterior phase of the dispersion.

(2) By inversion of the phases, the cohesiveness of the binding agent is activated and, immediately thereupon, suspended by the application of protective layers; a stage in which the particles of the solid are bound to particles of the binding agent, while the outwardly effective cohesiveness of the corpuscles thus formed is kept in a latent or a potential condition.

(3) A stage in which the cohesiveness of the corpuscles is restored by non-thermic means and the corpuscles are agglomerated, with or without admixture of other materials.

The first 2 stages will preferably be carried out in a central plant, a factory or laboratory, or other place where the operations, even if complicated, may be executed by appropriate machinery, apparatus, and skilled labor, whereas the second stage, which requires comparatively simple means for eliminating the protective layers, and eventually, for compacting the material, may be carried out anywhere at any place.

The new processes of this invention may be utilized whereever and whenever particles of solid material are to be bound or cemented together by means of, or with, any organic binding agent, and eventually, together with additional aggregate. The processes thus may be used for the production of molded or press-molded bodies of any kind for building and constructing purposes, such as road work, pavements, flooring, wall covering, concrete structures, filling of joints, roofing material, waterproof coatings and insulation, or the like.

Accordingly, the expression "solid," for the purposes of the invention, includes any kind of inert material useful for the aforesaid purposes; mineral fillers, such as slate dust, calcium carbonate, talcum, kaolin, zinc-oxide, asbestos fines, or the like; hydraulic cement; pigments; fibres of cotton, wool, cellulose, paper, or wood, or other vegetable, animal, mineral or artificial fibres; wood flour, cork flour, sawdust, lignin, ground scrap rubber, or the like.

The expression "organic binding agent" as used herein, is intended to include any organic, preferably plastic material apt to be rendered cohesive by application of heat or solvents and, in its cohesive condition, to bind together the particles of the solid and, if desired, together with additional aggregate, material as understood under

the term of "thermoplastic resins." The expression "organic binding agent" may thus include resins, such as rosin or the like; bitumen, the designation "bitumen" being intended to include asphalts, either native asphalts or residuals originating from petroleum; or tar and pitches produced in the destructive distillation of coal, or the like.

The expression "binding agent" may further include drying fatty oils, e. g. linseed oil, or other oils which harden by oxidation or polymerisation under artificial or atmospheric conditions.

The invention permits of the attainment of great stability of the finished material.

By using a filler of sufficiently fine grade, the total surface which is covered by a binding agent can be made very large relative to the mass of the filler. In the mixture produced in the first stage of my process, the binder will therefore be spread over a large contact surface, so as to cover the filler particles in thin layers. When such a mixture is compacted, the stabilizing effect of the filler will prevail over the soft component of the binding agent because the latter will exist in the mixture in the form of thin layers between the particles of the filler to which they are intimately bound by cohesion.

When using bituminous matter for road building or constructing purposes, the invention permits of the application of soft bitumen which hitherto could not be used. This is due to the fact that in the compacted mass the binding agent is bound to the filler particles by an extremely fast and intimate cohesive bond. Thus, it will be possible to attain to a degree of stability which with other methods would require a bitumen of a higher flow point.

Accordingly, combination of filler with soft bitumen, e. g. bitumen of a penetration of not less than 100 and up to 120 or 130, 200, or even more, according to climatical or other conditions, the use of which is limited in conventional methods, may now be used.

For carrying out the first stage of my process, the binding agent is thoroughly dispersed in the pulverulent solid by any appropriate means, by spraying for instance. A valuable method for such dispersion is the contact atomization process which I have disclosed in detail in my U. S. Patents Reissue 20,119 and 2,125,860.

In this process, a pulverulent material, herein called "solid" is atomized by means of compressed air. Liquefied or liquid binder material is likewise atomized by means of compressed air, and the two clouds are caused to impinge upon each other within a mixing chamber. The particles of the solid and of the binder are thus brought into intimate contact and the binder will be deposited in minute particles upon the particles of the solid. The resulting corpuscles are held in suspension until they have cooled down to an extent to be no longer cohesive. The amount of binder thus deposited upon the particles of the solid will vary in accordance with prevailing conditions and may reach up to 60% by weight of the solid.

A mixture may thus be obtained which represents a dispersive system in which the solid forms the exterior phase and the entire mass retains the pulverulent condition of the solid, even if a liquid of low viscosity, e. g. a residual oil has been used as a binder. The apparent physical characteristics of the mass are those of its external phase, namely the solid. The stability of the system depends on the viscosity of the disperse phase, the binder, and the interfacial state of energy between the particles of the solid and the binder particles. The viscosity of the disperse phase under ordinary conditions is sufficiently high to resist the flowing of the particles, and there is an interfacial state of equilibrium in which the wetting of the particles of the solid by the binder particles deposited thereupon is counteracted.

In this stage, therefore, the cohesiveness of the binder particles is suspended. The next step will be the inversion of the phases or the activation of the cohesiveness of the binder. This step may be carried out either by subjecting the corpuscles to the action of a solvent or liquefier, or of heat. This inversion of the phases or activation may immediately follow the dispersion, or it may be effected simultaneously therewith.

With the application of solvent or heat to the dispersive system, the equilibrium is disturbed, viscosity and surface tension of the binder particles drop considerably. The binder particles will now wet and envelop the particles of the solid as minute layers or films, probably of less than 1 micron, and will simultaneously become cohesive and thus present the viscous and plastic characteristics of the binder. There results a strong cohesive action between particles of the solid and binder; the cohesiveness of the corpuscles has been activated, and thus the phases of the dispersion have been inverted. On the other hand, the outward effect of this cohesiveness, the coalescence of the corpulscles, is suspended by

(1) Agitating the corpuscles or otherwise keeping them apart from each other, by suspension in air or another gaseous medium, while in this gas suspended state.

(2) Protective layers of a liquid immiscible with the binder are applied to the surfaces of the corpuscles to prevent contact between them.

For these protective layers upon the corpuscles a liquid immiscible with the binder will be used. Water will be generally suitable for this purpose, however, according to the nature of the binder and the desired effect, other liquids may be used. For instance, in the case of a bituminated filler, alcohol in aqueous dilution may be used, specifically for frostproof preparations. In the case of drying oils as binders certain alcohols may be used which may become a valuable component in the final mixture.

By the application of protective liquid layers to the surfaces of the corpuscles, the cohesiveness of these surfaces is rendered ineffective and reduced to a latent condition.

After the excess liquid is drained off, a loose mass of corpuscles is recovered which will retain a small amount of liquid just sufficient to cover the corpuscles. This liquid is kept in place by capillary forces and cannot be removed without application of pressure or physical force. This mass is therefore extremely stable under normal atmospheric conditions and may be stored either in bulk, or in containers or bags for any length of time, handled, shipped, or otherwise manipulated at ease without any risk of the corpuscles coalescing by any inadvertent revival of the cohesiveness of the corpuscles.

For ultimate use, the corpuscles which are still provided with their protective liquid layers are brought into the form of the desired structure and the liquid layers removed by processes which will be described later on in detail.

For paving purposes the mass may be spread loosely upon the road-bed and subsequently compressed by rolling; playgrounds, tennis courts,

COATING OR PLASTIC

CROSS REFERENCE

Examiner

concrete roads may be covered, or ordinary streets may be surfaced with thin protective coats, or the material may be used for flooring purposes, or sprayed or spread upon felt, fabrics, cardboard, paper, or similar material for insulating or roofing purposes, or cast or rolled into webs or sheets, or it may be sprayed, if desired, together with Portland cement powder and sand, upon walls, ceilings, etc., or it may be used for filling joints or openings, and for general repair work. The process of this invention may be applied for the preparation of paints by coating filler particles, with or without the addition of pigments, with a painting oil, heating under agitation and holding the now coated particles separate by means of water layers. For ultimate use, the paint may be worked up in any convenient way.

By the method described, the particles of the solid are covered by the binder material and strongly linked thereto. The ensuing conglomeration and solidification therefore results from the action of binder upon binder without regard to the nucleus of the particles of the solid contained in the corpuscles. This renders possible the utilization of certain filler materials which it heretofore had been difficult or impossible to utilize in mixtures with bitumen. Dusts of colloidal fineness, light dusts, corkdust, etc. can be coated with bitumen or other binders in the manner described. Additional hard aggregate may be added to the dispersion before the activating process, thus for instance, sand up to 50% by weight, or more, to a dispersion of filler and bituminous material.

Light, highly voluminous insulating material may be made from fine corkdust with bituminated filler or by bituminating the cork-powder directly. By the application of pigments or other color material, coloring effects may be produced.

After the material has been brought into final shape, non-thermic means are applied to the material for eliminating the protective liquid layers and thus re-establishing the cohesiveness of the corpuscles which now will cohere to each other and solidify the structure. This possibility of solidifying the structure without the application of heat is of utmost importance as extremely simple, and, correspondingly, inexpensive processes may be used for carrying out the building or constructing operations.

The protective liquid layers may be removed by the application of pressure upon the mass of corpuscles, for instance by means of adequately weighted street rollers, tampers, or the like, or by applying the mass to a surface by means of a spraying pistol.

Water as a protective liquid may be removed by means of a hydraulic mineral such as lime, plaster, hydraulic cement, which materials, when admixed in appropriate quantities, will just bind the water present in the mass of corpuscles and separating their surfaces, and the hydraulic mineral by setting will assist in solidifying and compacting the structure.

By this means, a number of new structure or building compositions will be produced which excel in their stability and other mechanical characteristics. Concrete pavements or surfaces may be plasticized and elasticized without the necessity of applying complicated processes or specialist's work to the structure as would be required, for instance, with any application of heat in this stage of the process.

For further illustration of the invention I shall now give examples for the preparation and application of the new building compositions. It will be readily understood however that these examples are intended to be explicative but not limitative.

Example 1

85 parts of a mineral filler, 80% of which pass a 200 mesh sieve, are impregnated by contact atomization with 15 parts of bitumen of a penetration of 100. This material, in which the filler forms the exterior phase, is placed into a pug mill and is heated to 150° C. whilst being agitated and thus held in gas suspended state, and water in the amount of 30% by weight is added under constant agitation. When the mass has cooled down about half the amount of water will have evaporated, and a loose corpuscular material will result consisting of corpuscles the cohesiveness of which has been suspended. After the excess water has been drained off, the mass will retain 10%, down to 5%, of water.

Example 2

60 parts of a bituminous filler containing 25 percent of bitumen are heated in a pug mill to 140° C. and treated as in Example 1. At the location of the construction, the dispersion is mixed with 40 parts of dry filler or sand, and solidified by pressure.

Example 3

90 parts of a bituminous filler containing 18 percent of bitumen are treated as in Example 1. At the location of the construction, 10 parts of sand are added to the mass in a suitable mixer and the mass is applied to the structure as usual.

Example 4

80 parts of a bituminated filler containing 25 percent of bitumen, in which the filler forms the exterior phase, are agitated in a pug mill and and thus held suspended. Two percent by weight of a solvent naphtha are gradually admixed. After thorough homogenization the sticky but still loose mass of suspended corpuscles is thoroughly mixed with water, and the mass is then withdrawn from the mill.

Example 5

Two parts of a mass as prepared by Example 1, one part of pit sand, one part of Portland cement, are mixed with each other in a concrete mixer at the location of construction, and any amount of water which may be required to obtain proper consistency may be added. The mortar thus produced is handled and applied as ordinary cement mortar.

Example 6

A white neutral mineral filler, e. g. barytes, admixed if desired with a mineral pigment, is treated by contact atomization with 10 percent by weight of linseed oil. The mixture, after having been heated in a suitable vessel in air suspended state, in this state is sprayed with water and, after the excess water had been drained off, may be handled, stored, and shipped as a loose mass. At the place where they are used, the masses can either be worked up into an emulsion paint, or into another kind of paint by admixing them with a conventional or convenient liquefier.

I claim:

1. The process of producing a pulverulent building composition which remains in a non-coalescent state comprising a pulverulent inert filler and a binder of the group which consists of the soluble and fusible bitumens, the thermo-

plastic resins, and the drying fatty oils, which includes the steps of dispersing liquefied binder in the form of minute particles among dispersed minute particles of said filler in a gaseous medium thereby causing said binder particles and said filler particles to adhere to one another and to form non-cohesive and non-coalescent corpuscles, the filler forming the exterior phase of said corpuscles, applying moderate liquefying conditions to said binder particles thus reducing their surface tension and viscosity and rendering them cohesive whilst maintaining said corpuscles in gas suspended state apart from one another, and applying to said corpuscles while still in said gas suspended state a liquid immiscible with said binder to prevent their coalescence.

2. The process of producing a pulverulent building composition which remains in a non-coalescent state, on the basis of a mixture of a pulverulent, inert, and under the conditions of the process non-liquefiable solid and an organic binding agent selected from the group which consists of the soluble and fusible bitumens, the thermoplastic resins, and the drying fatty oils, which includes the steps of intimately dispersing in a gaseous medium minute liquefied particles of said binding agent among dispersed minute particles of said solid thereby forming non-cohesive and non-coalescent corpuscles in which particles of said binding agent are attached to particles of said solid, the solid forming the exterior phase of said corpulscles, submitting to moderate liquefying conditions the particles of said binding agent thus reducing their surface tension and viscosity and causing them to spread about the surfaces of the particles of said solid and to form cohesive coatings thereon whilst keeping the resulting cohesive corpuscles in gas suspended state apart from one another and thus preventing them from coalescing, and, immediately upon formation of said cohesive coatings and while maintaining said corpuscles in gas suspended state apart from one another, suspending their cohesiveness by applying to said corpuscles a liquid immiscible with said binding agent and causing it to cover said cohesive corpuscles in fine layers, for storing and manipulating the mass of said corpuscles in suspended cohesive condition and ultimately bringing said mass of corpuscles into the form of the desired structure by applying non-thermic means for eliminating said protective layers and thus re-establishing the cohesiveness of said corpuscles and causing them to coalesce and said structure to solidify.

3. The process of producing a pulverulent building composition which remains in a non-coalescent state, on the basis of a mixture of a pulverulent, inert, and under the conditions of the process non-liquefiable solid and an organic binding agent selected from the group which consists of the soluble and fusible bitumens, the thermoplastic resins, and the drying fatty oils, which includes the steps of intimately dispersing in a gaseous medium minute liquefied particles of said binding agent among dispersed minute particles of said solid thereby forming non-cohesive and non-coalescent corpuscles in which particles of said binding agent are attached to particles of said solid, said solid forming the exterior phase of said corpuscles, submitting to moderate liquefying conditions the particles of said binding agent thus reducing their surface tension and viscosity and causing them to spread about the surface of the particles of said solid and to form cohesive coatings thereon whilst keeping the resulting cohesive corpuscles in gas suspended state apart from one another by agitation and thus preventing them from coalescing, and, immediately upon formation of said cohesive coatings and while maintaining said corpuscles in gas suspended state apart from one another by agitation, suspending their cohesiveness by applying to said corpuscles a liquid immiscible with said binding agent and causing said liquid to cover said cohesive corpuscles in fine layers, for storing and manipulating the mass of said corpuscles in suspended cohesive condition and ultimately bringing said mass of corpuscles into the form of the desired structure, eliminating said protective layers and thus reestablishing the cohesiveness of said corpuscles and causing them to coalesce and said structure to solidify.

4. The process of producing a pulverulent building composition which remains in a non-coalescent state, on the basis of a pulverulent, inert, and under the conditions of the process non-liquefiable solid and an organic binding agent selected from the group which consists of the fusible and soluble bitumens, the thermoplastic resins, and the drying fatty oils, which includes the steps of dispersing by contact atomization minute liquefied particles of said binding agent with and among particles of said solid and causing them to adhere to one another and to form non-cohesive and non-coalescent corpuscles by controlling the process so as to cause said solid to form the exterior phase of said corpuscles; submitting to liquefying conditions the particles of said binding agent thereby reducing their surface tension and viscosity and causing them to spread about the surfaces of the particles of said solid and to form thin cohesive coatings thereon whilst keeping said corpuscles in gas suspended state apart from one another and thus preventing them from coalescing, and, while said corpuscles are still in said gas suspended state, adding a liquid immiscible with said binding agent and causing said liquid to cover said cohesive corpuscles in fine protective layers.

5. The process of producing a pulverulent building composition which remains in a non-coalescent state, on the basis of a pulverulent, inert, and under the conditions of the process non-liquefiable solid and an organic binding agent selected from the group which consists of the fusible and soluble bitumens, the thermoplastic resins, and the drying fatty oils, which includes the steps of dispersing by contact atomization minute liquefied particles of said binding agent with and among particles of said solid and causing them to adhere to one another and to form non-cohesive and non-coalescent corpuscles by controlling the process so as to cause said solid to form the exterior phase of said corpuscles; adding to said corpuscles an organic solvent for said binding agent thereby reducing the surface tension and viscosity of said particles of the binding agent and causing them to spread about the surfaces of the particles of said solid and to form thin cohesive coatings thereon whilst keeping said corpuscles in gas suspended state apart from one another by agitation and thus preventing the resulting cohesive corpuscles from coalescing, and, while said corpuscles are still in said gas suspended state, adding a liquid immiscible with said binding agent and causing said liquid to covef said cohesive corpuscles in fine protective layers.

6. The process of producing a pulverulent building composition which remains in a non-

COATING OR PLASTIC CROSS REFERENCE Examiner
96

coalescent state, on the basis of a pulverulent, inert, and under the conditions of the process non-liquefiable solid and an organic binding agent selected from the group which consists of the fusible and soluble bitumens, the thermoplastic resins, and the drying fatty oils, which includes the steps of dispersing by contact atomization minute liquefied particles of said binding agent with and among particles of said solid and causing them to adhere to one another and to form non-cohesive and non-coalescent corpuscles by controlling the process so as to cause said solid to form the exterior phase of said corpuscles; submitting to heat said corpuscles thereby reducing surface tension and viscosity of said particles of the binding agent and causing them to spread about the surfaces of said particles of the solid whilst keeping the resulting cohesive corpuscles in gas suspended state apart from one another and thus preventing them from coalescing, and, while said corpuscles are still in said gas suspended state, adding water to said corpuscles and causing a liquid immiscible with said binding agent and causing said liquid to cover said cohesive corpuscles in fine protective layers.

7. The process of producing a pulverulent building composition which remains in a non-coalescent state, on the basis of a pulverulent, inert filler and a bituminous binder, which includes the steps of bringing within a gaseous medium into mutual contact and to coherence dispersed minute liquefied particles of said binder and dispersed minute particles of said filler to form non-cohesive and non-coalescent corpuscles by controlling the process so as to cause said filler to form the exterior phase of said corpuscles; submitting to liquefying conditions the particles of said bituminous binder thus reducing their surface tension and viscosity and thereby causing them to spread about the surfaces of said particles of said filler and to form thin cohesive surfaces thereon whilst keeping said corpuscles in gas suspended state apart from one another and thereby preventing them from coalescing, and, immediately upon formation of said cohesive surface and while said corpuscles are still in said gas suspended state adding water to said corpuscles and causing said water to cover said cohesive corpuscles in fine protective layers.

8. The process of producing a pulverulent building composition which remains in a non-coalescent state, on the basis of a pulverulent, inert filler and a bituminous binder, which includes the steps of bringing within a gaseous medium into mutual contact and to coherence dispersed minute liquefied particles of said binder and dispersed minute particles of said filler to form non-cohesive and non-coalescent corpuscles by controlling the process so as to cause said filler to form the exterior phase of said corpuscles; reducing by application of heat surface tension and viscosity of the particles of said binder thereby causing them to coat in the form of minute cohesive layers said particles of said filler whilst keeping the resulting cohesive corpuscles in gas suspended state apart from one another by agitating same and while said corpuscles are in said gas suspended state suspending their cohesiveness by adding water to said corpuscles and causing said water to form fine protective layers upon the surfaces of said corpuscles.

9. The process of producing a pulverulent building composition which remains in a non-coalescent state comprising a pulverulent, inert filler and a binder selected from the group which consists of the soluble and fusible bitumens, the thermoplastic resins, and the drying fatty oils, which includes the steps of dispersing minute liquefied particles of said binder among dispersed minute particles of said filler in a gaseous medium and attaching them to one another to form discrete non-cohesive and non-coalescing corpuscles, the filler forming the exterior phase of said corpuscles; submitting said corpuscles while still suspended in said gaseous medium to heat sufficient to cause said binder particles to spread about the surfaces of said filler particles to which they are attached, and applying to said corpuscles while still in said gas suspended state a liquid immiscible with said binder and causing it to form fine protective layers upon the surfaces of said corpuscles.

10. The process of producing a pulverulent building composition which remains in a non-coalescent state comprising a pulverulent, inert filler and a binder selected from the group which consists of the soluble and fusible bitumens, the thermoplastic resins, and the drying fatty oils which includes the steps of dispersing minute liquefied particles of said binder among dispersed minute particles of said filler in a gaseous medium and attaching them to one another to form discrete non-cohesive and non-coalescing corpuscles, the filler forming the exterior phase of said corpuscles, keeping said corpuscles suspended in said gaseous medium by agitation whilst submitting them to heat sufficient to cause said binder particles to spread about the surfaces of said filler particles to which they are attached, and applying to said corpuscles while still in said gas suspended state a liquid immiscible with said binder and causing it to form fine protective layers upon the surfaces of said corpuscles.

11. The process of preparing a pulverulent building composition which remains in a non-coalescent state comprising a pulverulent inert filler and a bituminous binder which includes the steps of dispersing minute liquefied particles of said binder among dispersed minute particles of said filler in a gaseous medium and attaching them to one another to form discrete non-cohesive and non-coalescing corpuscles, the filler forming the exterior phase of said corpuscles; submitting said corpuscles while still suspended in said gaseous medium to heat sufficient to cause said binder particles to spread about the surfaces of said filler particles to which they are attached, and applying to said corpuscles while still in said gas suspended state water and causing it to form fine protective layers upon the surfaces of said corpuscles.

ALBERT SOMMER.