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(54) A PROCESS FOR COATING CEMENTITIOUS SUBSTRATES

(71) We, MONIER RESEARCH & DEVELOPMENT PTY. LIMITED, a Company incorporated under the laws of the State of New South Wales, Commonwealth of Australia, of Monier Square, Villawood, near Sydney, in the State of New South Wales, Commonwealth of Australia, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to composite cementitious building elements and structures, and to a process for coating such elements and structures with a protective and/or decorative film. The cementitious building elements and structures to which a film may be applied according to the invention include roofing tiles, paving slabs, floor slabs, and wall cladding.

It is frequently necessary or desirable to coat cementitious building elements and structures with a protective film to protect them from atmospheric or vapour attack, or merely to improve their appearance. To this end, it is well known to apply one or more coats of paint to a finished building. Furthermore, various methods have been proposed for coating or glazing building materials prior to their emplacement in a building.

The main problems encountered have been in the deterioration of the coatings or glazes, and in the tendency of such coatings and glazes to separate from their cementitious substrates.

In accordance with the present invention, there is provided a process for coating a cementitious substrate, which comprises casting, pressing, extruding or otherwise forming at least an outer layer of said substrate, applying a non-aqueous coating medium to said substrate before any curing of said substrate or outer layer has taken place and before any water is lost, and then

curing the whole assembly so as to produce an intimately bonded laminated product, wherein said non-aqueous coating medium consists of a non-saponifiable film-forming coating material dissolved in a non-aqueous solvent, with or without pigments and/or plasticisers.

One major benefit of the process according to the invention is the suppression of efflorescence. In the normal curing process of cementitious materials such as Portland cement (which occurs at a significant rate for as much as two years), calcium hydroxide is evolved. Normally, this calcium hydroxide is attacked by atmospheric carbon dioxide to produce an efflorescence of calcium carbonate. The calcium carbonate is unsightly, particularly on a coloured substrate, and the calcium hydroxide is removed from the curing process.

Another major benefit of the process according to the invention is that the film-forming material forms an impervious barrier which immediately prevents evaporation of water from the substrate as it cures. The retention of this water results in a stronger set than would otherwise be attained.

A third benefit of the process according to the invention is that the product is more attractive than a conventional, uncoated product.

The invention also comprises a building element comprising a cementitious substrate coated with a protective non-aqueous medium consisting of non-saponifiable film-forming coating material dissolved in a non-aqueous solvent, with or without pigments and/or plasticisers, said protective coating medium being intimately bonded to the substrate by the application of the coating medium to the substrate before any curing of said substrate or the outer layer of the substrate has taken place and before any water is lost, and then curing the whole assembly.

The cementitious substrate may comprise

sand and/or coarse aggregate and a cementitious binder of which a typical example is Portland cement, although other cementitious binders may be used. This substrate may be pressed, cast or extruded into its final shape and will typically have between 5% and 15% by weight water added to enable it to be so moulded and to promote a hydraulic set. In some embodiments, the sand and aggregate may be omitted without deleterious effect. In such embodiments the substrate consists entirely of a cementitious material to which sufficient water has been added to enable it to be cast, pressed, extruded or otherwise moulded.

In alternative embodiments of the invention, the substrate may comprise a base layer of any material to which a cementitious outer layer (such as mortar) has been added. Thus, the process may be applied to existing structures such as brick walls by applying an outer, cementitious layer to the existing structure and adding the protective and/or decorative film to that outer substrate layer before any curing of the outer substrate layer has taken place and before any water is lost.

The substrate may further comprise, on at least one surface, a similarly based cementitious material of high wear resistance (but without any sand or other aggregate) in such a way that it becomes an integral part of the substrate. To this outer layer may be added an appropriate pigment. The incorporation of this "colour coat", if it is applied, is part of the original manufacturing process of the substrate.

When the substrate has been formed into its final shape, and before any curing commences and before any water is lost, the coating of non-saponifiable film-forming material is applied. The coating medium may comprise one or more organic resins in an organic solvent or non-aqueous solvent mixture. The coating so applied becomes an integral part of the product, so that during and after appropriate curing or heat treatment, it provides an effective barrier against water vapour, carbon dioxide and such other atmospheric acids or pollutants as may be present, while at the same time providing a visually attractive and decorative surface.

Because of the plastic nature of the uncured substrate, it is preferable to apply the coating medium by spraying. However, it may be applied by pouring or dipping, or even by brushing if sufficient care is taken not to damage the substrate surface.

A typical example of such a product would be a roofing tile comprising a substrate moulded from sand and Portland cement (with or without a "colour coat" as described above) to which a resinous organic film has also been applied, the whole laminate (comprising substrate and film) being

finally cured so that it becomes one intimately bonded laminated product.

By way of example, a roofing tile may be made by mixing sand and cement in the proportion by weight of three parts sand; one part cement and about 8% water, extruding on a pallet beneath a slipper, applying a colour coat of Portland cement paste and pigment with about 35% water by weight and then spraying over the colour coat as the "wet" tile moves down the production line, a protective and decorative film consisting of a resinous compound dissolved in an organic solvent and curing the whole assembly under controlled conditions of temperature and humidity.

An important feature of the invention is that the film is applied to the substrate as soon as possible and before at least the outer layer of the substrate has begun to cure. It is appreciated that the curing process of the substrate will commence as soon as the substrate is formed, but by applying the film to the substrate as quickly as possible any curing of the substrate will be insignificant so that all components of the laminate will become virtually inseparably bonded during the curing operation.

In an alternative embodiment of the invention, a pigment is added to the coating medium before it is applied to the substrate.

Examples of suitable non-saponifiable film forming coating materials are resins of the following types:— homo and co-polymers of acrylic resins, homo and co-polymers of vinyl resins, chlorinated rubber, chlorinated polyethylene and chlorinated polypropylene, which resins are dissolved in suitable solvents. These materials may or may not be plasticised, and example of typical plasticisers are chlorinated paraffins and polyesters.

WHAT WE CLAIM IS:—

1. A process for coating a cementitious substrate, which comprises casting, pressing, extruding or otherwise forming at least an outer layer of said substrate, applying a non-aqueous coating medium to said substrate before any curing of said substrate or outer layer has taken place and before any water is lost, and then curing the whole assembly so as to produce an intimately bonded laminated product, wherein said non-aqueous coating medium consists of a non-saponifiable film-forming coating material dissolved in a non-aqueous solvent, with or without pigments and/or plasticisers.

2. A process for coating a cementitious substrate as claimed in claim 1, wherein said film-forming coating material comprises a resin.

3. A process for coating a cementitious substrate as claimed in claim 2, wherein



13
sand and/or coarse aggregate and a cementitious binder of which a typical example is Portland cement, although other cementitious binders may be used. This substrate may be pressed, cast or extruded into its final shape and will typically have between 5% and 15% by weight water added to enable it to be so moulded and to promote a hydraulic set. In some embodiments, the sand and aggregate may be omitted without deleterious effect. In such embodiments the substrate consists entirely of a cementitious material to which sufficient water has been added to enable it to be cast, pressed, extruded or otherwise moulded.

In alternative embodiments of the invention, the substrate may comprise a base layer of any material to which a cementitious outer layer (such as mortar) has been added. Thus, the process may be applied to existing structures such as brick walls by applying an outer, cementitious layer to the existing structure and adding the protective and/or decorative film to that outer substrate layer before any curing of the outer substrate layer has taken place and before any water is lost.

The substrate may further comprise, on at least one surface, a similarly based cementitious material of high wear resistance (but without any sand or other aggregate) in such a way that it becomes an integral part of the substrate. To this outer layer may be added an appropriate pigment. The incorporation of this "colour coat", if it is applied, is part of the original manufacturing process of the substrate.

When the substrate has been formed into its final shape, and before any curing commences and before any water is lost, the coating of non-saponifiable film-forming material is applied. The coating medium may comprise one or more organic resins in an organic solvent or non-aqueous solvent mixture. The coating so applied becomes an integral part of the product, so that during and after appropriate curing or heat treatment, it provides an effective barrier against water vapour, carbon dioxide and such other atmospheric acids or pollutants as may be present, while at the same time providing a visually attractive and decorative surface.

Because of the plastic nature of the uncured substrate, it is preferable to apply the coating medium by spraying. However, it may be applied by pouring or dipping, or even by brushing if sufficient care is taken not to damage the substrate surface.

A typical example of such a product would be a roofing tile comprising a substrate moulded from sand and Portland cement (with or without a "colour coat" as described above) to which a resinous organic film has also been applied, the whole laminate (comprising substrate and film) being

finally cured so that it becomes one intimately bonded laminated product.

By way of example, a roofing tile may be made by mixing sand and cement in the proportion by weight of three parts sand; one part cement and about 8% water, extruding on a pallet beneath a slipper, applying a colour coat of Portland cement paste and pigment with about 35% water by weight and then spraying over the colour coat as the "wet" tile moves down the production line, a protective and decorative film consisting of a resinous compound dissolved in an organic solvent and curing the whole assembly under controlled conditions of temperature and humidity.

An important feature of the invention is that the film is applied to the substrate as soon as possible and before at least the outer layer of the substrate has begun to cure. It is appreciated that the curing process of the substrate will commence as soon as the substrate is formed, but by applying the film to the substrate as quickly as possible any curing of the substrate will be insignificant so that all components of the laminate will become virtually inseparably bonded during the curing operation.

In an alternative embodiment of the invention, a pigment is added to the coating medium before it is applied to the substrate.

Examples of suitable non-saponifiable film forming coating materials are resins of the following types:— homo and co-polymers of acrylic resins, homo and co-polymers of vinyl resins, chlorinated rubber, chlorinated polyethylene and chlorinated polypropylene, which resins are dissolved in suitable solvents. These materials may or may not be plasticised, and example of typical plasticisers are chlorinated paraffins and polyesters.

WHAT WE CLAIM IS:—

1. A process for coating a cementitious substrate, which comprises casting, pressing, extruding or otherwise forming at least an outer layer of said substrate, applying a non-aqueous coating medium to said substrate before any curing of said substrate or outer layer has taken place and before any water is lost, and then curing the whole assembly so as to produce an intimately bonded laminated product, wherein said non-aqueous coating medium consists of a non-saponifiable film-forming coating material dissolved in a non-aqueous solvent, with or without pigments and/or plasticisers.
2. A process for coating a cementitious substrate as claimed in claim 1, wherein said film-forming coating material comprises a resin.
3. A process for coating a cementitious substrate as claimed in claim 2, wherein

said resin contains a pigment and is dissolved in a volatile non-aqueous solvent.

4. A process for coating a cementitious substrate as claimed in any one of the preceding claims, wherein said substrate comprises sand and/or coarse aggregate and a cementitious binder.

5. A process for coating a cementitious substrate as claimed in claim 4, wherein said cementitious binder is Portland cement.

6. A process for coating a cementitious substrate as claimed in any one of the preceding claims, wherein said substrate contains between 5% and 15% water by weight of the dry ingredients.

7. A process for coating a cementitious substrate as claimed in any one of claims 1 to 5, wherein the outer layer of said substrate is a colour coat comprising Portland cement paste and pigment with about 35% by weight water.

8. A process for coating a cementitious substrate as claimed in any one of Claims 2 to 7, wherein said resin is a vinyl or acrylic homopolymer or co-polymer, or chlorinated rubber, or chlorinated polyethylene, or chlorinated polypropylene, and is dissolved in a solvent.

9. A process for coating a cementitious substrate as claimed in any one of Claims 2 to 8, wherein said film-forming coating contains chlorinated paraffins or polyesters or plasticisers.

10. A process for coating a cementitious substrate as claimed in any one of the preceding claims, wherein said substrate is a substrate as claimed in any one of the preceding claims.

11. A process according to any one of Claims 1 to 10, wherein said non-aqueous coating material is applied by spraying.

12. A building element comprising a cementitious substrate coated with a protective non-aqueous medium consisting of a non-saponifiable film-forming coating material dissolved in a non-aqueous solvent, with or without pigments and/or plasticisers, said protective coating medium being intimately bonded to the substrate by the application of the coating medium to the substrate before any curing of said substrate or the outer layer of the substrate has taken place and before any water is lost, and then curing the whole assembly.

13. A building element as claimed in Claim 12, wherein said cementitious substrate has an outer cementitious layer with a colouring substance added thereto.

14. A building element as claimed in Claim 12 or Claim 13, wherein said cementitious material is Portland cement.

15. A building element as claimed in any one of Claims 12 to 14, wherein said protective coating medium comprises an organic resin.

16. A building element as claimed in Claim 15, wherein the proportions of the component materials of said substrate comprises three parts sand, one part cement, and 8% water by weight, the resulting mixture having been extruded on a pallet beneath a slipper before applying a colour coat of Portland cement paste and pigment, said colour coat having been then covered with a film of said organic resin dissolved in a solvent, and whereby all components of the laminate so formed have been inseparably bonded during a subsequent curing operation.

17. A process for coating a cementitious substrate as claimed in claim 1 substantially as hereinbefore described.

18. A building element as claimed in claim 12, substantially as hereinbefore described.

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