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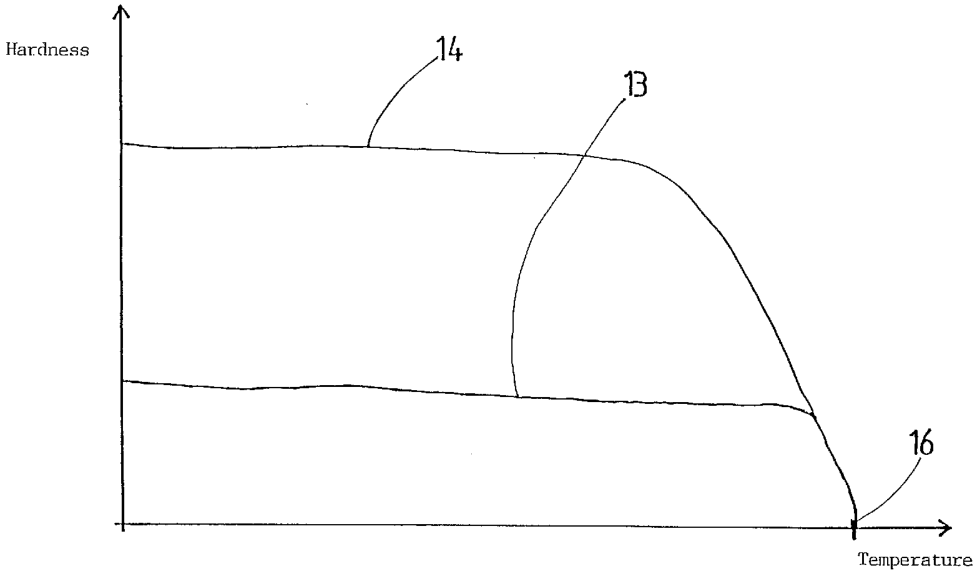
(54) Title: MATERIAL COMPOSITION



(57) Abstract: A material composition comprises, on the one hand, a particulate material and, on the other hand, a binder which is provided as a coating on the material particles. The binder has at least two solid phases (13, 14), of which one harder phase (14) is configurationally stable and a softer phase (13) is plastic and readily deformable at temperatures below the melting point of the binder. A method for producing the above material comprises the steps that at least two components included in the binder are melted and mixed, whereafter kneading takes place during cooling. The material composition is usable, for example, as a play material, educational material, for sculptures or prototypes or as landscape architectonic material..

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MATERIAL COMPOSITION

TECHNICAL FIELD

The present invention relates to a material composition comprising, on the one hand, a particulate or granulate material and, on the other hand, a binder which is provided as a coating on the particles or grains of the material.

The present invention also relates to a method of producing a material composition comprising a particulate or granulate material and a binder, with at least two components, which is solid at room temperature, the components included in the binder being heated above their respective melting points and mixed.

The present invention further relates to the use of a material composition

Finally, the present invention relates to a binder for a material composition, the binder comprising at least two components.

BACKGROUND ART

Different types of modelling clays and the like for producing figures or sculptures have long been known in the art, on the one hand for artistic purposes and, on the other hand as a plaything or educational material for children. The problems inherent in many of these clay-like materials is that they are sticky and greasy and, in many cases, require pre-processing in order to render the material formable to the desired extent. Unfortunately, these clays may, after a period of use, become excessively soft and as a result tend to lose their shape at the same time as tackiness increases. Another drawback inherent in this type of clay-like material is that they are impossible to harden so that, for example, they can be used in the construction of, for example, landscapes for model railways or as decoration in aquariums etc.

A slightly different type of material has evolved in recent years in the form of sand compositions that have formability properties which can be likened to wet sand. A number of representative examples of this type of material are disclosed in US 5,711,795 and WO 98/41408. These materials do not possess any real clay feeling as in the traditional modelling clays, but the graininess of the composition is manifest, i.e. the granulate structure of the sand included in the material is clearly apparent. The grains included in the sand or sand-like material have been coated with a layer of binder in order to hold together the grains when they are pressed against one another on the production of, for example, sculptures. The interspaces between the gains need not necessarily be entirely filled with binder, it being sufficient that the grains adhere to one another. Before working into different shapes, the material may very well be freely running, as is disclosed in, for example, US 5,711,795. A freely running material must be pressed together to form an unbroken, plastic body before, for instance, a sculpture can be produced therefrom. This is a major drawback.

The binder in these later compositions is a wax or wax-like material, for example beeswax. Unfortunately, this binder suffers from a number of drawbacks. One drawback is that was shows a tendency to gradually soften as the temperature increases. In such instance, it also becomes sticky. Such an increase in temperature, as typically takes place when the material is manually worked, implies that the material becomes even stickier and it is then difficult for the material to retain its pristine shape. When the temperature becomes excessively high, for example if the finished figures or sculptures are illuminated by powerful spotlights, they cannot always keep their shape but show a tendency to collapse or sink together.

At the same time, the wax is quite hard at lower temperatures and, in order to achieve the desirable formability, the material must first be processed or worked for a while. This may be tiring and demanding on the patience if the sand material is to be used by young children. A further disadvantage is that wax often gives a greasy or sticky feeling and the risk of stains on clothing or to the surroundings cannot be discounted.

PROBLEM STRUCTURE

There is thus a need in the art to realise a material composition which is of moderate softness for direct use and which maintains approximately the same softness throughout its entire service life, but which also may successfully be hardened in order to maintain the achieved shape. Moreover, the material should be suitable to be handled by children.

SOLUTION

The objects forming the basis of the present invention will be attained if the material composition intimated by way of introduction is characterised in that the binder has at least two solid phases, one harder phase being configurationally stable and a softer phase being plastic and readily deformable at temperatures below the melting point of the binder.

Regarding the production method, the object of the present invention will be attained if the method is characterised in that the binder composition is kneaded during the cooling, there being formed a softer, solid phase which is plastic and readily deformable at temperatures below the melting point of the binder.

The use according to the present invention is characterised in that the material composition is a composition according to any of Claims 1 to 6 and is used as a play material, an educational material, a landscape architectonic aid, sculptures, prototypes, a material for museum interior design an aquarium decoration, a material for industrial design or a liquid-proof layer in which event the sand material composition is formed to a desired shape.

Finally, the objects according to the present invention in respect of the binder will be attained if the binder is characterised in that it has at least two solid phases, a harder phase being configurationally stable and a softer phase being plastic and readily deformable at temperatures below the melting point of the binder.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

The present invention will now be described in greater detail hereinbelow, with reference to the accompanying Drawings. In the accompanying Drawings:

Fig. 1	is a block diagram showing the production process; and
Fig. 2	is a skeleton diagram of the hardness of the material as a function of the temperature in two different solid phases.

DESCRIPTION OF PREFERRED EMBODIMENT

In general, the material composition according to the invention consists at least of one binder and one particulate or granulate material. For such a material composition, it applies that it is important that a feeling of a certain graininess is obtained and that not excessive amounts of binder are added to the composition. The quantity of binder lies in the order of magnitude of between 1 volume % and 15 volume % of the finished material composition. Preferably, the binder concentration is between 2 and 10 volume %.

The grain size of the particulate or granular material included in the material is important, since it is a part of the control apparatus for absorbing the correct quantity of binder on the grains in order to obtain the sought-for handling properties. If the grains are too large, the absorbed quantity of binder on their surface will not be sufficient for the grains to hold together and function as a building material for models and figures, since large grains or particles have far too few points of contact with one another. If the grains are too small, their total surface area will be too large and the binder cannot cover the grains, which will have as a consequence that the finished composition will tend to be dusty as a result of uncovered grains that are released on kneading of the material composition. It might possibly be conceivable to provide an increase of binder in order to compensate for this, but such an increase often results in the material having an undesired consistency, since a part of the sand grains included will be wholly enclosed in the binder mass and the granular structure will be suppressed or disappear.

Since the object of the present invention is that each grain or particle will display, if possible, a wholly covering layer of binder, the size and natural density of the grains is of crucial importance at least as long as the recipes are calculated in weight %. For this reason, both weight and volume % are given in the table below.

If the natural density of the particles at constant particle size is high, such as, for example, in sand, they will have a surface per weight unit of 200 to 350 cm^2/g; if the natural density is medium high, as in ceramic light weight particles, the corresponding value will be approx. 1,000 cm^2/g; while in light particles (polymer light weight particles), it will be of the order of magnitude of 60,000 cm^2/g. Practical trials have shown that it is possible without difficulty to surface coat particles with a surface-weight ratio of at least up to 1,000 with the binder compositions pertinent according to the present invention, while it has proved to be impossible to achieve this if the surface-weight ratio is of the order of magnitude of 60,000 cm^2/g.

Correspondingly, the particle size at constant natural density of the particles also has an effect, since small particles have a larger surface in relation to weight. This effect must thus be superposed on the effect of the density. Trials have demonstrated that, with sand as the particulate material, mean particle sizes of between 0.02 and 0.5 mm can be handled, preferably between 0.05 and 0.15 mm.

As particulate material, use may be made of sand or other sand-like materials, but also ground marble, grains or balls of polymers, flying ash, microspheres of plastic, ceramics or glass which are hollow in order to achieve a lower weight in the material. Moreover, mixtures of several different types of sand or sand-like materials may be employed. The material must also withstand the temperatures that are attained during the production process, i.e. at least 60 to 120°C.

The material composition is intended, in many cases, to be handled by children even though adults may also greatly enjoy the material. As a result, the material composition should be non-toxic, both in normal handling and if minor quantities are swallowed or if a child licks its fingers after having handled the material composition. Further, the material should have a tolerable smell, so that neither those working with the material composition nor the surroundings find such handling unpleasant or repellent, both during and after handling.

The material composition should further have a well-balanced tackiness so that it is simple to cause the material to hold together for the formation of figures and/or sculptures. Moreover, it should be of moderate softness at the temperature at which it is intended to be handled, i.e. in general a room temperature of about 20°C. The softness should be such that the material can be used by children even though they have limited strength in the grip. The material should also be capable of being used immediately without any introductory working or kneading that requires patience. Nor should the material change properties after a period of handling, since it typically becomes warmer because of the temperature of the user's hands. The limited forces that are required for working the material also make for fine chiselling of the figures and sculptures that are produced without any advanced tools. The softness of the material should be constant so that it does not soften considerably on a slight increase in temperature during lengthy periods of time, a feature that, within the prior art technology, could occasionally result in finished sculptures collapsing or deflating. Finally, the material should also be such that it is not greasy or sticky. The material should not deposit residue on material such as clothes or carpets or other surfaces. This facilitates cleaning of the places where the material is used, such as dayhome nurseries and schools.

In general, the binder included in the material composition consists at least of, on the one hand, a polymer and, on the other hand, of a tackifier and a plasticizer such as a synthetic rubber or a so-called hot melt material containing a tackifier. Further, the binder possesses the property of being, at one and the same temperature of the order of magnitude of between 20 and 30°C, to have two different states, a soft, deformable and tacky state and a considerably harder, not readily formable and non-tacky state. How the different states are formed will be described in detail below. It should be emphasised that all binders with the above-indicated properties, and regardless of composition, may be employed according to the invention.

If the binder mixture, from molten state is quite simply permitted to cool, the hard state or phase will be formed. If, on the other hand, the binder mixture, during the cooling, is agitated or kneaded, the soft state or phase is formed. Exactly what mechanisms lie behind this surprising result are not known, but one hypothesis is that the mechanical processing disturbs the crystallisation of the polymer so that, instead of a stable (hard) crystal structure, there is formed a fine crystalline structure where the individual crystals are more or less completely enclosed by the amorphous synthetic rubber or some other tacky and amorphous material. Hereby, the amorphous properties would dominate and the material composition become soft and formable.

The previously mentioned properties regarding non-toxicity, smell, tackiness and softness depend for the greater part on the binder included in the material composition. A binder that, to a greater degree than prior art binders, satisfies these requirements is, in the preferred embodiment, a mixture of a polymer and a synthetic rubber, possibly a so-called hot melt material. It is to be particularly preferred if the polymer is an ethylene vinyl acetate polymer (EVA) and if the synthetic rubber is polyisobutylene. The softness and tackiness of the two ingredients are such that when they are mixed in suitable proportions, typically where the synthetic rubber constitutes between 20 and 35 weight % of the binder composition, the final product will be approximately as that just disclosed, but on condition that the following method is applied. Relatively hard polymers that per se are not tacky generally function well as a base for the binder.

Every admixture of synthetic rubber in the polymer improves its properties however, in particular as regards the desired softness. By an admixture of synthetic rubber, there will be obtained the possibility of obtaining the above-mentioned two solid phases, one soft and one hard solid phase. These phases can exist at the same temperature. The soft phase is readily deformable and plastic, while the hard phase is configurationally stable. The concentration of synthetic rubber may be quite high, approx. 20 to 35%, but should not exceed 50% of the binder composition given that the polymer is to be considered as the base of the binder. In one particularly preferred embodiment, 32.4% Oppanol® and 67.6%

EVA polymer were used. Further examples of mixtures will be disclosed in the table, both in weight % and in volume %.

The preferred method for the production of the binder is shown in Fig. 1 in the form of a block diagram. In step 1, the basic component, i.e. the polymer, which, in a hard state, may be considered as a crystalline material, is melted. The melting point lies in the range of between 60 and 120°C. In step 2, the melted polymer is mixed with the synthetic rubber or hot melt material which, already at room temperature, are to be considered as fluid even though with high viscosity (amorphous). This is occasionally described such that the material is cold fluid. Possibly, the mixture of the two included components may take place simultaneously with heating to the melting point of the polymer, i.e. steps 1 and 2 are carried out at the same time. In another vessel, the sand or particulate material which is to be included in the finished material is heated up, in step 3, to substantially the same temperature as the mixed melt of polymer and synthetic rubber.

In step 4, the mixture of polymer and synthetic rubber is agitated, kneaded or processed mechanically, at the same time as heat is given off, i.e. during cooling.

The heated particulate material or sand is added either before or during step 4, i.e. the kneading step. The desired result, i.e. the sand material with the desired properties, will be attained when the material has, on the one hand, been kneaded so much that the binder has reached its soft solid phase, at the same time as in principle all or the greater part of the included particles have received a coating of the binder and tend to separate, i.e. it is possible to have a certain spacing between the binder-coated grains. When this has taken place and room temperature has been reached, there will be obtained a sand material with a binder in the soft phase, i.e. the binder is in solid form but is soft and can be worked with the hands. Further, it is tacky. Preferably, the material is composite rather than freely running as was the case in the prior art technology.

The material composition is soft at both room temperature (about 20°C) and at storage temperature (about 10°C) and hand temperature (about 35°C). The material mixture is thus quite insensitive to temperature and maintains its superior working properties within a broad temperature range. It has been possible to ascertain that the softness of the sand material that is obtained in step 6 depends on how powerfully and prolonged the processing or working was which was carried out in step 4. Further, the softness and tackiness of the material composition increase the lower down in the temperature that the processing continues. It should however be noted that an excessive processing because of inner friction in the material composition can prevent a temperature reduction in this, or even cause the temperature to increase.

The softness and hardness, respectively, may be assessed, for example, by testing with a metal cone which is pressed against the material with a predetermined force over a predetermined period of time. The softer the material is, the deeper will be the depression after the cone. Other measurement methods also occur.

It has also proved in practical experiments that the higher the proportion of binder employed in the material composition, the harder it may be, and vice versa.

The material which is obtained in step 6 can then be directly worked into sculptures or figures without any pre-working or additional heating in step 7. When such a figure or sculpture has been created which is to be saved, it is possible to harden the sculpture by heating above the melting point in step 8. Such a heating may either be carried out in a normal household oven or, as may be necessary in larger sculptures or landscapes, with the aid of a hot air gun. In such an event, the binder will melt, but, since the viscosity of the binder is high, even in the molten state the shape and configuration of the sculpture will be maintained at least on condition that, at this point in time, it is not subjected to any mechanical action. This is a major advantage which may be further accentuated if particles of low natural density are employed, since the effects of the force of gravity will then be reduced.

Thereafter, the sculpture is left in step 9 to cool. Since no mechanical processing takes place in this step while the heat is dissipated, the binder will assume its solid, hard phase. At the same time, bridges of binder are also formed between the particles and, also in these bridges, the binder is in its hard phase. A permanent, hard figure will therefore be obtained in step 10. The figure is not only hard, but also water resistant. Thus, sculptures and landscapes that have been produced in this manner are possible to use as aquarium decoration or the like.

It is also possible in this step to obtain a shell structure if only the surface of a figure has reached the melting point of the binder. If, in such instance, the bottom of the figure is left unaffected, the interior of the figure will still be soft and can therefore be hollowed out. The same applies if a relief structure is created and hardened on its upper side, for example a landscape structure, whereafter the upper, hardened layer is lifted off from the substrate. In such instance, the soft, unhardened material on the underside of the structure will remain on the substrate.

If the intention is not to keep a hardened structure, it is possible to recycle it by heating to the melting point of the binder in step 11 and a subsequent kneading or other mechanical processing in step 12. In such instance, the material is recycled, when it has cooled to room temperature, to its original shape as in step 6. Thereafter, it is possible once again to work the material into new sculptures.

If desired, the sculpture may be reworked in that the heating in step 11 is followed by a local mechanical processing of the sculpture where it is desired to rework the sculpture. The heating in step 11 should also be partial. As a result of the renewed heating, the binder of the material will melt and before it has returned to its hard phase at room temperature, it is possible to work the figure further. Thereafter, it is possible once again to allow the sculpture to cool to its solid, hard phase. This may be carried out an indeterminate, not to say infinite number of times.

DESCRIPTION OF ALTERNATIVE EMBODIMENTS

In the foregoing, a mixture of a polymer and a synthetic rubber was described. It is possible to obtain corresponding material properties with a hard and soft phase, respectively, at room temperature even if the polymer, which is the base of the binder, has been replaced by microcrystalline wax. The addition of synthetic rubber may be modified to some degree depending on its proportion of the total composition. A number of examples of working compositions are given below in the table.

In the table, examples are given of compositions of polymers or wax and synthetic rubbers of different types. Those particles that are employed may also be of different types.

Escorene are copolymers of ethylene and vinyl acetate, and two different variations thereof are included in the table.

Luvax EVA 1 is an ethylene copolymer wax, while Luvax A is an ethylene homopolymer wax.

Those synthetic rubbers that are presented in the table are a couple of variations of Oppanol, which is a polyisobutene, Hyvis 2000, which is an isobutene, Vistanex, which is a polyisobutylene, as well as Dynapak, which is a polyisobutylene.

The particles that are employed are E-spheres, hollow ceramic spheres, or so-called cenospheres and Silica sand, which is silicate sand or natural sand. E-spheres have lower density than the sand, which implies that their surface area per unit of mass is greater at equal particle size. This implies that the concentration of binder in weight % must be greater for light particles than for heavy.

It is also possible to apply other methods for hardening of the surface of sculptures produced from the material composition in its soft phase. In such instance, a polymer dispersion is brushed or sprayed onto to the surface of the finished sculpture. Thereafter, the sculpture is not subjected to any further mechanical action. The applied polymers penetrate into the material composition in the interspaces between the coated grains included in the material composition. In order to facilitate this penetration, tensides have been added in the polymer dispersion in order to break down the surface tension. Moreover, an emulsifier is possibly also added. Since the sculpture, which is drenched in its surface layer with the polymer dispersion, is not subjected to any additional kneading, the polymers will set to a hard phase when the carrier in the dispersion has evaporated. The hard surface can be up to a centimetre thick. By such means, a shell structure will be realised which corresponds to that obtained if only the surface layer of a sculpture is heated, as was described above. If the desire is to recycle a sculpture which has been hardened using a polymer dispersion, a heating as described in step 11 with respect to Fig. 1 with subsequent kneading in accordance with step 12 would probably result in a soft material being obtained, as in step 6. However, the concentration of polymer in the recycled material has increased somewhat.

For the preferred embodiment, it was disclosed that the kneading begins immediately after the molten polymer has been mixed with the synthetic rubber, i.e. while the temperature of the composition is still close to the melting point of the polymer. However, it is possible to cool the compound partly without mechanical processing and only thereafter begin a kneading of the composition of the binder and the particulate material or the sand until such time as all particles are separated and have been coated with a surface layer of kneaded binder.

Yet a further alternative method is that the particles which have been mixed with the binder composition are cooled so that they separate and a stratum of binder hardens and sets on their surface. Thereafter, the coated particles are kneaded while cooling to room temperature continues. The more and longer the kneading is carried out, the greater will be the difference between the hard phase and the soft phase achieved in the binder.

The present invention may be modified further without departing from the scope of the appended Claims.

TABLE

	Polymer/wax	Synthetic rubber	Particle		
Recipe 1	Escorene MV02514	Oppanol B10N	E-Spheres SLG	Total weight (gram)	Total volume (cc)
Dosing (g)	4760	2040	130000	136800	
Weight %	3.5%	1.5%	95.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	0.40	Compacted density 0.45 g/cc	
Volume (cm^3)	5118	2217	325000		332336
Volume %	1.5%	0.7%	97.8%		100.0%
Recipe 2	Escorene MV30013	Oppanol B12N	E-Spheres SLG	Total weight (gram)	Total volume (cc)
Dosing (g)	5100	1700	61000	67800	
Weight %	7.5%	2.5%	90.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	0.40	Compacted density 0.45 g/cc	
Volume (cm^3)	5484	1848	152500		159832
Volume %	3.4%	1.2%	95.4%		100.0%
Recipe 3	Luvax EVA1	Hyvis 2000	E-Spheres SLG	Total weight (gram)	Total volume (cc)
Dosing (g)	5400	1360	38500	45300	
Weight %	12.0%	3.0%	85.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	0.40	Compacted density 0.45 g/cc	
Volume (cm^3)	5849	1478	96250		103578
Volume %	5.6%	1.4%	92.9%		100.0%
Recipe 4	Escorene MV02514	Vistanex LM-MS	E-Spheres SL150	Total weight (gram)	Total volume (cc)
Dosing (g)	4760	2040	130000	136800	
Weight %	3.5%	1.5%	95.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	0.40	Compacted density 0.45 g/cc	
Volume (cm^3)	5118	2217	325000		332336
Volume %	1.5%	0.7%	97.8%		100.0%
Recipe 5	Escorene MV30013	Oppanol B10N	E-Spheres SL150	Total weight (gram)	Total volume (cc)
Dosing (g)	5100	1700	61000	67800	
Weight %	7.5%	2.5%	90.0%	100.0%	
Density/bulk density(g/cm^3)	0.93	0.92	0.40	Compacted density 0.45 g/cc	
Volume (cm^3)	5484	1848	152500		159832
Volume %	3.4%	1.2%	95.4%		100.0%

	Polymer/wax	Synthetic rubber	Particle		
Recipe 6	Luvax EVA1	Hyvis 2000	E-Spheres SL150	Total weight (gram)	Total volume (cc)
Dosing (g)	5440	1360	38500	45300	
Weight %	12.0%	3.0%	85.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	0.40	Compacted density 0.45 g/cc	
Volume (cm^3)	5849	1478	96250		103578
Volume %	5.6%	1.4%	92.9%		100.0%
Recipe 7	Escorene MV02514	Dynapak Poly-4250	Silica sand GA39	Total weight (gram)	Total volume (cc)
Dosing (g)	4760	2040	330000	336800	
Weight %	1.4%	0.6%	98.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	1.50	Compacted density 1.50 g/cc	
Volume (cm^3)	5118	2217	220000		227336
Volume %	2.3%	1.0%	96.8%		100.0%
Recipe 8	Polyethylene wax PE520	Oppanol B10N	Silica sand GA39	Total weight (gram)	Total volume (cc)
Dosing (g)	5100	1700	165000	171800	
Weight %	3.0%	1.0%	96.0%	100.0%	
Density/bulk density (g/cm^3)	0.93	0.92	1.50	Compacted density 1.50 g/cc	
Volume (cm^3)	5484	1848	110000		117332
Volume %	4.7%	1.6%	93.8%		100.0%
Recipe 9	Luvax EVA1	Oppanol B15N	Silica sand GA39	Total weight (gram)	Total volume (cc)
Dosing (g)	5440	1360	106000	112800	
Weight %	4.8%	1.2%	94.0%	100.0%	
Density/bulk density(g/cm^3)	0.93	0.92	1.50	Compacted density 1.50 g/cc	
Volume (cm^3)	5849	1478	70667		77994
Volume %	7.5%	1.9%	90.6%		100.0%

Recipes 1 to 6 relate to light particulate material, while 7 to 9 relate to heavy particulate material, such as sand.

WHAT IS CLAIMED IS:

1. A material composition comprising, on the one hand, a particulate or granulate material and, on the other hand, a binder which is provided as a coating on the particles or grains of the material, **characterised in that** the binder has at least two solid phases (13, 14) of which one harder phase (14) is configurationally stable and a softer phase (13) is plastic and readily deformable at temperatures below the melting point (16) of the binder.

2. The material composition as claimed in Claim 1, **characterised in that** the softer phase (13) of the binder is attained after kneading of the binder during cooling from its melting point (16).

3. The material composition as claimed in Claim 1 or 2, **characterised in that** the harder phase (14) of the binder is attained after cooling while the binder is mechanically unaffected.

4. The material composition as claimed in any of Claims 1 to 3, **characterised in that** the binder has a first component which is synthetic rubber.

5. The material composition as claimed in Claim 4, **characterised in that** the second component in the binder is a polymer or a wax.

6. The material composition as claimed in any of Claims 1 to 5, **characterised in that** the grains in the particulate or granulate material have a grain or particle size of between 0.02 and 0.5 mm, preferably between 0.05 and 0.150 mm.

7. A method of producing a material composition comprising a particulate or granulate material and a binder with at least two included components which are solid at room temperature, the components included in the binder being heated (1) to above their respective melting points and mixed (12), **characterised in that** the binder composition is

kneaded (4) during cooling, one solid, soft phase (13) which is plastic and readily deformable being obtained (6) from the binder composition.

8. The method as claimed in Claim 7, **characterised in that** the particulate or granulate material is mixed (5) in the binder while this cools.

9. The method as claimed in Claim 8, **characterised in that** the particulate or granulate material is mixed (5) in the binder when this is in its fluid phase.

10. Use of a material composition as claimed in any of Claims 1 to 6 as a play material, educational material, a landscape architectonic aid, sculptures, prototypes or material for museum interior decoration or aquarium decoration, a material for industrial design or a liquid-sealing layer, the material composition being formed (7) to the desired shape.

11. Use as claimed in Claim 10, **characterised in that** when the sand material composition has been given its desired configuration, it is hardened in at least a surface layer by a temperature elevation (8) and subsequent cooling (9).

12. Use as claimed in Claim 10 or 11, **characterised in that** the material composition is, in its desired configuration, hardened by the application of a fixing agent on the surface of the shape.

13. A binder for a material composition, the composition comprising at least two components, **characterised in that** the binder has at least two solid phases (13, 14), of which one harder phase (14) is configurationally stable and a softer phase (13) is plastic and readily deformable at temperatures below the melting point (16) of the binder.

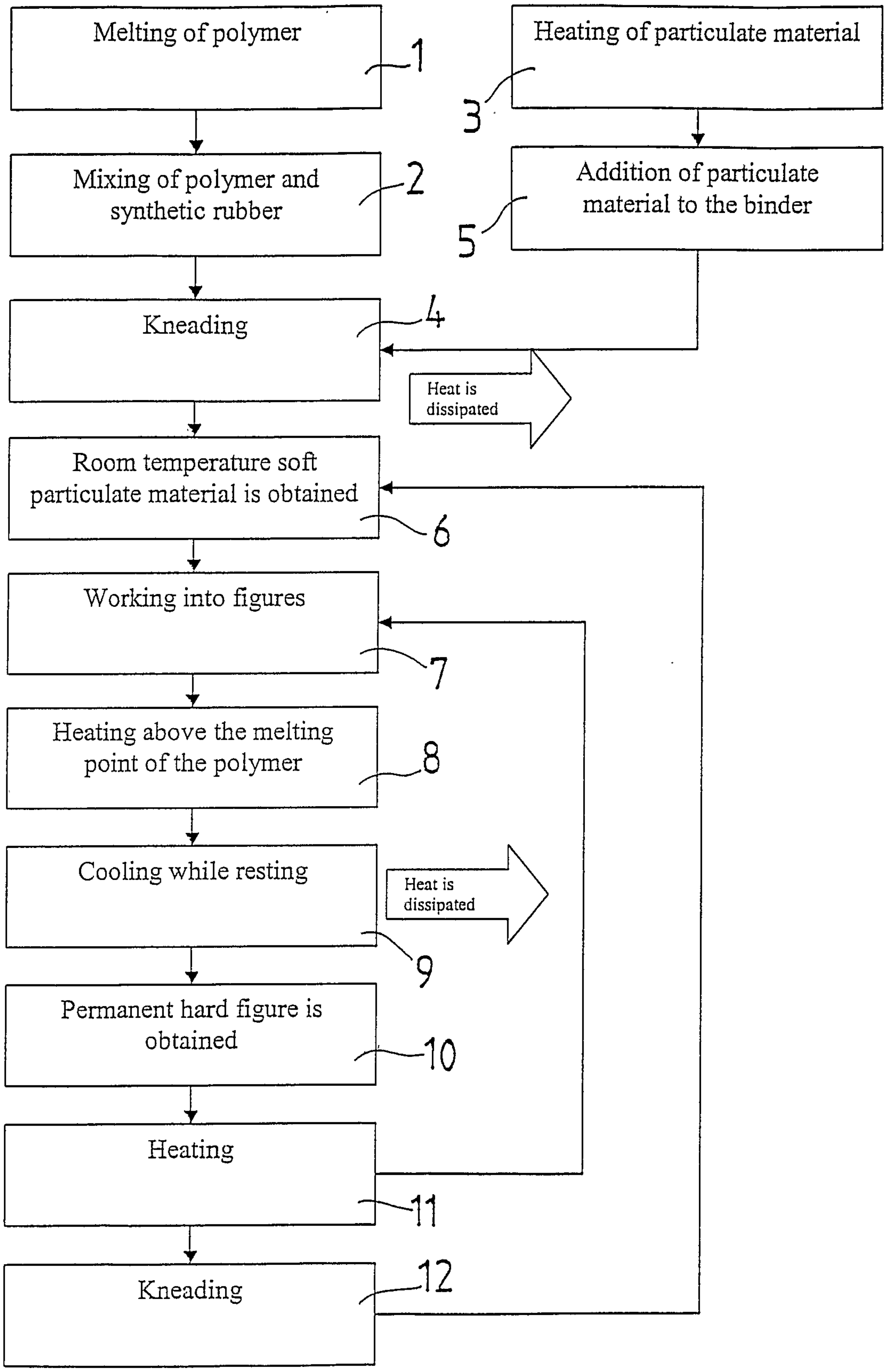
14. The binder as claimed in Claim 13, **characterised in that** a softer phase (13) is attained after kneading of the binder during cooling from its melting point (16).

15. The binder as claimed in Claim 13 or 14, **characterised in that** a harder phase (14) is attained after cooling while the binder is mechanically unaffected.

16. The binder as claimed in any of Claims 13 to 15, **characterised in that** a first component is a synthetic rubber.

17. The binder as claimed in Claim 16, characterised in that a second component is a polymer or a wax.

Fig 1


Melting of polymer
1
Heating of particulate material
3
Mixing of polymer and synthetic rubber
2
Addition of particulate material to the binder
5
Kneading
4
Heat is dissipated
Room temperature soft particulate material is obtained
6
Working into figures
7
Heating above the melting point of the polymer
8
Cooling while resting
Heat is dissipated
9
Permanent hard figure is obtained
10
Heating
11
Kneading
12

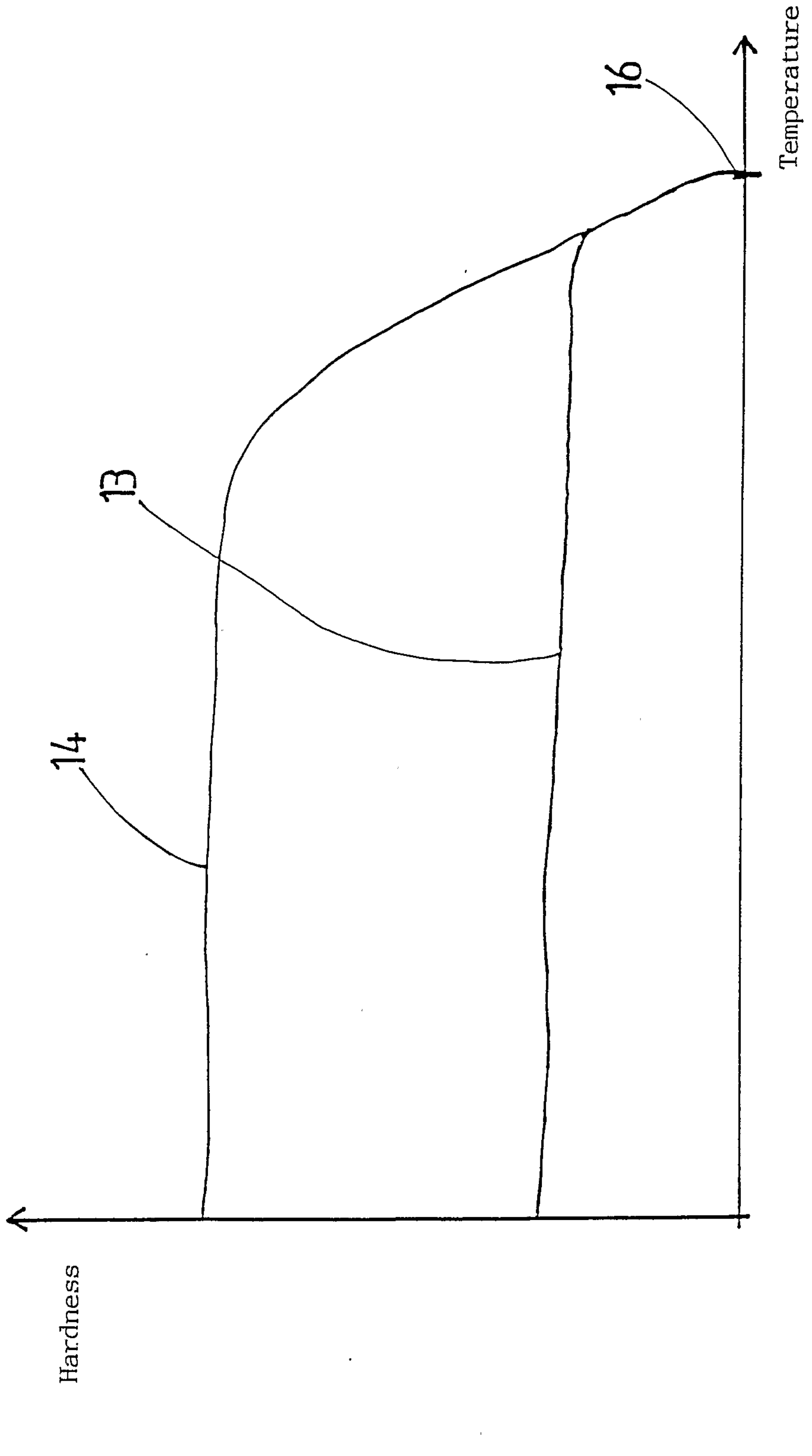


Fig 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/000357

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: C08L, C08K, C04B, B04C, B22C, A63H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SE 371101 B (G U U LUNDBERG), 11 November 1974 (11.11.1974), claims 1-4, page 1 paragraph 1; page 4 paragraph 2; example 4 --	1-5,10-17
X	US 5567757 A (THOMAS R. SZCZEPANSKI), 22 October 1996 (22.10.1996), column 1, line 29 - line 38; column 1, line 54 - line 56; column 4, line 21 - line 31, claim 1, abstract --	1-5M13-17

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search 29 June 2006	Date of mailing of the international search report 30 -06- 2006
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Monika Bohlin/Els Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/000357

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 199927 Derwent Publications Ltd., London, GB; Class A17, AN 1999-319011 & JP 11 111518 A (CI KASEI CO LTD) abstract --	1-5,13-17
X	WO 0007791 A1 (WINDSOR TECHNOLOGIES LIMITED), 17 February 2000 (17.02.2000), claims 1-20, abstract, page 3 paragraph 2; page 5 paragraph 6; page 6 paragraph 4; page 8 paragraph 4 - page 9 paragraph 6; example 1 --	1-6,10-17
X	US 5153039 A (JAY P. PORTER ET AL), 6 October 1992 (06.10.1992), column 1, line 46 - line 57; column 2, line 35 - line 43, claims 1-14, abstract, example 1 --	1-6,13-17
A	US 5711795 A (JAMES D. BROWNING), 27 January 1998 (27.01.1998), column 3, line 6 - line 12, abstract, examples --	1-17
A	SE 511814 C (DELTASAND AB), 29 November 1999 (29.11.1999), abstract --	1-17
A	US 20030131758 A1 (JOHANN BREINDL ET AL), 17 July 2003 (17.07.2003), abstract, paragraphs 7-18 --	1-17
A	DE 20200796 U1 (J.S. STAEDTLER GMBH & CO.), 20 June 2002 (20.06.2002), page 2 - page 3, abstract, examples --	1-17

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/000357

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19615896 A1 (BEERMANN, NORBERT), 17 July 1997 (17.07.1997), column 1, line 40 - line 53, abstract --	1-17
A	WO 9903936 A1 (MATTEL, INC.), 28 January 1999 (28.01.1999), figure 1, abstract --	1-17
A	US 5374384 A (ROBERT R. BERKS), 20 December 1994 (20.12.1994), figure 1, abstract --	1-17
P,X	US 6881781 B1 (GUILLERMO GAMBA), 19 April 2005 (19.04.2005), column 1, line 49 - column 2, line 50; column 2, line 63 - column 4, line 1, abstract, examples -- --------	1-17

International patent classification (IPC)

A63H 33/00 (2006.01)
B22C 1/20 (2006.01)
B44C 3/04 (2006.01)
C04B 26/04 (2006.01)
C08L 101/12(2006.01)
C08L 91/06 (2006.01)
C08K 3/34 (2006.01)
C08L 23/08 (2006.01)
C08L 23/20 (2006.01)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2006/000357

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 1-3 and 13-15 in part
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

See separate page

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Cont. of Box II

Claims 1-3 and 13-15 lacks clarity in the sense of Article 6 PCT. The expression "the binder has at least two solid phases" used in claims 1 and 13 can be interpreted in more than one way. One interpretation is that the binder is non-homogenous, i.e. the binder comprises at least two non-compatible phases. However, it is clear from the description that the binder is homogenous but can exist in at least two different solid phases at temperatures below the melting point depending on how it has been treated. It is this, latter interpretation that has been searched by the ISA.

Present claims 1-3 and 13-15 relate to a composition comprising a binder defined by reference to a desirable characteristic or property, namely that the binder can exist in at least two different solid phases at temperatures below the melting point depending on how it has been treated. The claims cover all binders having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and / or disclosure within the meaning of Article 5 PCT for only a very limited number of such binders. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lacks clarity (Article 6 PCT). An attempt is made to define the binder by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to binders as defined in claims 4-5 and 16-17.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

04/03/2006

International application No.
PCT/SE2006/000357

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