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(21) International Application Number: PCT/GB95/02181 (22) International Filing Date: 15 September 1995 (15.09.95) (30) Priority Data: 9418889.3 20 September 1994 (20.09.94) GB (71) Applicant (for all designated States except US): BOWERS, Jacqueline, Mary [GB/US]; Miracle Recreation Equipment Co., P.O. Box 420, Monett, MO 65708 (US). (71)(72) Applicant and Inventor: BOWERS, Frank [GB/US]; Miracle Recreation Equipment Co., P.O. Box 420, Monett, MO 65708 (US). (74) Agents: McNEIGHT, David, Leslie et al.; McNeight & Lawrence, Regent House, Heaton Lane, Stockport, Cheshire SK4 1BS (GB).		(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and be republished in the event of the receipt of amendments.</i>
(54) Title: PRE-MIXED POLYMER COMPOSITIONS (57) Abstract There is disclosed a method of producing a pre-mixed porous polymeric composition comprising the steps of: encapsulating granules of rubber to isolate any contained curing agent or water; mixing a moisture curing quasi-prepolymer or prepolymer with the encapsulated granules, in a low moisture or moisture free environment; depositing the mixture, in a low moisture or moisture free environment, into containers which are impermeable to water vapour or which have a low water transmission rate; storing the mixture containing containers for later use; and when required without further mixing, applying the composition to a suitable sub-base and allowing the composition to polymerise by reaction with water.		

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Pre-Mixed Polymer Compositions

This invention concerns a method for the production of pre-mixed porous polymeric compositions, particularly, though by no means exclusively, suitable for use in the formation of impact absorbing surfaces or substrates for sports or childrens' play areas.

Known such impact absorbing surfaces comprise granules of natural or synthetic rubber, such as SBR and EPDM for example, in a matrix of polymer, such as polyurethane for example.

The matrix may completely fill the spaces between the granules to give a non-porous composition or may simply coat the surfaces of the granules to cause them to adhere leaving the interstices between the granules void to give a porous product.

Either kind of composition may be laid to form a sports or play surface or to form a substrate to another surface such as that provided by synthetic turf for example.

The compositions are prepared on site immediately before installation by accurately metering out the granules, liquid pre-polymer and, if necessary, a catalyst, and thoroughly mixing them prior to laying in the manner of asphalt.

The on-site preparation necessitates the use of mixing equipment and trained operators regardless of the size of the project. It would be desirable to eliminate

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the need for accurate on-site metering of constituent materials and thorough mixing thereof by pre-mixing the granule and pre-polymer and storing this mixture for later application. However, attempts to do so have previously been thwarted by unwanted polymerisation of the pre-polymer induced at mixing by the presence of moisture on the surface of the granules or curing agents present in the granules and after bagging by the diffusion of atmospheric moisture through the bag walls.

It is an object of the present invention to provide a method and materials for production of a pre-mixed porous composite which overcomes the disadvantages aforesaid.

According to a preferred aspect of the invention there is provided a method of producing a pre-mixed porous polymeric composition comprising the steps of :

encapsulating granules of rubber to isolate any contained curing agent or water;

mixing a moisture curing quasi-prepolymer or prepolymer with the encapsulated granules, in a low moisture or moisture free environment;

depositing the mixture, in a low moisture or moisture free environment, into containers which are impermeable to water vapour or which have a low water transmission rate;

storing the mixture containing containers for later use;

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when required, and without further mixing applying the composition to a suitable sub-base and allowing the composition to polymerise by reaction with water.

Any water present may be removed from the granules prior to encapsulation.

The water to effect polymerisation may comprise atmospheric water or water applied as an atomised mist.

The granules may comprise natural or synthetic rubber and may be in the size range of from 1 mm to 10 mm.

The encapsulating agent may be polyurethane.

Processing of the granules may be carried out in a closed reactor or in an open system maintained at positive pressure by a stream of moisture free gas.

The removal of water from the rubber granules may be effected by evaporation at temperatures greater than room temperature. The evaporation may be carried out in a tunnel kiln.

Alternatively, the water may be removed from the granules by washing with a moisture solvent and the granules dried by a stream of moisture free gas.

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In both of the above instances, the moisture free gas may be dry carbon dioxide, dry nitrogen or moisture free air.

The pre-polymer may be polyurethane based.

The pre-polymer may contain a catalyst in sufficient quantity so as not to cause polymerisation in the stored container but reduce the time required for polymerisation after application of the composition.

The encapsulation of the granules and the mixing of pre-polymer with the rubber granules may be carried out with ribbon mixers.

The water may be removed from the rubber granules by a chemical reaction.

A method of producing a pre-mixed porous polymeric composition in accordance with the present invention will now be described with reference to the accompanying drawing which shows a plant design for the production of pre-mixed polymeric compositions wherein water is removed from the rubber granules by evaporation.

Rubber granules 10 of between 1 and 10 mm diameter are fed onto the conveyor belt 12 of a tunnel kiln 14. A portion of the tunnel kiln is heated to a temperature well in excess of room temperature, and the granules are slowly passed through this portion in order to evaporate moisture from the surface of the granules. In

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a typical evaporation process the granules may be heated to temperatures of around 160°C for a period of about 10 minutes.

The granules, now near moisture free, are passed into a ribbon mixer 15. A Diphenylmethane-4, 4'Di-Isocyanate pre-polymer is metered at the rate of 0.5% to 5% by weight of granules into the mixer 15.

The pre-polymer cures on the hot granules to encapsulate them with a coating of polyurethane. The granule/ pre-polymer mixture does not agglomerate due to the action of the mixer.

The encapsulated granules are emptied into a hopper 16. A stream of dry, refrigerated carbon dioxide or nitrogen gas or moisture free air is expanded into the bottom of the hopper at positive pressure with respect to ambient gas pressure via gas input ports 18,20. The gas stream has the effect of cooling the hot granules. The now heated exhaust gas from the hopper is ducted through the tunnel kiln at positive pressure; this process inhibits the intake of wet, atmospheric air into the tunnel kiln.

From the hopper the granules are metered into a ribbon mixer 22 along with an appropriate amount (5% to 35% by weight of the pre-coated granules) of a moisture curing polyurethane based pre-polymer. A catalyst such as amine based may be added with the pre-polymer in sufficient quantity so as not to cause polymerisation during storage but to reduce the time required for polymerisation after application of the composition. The positive pressure of the dry gas also prevents ingress of wet, atmospheric air during this operation.

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The mixture of dry granules and pre-polymer from the ribbon mixer is ducted to a bagging assembly 24, wherein water impermeable bags are filled with the granule/pre-polymer mixture. The water impermeable bags may comprise aluminium foil lined polythene sacks. The bags are opened, filled and sealed in the stream of dry gas, and once again the positive pressure of the gas stream inhibits seepage of wet, atmospheric air into the dry confines of the bagging assembly and the bag itself.

After sealing, the bags of mixed polymeric composition may be stored before use. At ordinary temperatures storage for up to a year is possible. The water transmission rate of the containers is an important factor in determining the shelf-life of the product. This storage lifetime may be extended still further by storing at cooler temperatures. The polymeric composition may be installed to produce an impact absorbing surface by simply emptying the bags of pre-mixed polymeric composition and spreading the composition on a suitable sub-base. The composition polymerises by reaction with ambient, atmospheric water vapour or by reaction with water applied as an atomised mist.

It will be appreciated that it is not intended to limit the invention to the above example only, many variations, such as might readily occur to one skilled in the art, being possible, without departing from the scope thereof as defined by the appended claims.

One such variation involves the removal of moisture from the granules by washing same with a dry solvent.

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Another variation involves coating the granules with an agent such as an isocyanate derivative. The agent removes water from the surface of the granules by chemical reaction.

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CLAIMS

1. A method of producing a pre-mixed porous polymeric composition comprising the steps of:-

encapsulating granules of rubber to isolate any contained curing agent or water;

mixing a moisture curing quasi-prepolymer or prepolymer with the encapsulated granules, in a low moisture or moisture free environment;

depositing the mixture, in a low moisture or moisture free environment, into containers which are impermeable to water vapour or which have a low water transmission rate;

storing the mixture containing containers for later use; and

when required, and without further mixing, applying the composition to a suitable sub-base and allowing the composition to polymerise by reaction with water.

2. A method according to claim 1 wherein water is removed from the granules prior to encapsulation.

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3. A method according to claim 2 wherein the removal of water from the rubber granules is effected by evaporation at temperatures greater than room temperature.

4. A method according to claim 2 wherein the water is removed from the granules by washing with a moisture free solvent and the granules dried by a stream of moisture free gas.

5. A method according to claim 2 wherein the water is removed from the rubber granules by a chemical reaction.

6. A method according to any preceding claim wherein the granules comprise natural or synthetic rubber and are in the size range of from 1 mm to 10 mm.

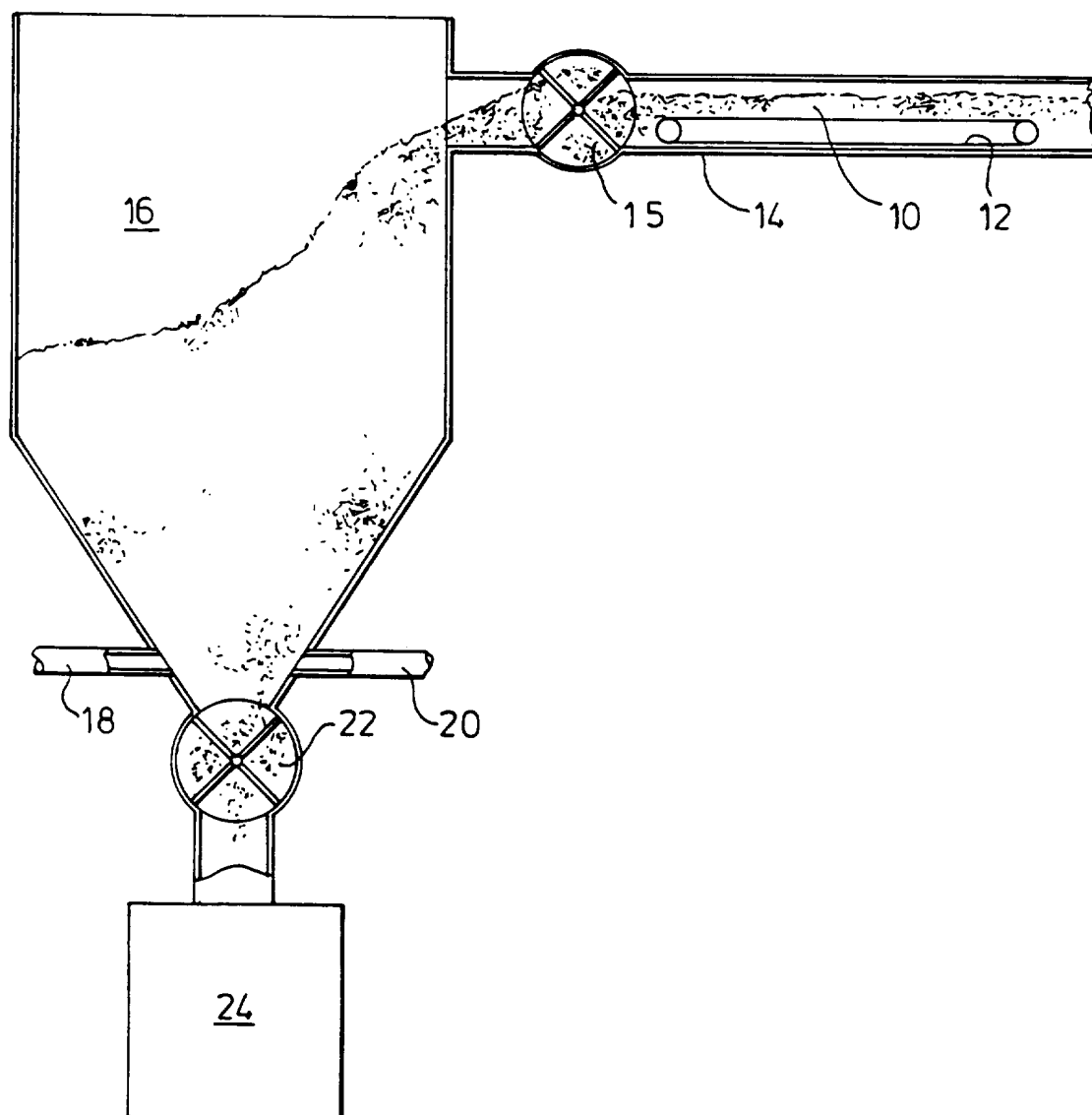
7. A method according to any preceding claim wherein the encapsulating agent is polyurethane.

8. A method according to any preceding claim wherein the per-polymer is polyurethane based.

9. A method according to any preceding claim wherein the per-polymer comprises a catalyst in sufficient quantity so as not to cause polymerisation in the stored composition but reduce the time required for polymerisation after application of the composition.

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10. A method according to any preceding claim wherein processing of the granules is carried out in a closed reactor or in an open system maintained at positive pressure by a stream of moisture free gas.



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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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 6 C08L C09J C08J E01C C08G

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant page	Relevance to claim No.
A	US,A,4 107 100 (BASF AG.) 15 August 1 see claims 1,2 see column 5, line 41 - line 46 ---	1
A	EP,A,0 216 344 (PHILIPP, LAUS ULRICH) April 1987 see claims 1,9,10 ---	1
A	DATABASE WPI Derwent Publications Ltd., London, GB; AN 84-097117[16] & JP,A,59 041 501 (DAIICHI KOGYO SEIYAKU) 7 March 1984 see abstract --- -/--	1



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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