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METHOD OF MAKING CEMENTITIOUS BUILDING UNITS

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The manufacture of building-parts such as plates, pipes or the like from setting materials e. g. cement or the like, in case of emergency, mixed with pulverulent, granular or fibrous loadings of organic or inorganic nature is unsatisfactory, particularly owing to the fact that the parts manufactured in this way show a proportionately low initial strength, and consequently have to be secured with wood-work for a long time or pressed, at least treated very carefully. Apart from this the building-parts manufactured in this manner have many disadvantages e. g. they are more or less pervious to gases or liquids, they possess rough surfaces, they are easily attacked chemically, and so forth. Thus according to circumstances special methods are required to pack them to some degree, or to smoothen their surface, or to render them more resistant chemically.

These disadvantages are removed by a new method by which according to the invention a binding-material e. g. a substance plastic in heat on the basis of the celluloses, hydro-carbons, natural asphalts etc. or a substance capable of being hardened such as artificial resins e. g. on the basis of phenol etc. are admixed, and by which the mass obtained in this manner is compressed in heat to form the building-part e. g. by pressing, hydro-extraction or the like. The water required for setting may be added to the pressed mass, if need be. According to the invention tighter building-parts are obtained, however, by pressing the mass without addition of water, and only after this step to allow it to set e. g. in water. According to the invention it is particularly advantageous to allow the building-part to set under increased pressure and at increased temperature. Not only time is saved thereby, but also a more uniform setting is achieved.

Furthermore it is advantageous to apply the binding-material to the other materials very finely distributed which may be effected by any of the known methods e. g. by spraying.

The binding-material endows the building-part with a proportionately great initial strength immediately after moulding. It also gives it after setting a smooth and glossy surface. Furthermore, filling out the pores partially at least, it makes it proportionately impervious to gas and liquid. It may be chosen according to the chemical attack to be expected, and it protects the building-part particularly well, as it produces a tight surface layer, and as it is distributed evenly throughout the entire building-part. In this manner the surface of attack is considerably reduced, even if any place of the surface layer should be damaged.

Thus the new method not only simplifies the known methods of manufacture by the fact that by means of the binding-material a building-part having a relatively great initial strength is produced immediately, it moreover improves simultaneously the properties of the building-parts manufactured regarding tightness, quality of surface, and also chemical attack, particularly the latter by corresponding choice of the building-material.

The building-part resulting after the pressing process, the strength of which is essentially achieved by the binding-material added, may be worked according to the invention even before setting, e. g. it may be bored, turned, milled, ground etc., e. g. also provided with threads.

The percentage of binding-materials added may amount to approximately 8 per cent by volume, but it may also be above or below this amount. Thus e. g. one of the many pressing-masses possible may consist of cement, asbestos fibres and benzyl cellulose with the volumetric percentage of 78,5, 13.5 and 8 or the percentage by weight of 85, 12 and 3 respectively.

The binding-material, in this case the benzyl cellulose may be admixed to the cement and the asbestos fibres by any of the known methods as they may be covered with it respectively.

The pressing may be effected e. g. in heated pressing-moulds by hydraulic presses or for the manufacture of pipes e. g. in heated strand-presses.

But e. g. it may also be effected in cold, even refrigerated moulds into which the hot, pasty pressing-mass is pressed or sprayed respectively.

Naturally the percentage by volume and weight of the binding-material vary with the different compositions of the pressing-mass. They may be determined without difficulty by tests and find their lowest limit in the binding capacity of the binding-material which has to impart to the building-material the initial strength.

When building-parts are used for electrotechnical, chemical and electrochemical purposes, great demands are made on them on account of the simultaneous occurrence of various stresses such as heat, mechanical, electrical and chemical forces to which the building-parts made from a setting substance such as cement, in case of emergency mixed with loading, are but little equal.

Consequently special methods have been resorted to to protect such building-parts e. g. by impregnation, by coatings and the like against chemical attacks, so as to make them suitable

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for the purpose in view, such methods having met with little success, though.

According to the invention building-parts from setting substances, e. g. cement or the like, in case of emergency mixed with granular, pulverulent and fibrous loading of organic or inorganic nature e. g. asbestos fibres, are adapted to the demands made by a substance plastic in heat on the basis of celluloses, hydro-carbons, natural asphalts or the like e. g. benzyl cellulose, or substance capable of being hardened on the basis of artificial resins e. g. of phenol etc. being added in such quantity and in so fine a distribution that every particle of substance is covered with a film-coat, though an extremely thin one, and by the pressing mass being pressed under application of such a high pressure and at such a high temperature that all the pores are filled by the binding material plastic in heat or capable of being hardened, and by the surface being formed by a tight film of binding material. A building-part manufactured in this manner is then completely tight and free from pores, and this condition is preserved, when afterwards the mass is allowed to set under increased pressure and at increased temperature.

It is important that in the pressing-mass the binding material be not only finely distributed, but also to a great extent free from solvent, as otherwise pores might be left on separation of the solvent. If, thus, solvent is used for the sake of achieving fine distribution, such solvent must be removed previously in the known manner. In a like manner water should be added to the pressing-mass for setting, as otherwise cavities are formed.

After, pressing, the building-part which owing to the addition of binding-material already possesses a relatively great strength and is perfectly tight, is allowed to set according to the invention under increased pressure and at increased temperature.

By suitable choice of the binding material, of the setting substance, and in case of emergency, of the loading, it is thus almost always possible to adapt the building part to the requirements.

Due to the fine distribution of the binding material the building parts are considerably resistant to physical change of conditions and chemical attacks to which the binding material or the setting substance would not be equal by themselves.

After setting the building part retains its shape and firmness due to the rigid cement skeleton even at such temperatures where e. g. a binding material plastic in heat turns again plastic and viscous itself and no longer shows any strength. The fine distribution of the binding material may be carried so far that even solvents for the binding material can only separate the latter gradually even at higher temperatures, whilst softening agents can penetrate but slightly into the pores even when higher temperatures are applied. Building parts manufactured in this way may thus be used in softening agents for the binding material for years even at higher temperatures.

Thus the building parts possess not only the properties inherent to their individual component parts in common, namely to the setting substance, the binding material and in case of emergency the loading, such as e. g. at ordinary temperatures a great strength, absolute imperviousness to gas, a smooth glossy surface, good isolation against heat and electric current, and power of resistance in chemical respect, but they retain these properties even at higher temperature, where one of the substances used is lacking a certain property already e. g. where cement is lacking power of resistance in chemical respect, or the binding material e. g. cellulose stability of form.

The percentage of addition of binding materials may be varied within a lower and higher limit according to the purpose the binding material is to serve. If the building part is to become impervious to liquid or gas, the percentage by weight of the binding material may be kept at 6–12 per-cent and above it. If moreover it is to isolate particularly well, the percentage by weight may amount to 30% and more.

Naturally such percentage by weight varies with the different binding materials. They may be determined without difficulty by tests and find their lower limit at the percentage that suffices to fill up the pores, and their higher limit at the capacity of setting of the setting substance e. g. of the cement part.

By way of example the following pressing masses may be indicated in percentage by weight:

92% of cement and 8% of benzyl cellulose or 80% of cement, 11% of asbestos fibres and 9% of cellulose for building parts impervious to gas and liquid, isolating, lyeproof.

As an example for the building part of particularly good isolating power and chemically stable may be mentioned a mass of 70% of cement, 15% of asbestos and 15% of benzyl cellulose.

The individual component parts are coated by any of the known methods with the binding material e. g. benzyl cellulose, and the pressing mass attained in this way is pressed e. g. in heated pressing moulds by hydraulic presses, or for the manufacture of pipes e. g. in heated strand presses. But it may also be carried through e. g. in cold, even refrigerated moulds into which the hot, pasty pressing mass is pressed or sprayed respectively from which it separates without difficulty. So as to prevent the pressing part from sticking to the hot walls, when using heated pressing moulds, they are painted with some suitable repulsing liquid before bringing in the mass e. g. when benzyl cellulose is used, with paraffin oil. But in its stead the pressing mould may also be lined with thin paper which may easily be detached from the pressed article after the pressing. After the pressing the pressing part is thrown out and a little cooling suffices to give it a proportionately great strength. But the pressing may also e. g. be effected in a cool or refrigerated mould in which the pasty hot pressing mass is pressed or sprayed respectively under high pressure.

These building parts are particularly suitable as building parts for electric and electrolytical apparatus or the like.

When manufacturing tight building parts consisting of a setting substance such as e. g. cement or the like, in case of emergency in the mixture of granulous, pulverulent or fibre-like loading of organic or inorganic nature and a substance plastic in heat on the basis of the cellulose, hydrocarbons, natural asphalt or the like e. g. benzyl cellulose etc. or binding materials capable of being hardened on the basis of the artificial resins e. g. phenol or the like, and which are pressed tight under high pressure and at increased tem-

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perature, the setting of such building parts subsequently presents great difficulty.

If water has been added to the pressing mass before pressing, the building part becomes less tight, and besides it presents difficulties to add further water to the setting material. The setting method commonly used does not lead to any success whatever with a so tightly manufactured building part. Even when lying in water of 100 centigrades for months only the surface layer sets in fractions of a millimetre.

The tighter the building material is, the higher must be the temperature and the pressure to be applied according to the invention to allow it to set. Even with 8% by weight of cellulose temperatures of 100 and 150 centigrades and more and pressures of up to 5 atm. and more must be applied. Under these circumstances the building part will then set in about a week to a depth of about 10 mm. In this connection temperature, pressure and time do not depend only on the amount of the portion of binding material, but to a particularly large extent on its distribution. The more finely the binding material is distributed, the tighter the building part becomes and the longer the complete setting takes. The time of setting is shortened by increasing the temperature, whilst on the other hand there is also a lower temperature below which no setting takes place at all, if the building part is tight. The temperature is approximately somewhat over 100 centigrades.

After setting it shows particles of mud deposited on its surface which may easily be removed e. g. by brushing them off, whereupon a smooth and brilliant surface appears. The pressure may be increased by admission of gas e. g. by introduction of compressed air into the setting boiler, it may also be reduced, if the setting is effected with a solution of e. g. chloride of soda in water or some alkaline solution instead of water. In any case with these different means at hand, the setting process may be regulated in a simple manner.

During setting, the temperature is kept constant according to the invention to avoid formation of cracks.

The building parts manufactured in this manner are particularly suited for being used as building parts for electric and electrolytic apparatus such as batteries or the like.

To manufacture a complicated body consisting of many individual parts and intended to be tight, the individual parts are commonly pressed against one another with intercalation of special packings or pasted together by means of special adhesives. In all these cases the packing of the individual separating surfaces is unsatisfactory, at least in the long run.

According to the invention individual building parts which are combined from a setting substance e. g. cement or the like, in case of emergency in mixture with granulous, fibrous, pulverulent loadings of organic or inorganic nature and a substance plastic in heat on the basis of the celluloses, hydrocarbons, natural asphalts or the like e. g. benzyl cellulose or binding material capable of hardening on the basis of artificial resins or phenol etc. respectively, into a tight body by the building parts being pressed on one another with their separating surfaces and allowed to set in preference at increased temperature and under increased pressure e. g. in the case of cement in water or aqueous vapour.

In doing so, it is advantageous to keep at the same temperature the pressing pressure under which the individual parts are pressed against one another, lower than the pressure under which the individual parts are manufactured.

Then the building parts grow together at the separating surfaces and e. g. by pressing many rings against one another in setting a pipe may be made which is completely tight also at the separating surfaces of the individual ring. In case of emergency the individual surfaces may also be pressed together, whilst inserting building parts of metal or other materials, so that they fit closely. When setting the separating surfaces grow into each other and become completely tight. Though the building parts do not grow together with the metal parts, even these separating surfaces keep completely tight.

The fact of the building parts growing into one another is presumably due to the fact that in setting, particularly with increased temperature, they extend and grow into places where they meet no resistance, that is where there are slightly uneven places. The binding material plastic in heat is then pushed aside so that the cement grains of the individual building parts touch each other at the separating surfaces and may set. The lengthening which a body combined in such a manner experiences in setting amounts to about 1% of its length.

To facilitate the method the separating surfaces of the individual building parts may be treated according to the invention with a solvent for the binding material before they are combined e. g. they may be painted or sprayed.

By intercalating elastic members e. g. springs in the chucking device, provision is made according to the invention for the lengthening being able to take place under the adjusted counter-pressure, otherwise the body would be staved.

Bodies of such complicated structure which may consist of many hundreds of individual parts e. g. filter presses, troughs for batteries, electric and electrolytic cells, have proved to be completely impervious to gas and liquid after setting and retained this property permanently.

Thus the method does not only save the packings which in all other cases must be laid between the individual building parts but it also produces a tightness which cannot be attained for any prolonged period with special packing.

Even at greatly fluctuating temperatures and with the extensions or reductions connected with it the bodies remain tight which may be permanently secured by intercalating elastic bracings even when e. g. metallic elastic insertions contained in the body, gas or liquid pressures or the like tend it asunder.

When manufacturing building parts from setting substances, e. g. cement, in case of emergency in mixture with loadings such as grains, fibres, powders of organic or inorganic nature, e. g. asbestos fibres and a substance plastic in heat on the basis of the celluloses, hydro-carbons, natural asphalts or the like e. g. benzyl cellulose or binding materials capable of being hardened on the basis of the artificial resins e. g. of phenol or the like, it is important that every single particle of substance be coated by a film of binding material before bringing the pressing mass into the heated mould.

Further it is advantageous that the particles of pressing mass are given as globular a shape as possible so that they are evenly distributed over the mould and excessive pressures at single places are avoided.

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This may be attained according to the invention by the binding material being distributed evenly over the setting substance e. g. cement in case of emergency in mixtures with loadings, by means of a solvent. The distribution may in case of emergency be accelerated by stirring and heat. Thereupon provision is made under gradual withdrawal of the solvent e. g. by vacuum, in case of emergency at an increased temperature and by suitable mechanical treatment for the pressing mass to conglobulate gradually into more or less globular particles.

Apart from the even coating and the globular shape this method has the advantage that by adjustment of a definite vacuum and at a definite temperature the uniformity of the pressing mass can be fixed. It is also possible to retain definite small rests of solvent in the pressing mass or withdraw them practically entirely, if it is of advantage for the pressing step.

The method may now be described by one of the many examples of execution possible:

In a ball mill e. g. 92 parts by weight of cement and 8 parts by weight of benzyl cellulose are brought in and ground, a solvent for the binding material e. g. 10 parts by weight of benzol being added. The grinding may be effected according to the invention at an increased temperature e. g. at 100 centigrades so as to obtain a particularly fine distribution of the cellulose in the shortest possible time. After a short time a uniform distribution is attained and the benzol is gradually sucked off by a water jet pump and condensed for fresh use. Then the mill is stopped and the mass taken out. The cement parts are now coated with a very fine layer of cellulose and combined into globular particles in great quantity. This mass is put into the pressing mould.

The pressing process may take place e. g. in heated pressing moulds by hydraulic presses or in heated strand presses e. g. for the manufacture of pipes. In the latter case the mass may be fed continually and the strand of pipes pressed out be cut off in definite lengths.

In our case a pressing mould is being used. Owing to the globular shape the mass is rather easily distributed, even in more complicated moulds. The pressing mould is heated to about 130–150 centigrade whereby the binding material becomes plastic under the action of a strong pressure which may amount to many hundred atmospheres per square centimetre and be produced hydraulically. Under the influence of the temperature and the action of the pressure it bakes together in approximately one minute to form a finished pressed article.

What we claim is:

1. Method of producing pressed cementitious construction elements such as plates, pipes and the like, having a high initial strength and imperviousness prior to hydration, comprising the steps of mixing Portland cement with a diminuted filler and an organic thermoplastic material at elevated temperature to intimately combine the heated thermoplastic with the cement and filler, pressing the mixture into the shape of the desired article, whereby, due to the presence of the thermoplastic the pressed article is of relatively great strength, and thereafter hydrating the pressed article at elevated pressure and temperature, and letting the cement set.

2. Method of producing construction elements such as plates, pipes and the like, having a high initial strength and imperviousness, comprising the steps of mixing Portland cement with a diminuted filler and a solidifiable material, pressing the mixture into the shape of the desired article, and thereafter admitting water to the shaped article at elevated pressure and temperature, whereby the cement is caused to set.

3. The method claimed in claim 1, in which the hydrating step is carried out by means of steam.

4. The method claimed in claim 1, in which a sufficient amount of the thermoplastic material is added to the mixture so that each particle thereof is surrounded by a thin film of said thermoplastic material, and in which sufficiently high pressure and temperature are applied to the mixture, whereby all pores of the final article are closed and the surface formed by an impervious layer of the said solidifiable material.

5. The method of producing strong articles composed of units from cementitious material, comprising the steps of mixing a cementitious material with a solidifiable material, pressing the mixed materials into a plurality of separate units, pressing said separate units together to form the final article, and thereafter admitting water to the shaped article to cause the cementitious material to set.

6. The method claimed in claim 5, in which a solvent for said solidifiable material is applied to the meeting surfaces of said units before they are pressed together.

7. The method claimed in claim 1, in which said pressed articles are subjected to a machining operation such as cutting, milling or the like before the hydrating step.

8. The method claimed in claim 5, in which the pressure used for joining the separate units together is inferior to that applied to each unit individually.

9. The method claimed in claim 1, in which a solvent for said thermoplastic material is admixed to the mixture of cement, filler and the thermoplastic, subdividing the resulting mixture into small ball shaped clumps, whereby the thermoplastic is finely distributed throughout the mixture, and thereafter with drawing said solvent by means of a vacuum action, whereby each of said small ball shaped clumps acquires a film-like coating of thermoplastic material.

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