

SPECIFICATION

Method of making flexible materials

5 This invention relates to a method of making flexible materials.

In British Patent Application No. 1512781 there is disclosed, *inter alia*, a method of building employing concrete structures and including the steps providing between at least two adjacent concrete structures a load bearing portion comprising a concrete composition containing a flexibilizing agent in the form of an elastomeric polymer, the proportion of the flexibilizing agent when calculated as polymer in the composition when set being 2 to 50% by weight. That invention is applicable to buildings, in particular tunnels, where adjacent concrete structures which are cast *in situ* or precast abut one another and there is a tendency for spalling to occur. Spalling is the undesirable splitting, splintering or chipping of the concrete which tends to occur when the concrete is subjected to high local stresses. It is particularly likely to occur in tunnels, where there is great pressure from above and the joints between the concrete structures go into compression as the gap between them deforms.

The present invention is a result of efforts to perfect a material for use between adjacent concrete structures, in particular in tunnels, although it may of course have, other applications.

According to the present invention there is provided a method of making a flexible cementitious material by mixing a flexibilising agent in the form of a natural or synthetic elastomeric polymer in the form of an aqueous dispersion or a latex with cement and subjecting the material to pressure in a non-destructive manner after setting of the cement, whereby the flexibility of the material is increased.

It is proposed to make a flexible cementitious material by mixing a flexibilising agent in a latex with cement and, preferably, another dessicant, and subjecting the material to pressure after setting of the cement, whereupon the material acquires flexibility and improved cohesion while retaining strength.

45 The compression is preferably performed by rolling, and appears to have the functions of "knitting" the flexibilising agent, filling any voids there may be and crushing the hardened cementitious content. As a result, the brittle characteristic which would otherwise be apparent is removed and flexibility is acquired and is maintained even though further setting of the cement may occur later on.

Preferably, as mentioned, a suitable secondary dessicant in addition to cement is employed.

55 The cement and dessicant can be added to the latex together, or in either possible succession.

We have found that the latex, cement (and possible secondary dessicant) mixture should, after shaping for instance into boards be initially cured for about 20 to 40 days, for instance 28 days, in conditions of high relative humidity, e.g. 90 to 100%. The compression operation preferably follows a subsequent period of 5 to 10, e.g. 7 days, in which the material is stored under ambient conditions.

65 As previously mentioned, the materials referred to

in British Patent Application No. 1512781 require the flexibilizing agent when calculated as polymer in the set composition to be 2 to 50% by weight. In the present Specification different criteria are adopted, and it is suggested that mixtures of 15 to 28% latex, 20 to 30% dessicant, 45 to 55% cement with up to 6% of other ingredients are suitable. One particular mixture which may be suitable comprises 22% latex, 50% cement, 24% dessicant and 4% other ingredients. These percentages are by weight. The cement may be portland, high aluminous sulphate resisting cement or any other appropriate cement. Examples of dessicants are silica gel, a calcium sulphate plaster (for example a hemi-hydrate plaster containing if necessary an accelerator of the rate of setting of the plaster), barium or calcium oxide, calcium chloride, or orthoester (for example trimethyl orthoformate) or a molecular sieve, or quicklime. Among the other ingredients there may be mentioned light oils, stabilisers, antioxidants and surfactants. The light oils can be added to slow down the action of the secondary dessicant. The antioxidants may be of substituted or hindered phenol type, e.g. 2, 2' methylene bis (4 - methyl - 6 - tertiary butyl phenol). The surfactants may be anionic surfactants, e.g. alkyl aryl sulphonates or straight chain alkyl sulphonates.

The flexibilizing agent can be an elastomeric polymer, natural or synthetic and is initially in the form of an aqueous dispersion or latex. Butyl rubber is one possibility. A latex with 30-70%, preferably 40-50% solids is most appropriate. Non-ionic stabilizers (for example polyoxyethylene esters of phenol or long chain aliphatic alcohols) may be fully added among the other ingredients to prevent premature precipitation of the latex.

The normal setting behaviour of the cement may be modified by impurities or additives. Thus accelerators or retarders may be required. Examples of accelerators are sulphuric acid, potassium and ammonium sulphate while borax is one possible retarder.

The material can, when mixed, be cast, moulded extruded or calendered and then subjected to the initial setting operation. The material can be so prepared in any suitable shape and size, for instance in the form of boards of 0.30 to 10 cm thick.

Good results have been achieved by initially adding lime, cement and the other ingredients to latex in high powered high speed mixer, casting the mixture into moulds to form boards, storing them for 28 days at nearly 100% relative humidity, then storing them for 7 days in ambient conditions, and then passing them between nip rolls. The resultant material contains a lot of moisture so that further setting can still occur, but is remarkably flexible, without cracking, and can be subjected to great stress and compressive strain without breaking down.

125 In addition to the above described process, the invention provides materials made by such process.

CLAIMS

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The flexibilizing agent can be an elastomeric polymer, natural or synthetic and is initially in the form of an aqueous dispersion or latex. Butyl rubber is one possibility. A latex with 30-70%, preferably 40-50% solids is most appropriate. Non-ionic stabilizers (for example polyoxyethylene esters of phenol or long chain aliphatic alcohols) may be usefully added among the other ingredients to prevent premature precipitation of the latex.

The normal setting behaviour of the cement may be modified by impurities or additives. Thus accelerators or retarders may be required. Examples of accelerators are sulphuric acid, potassium and ammonium sulphate while borax is one possible retarder.

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CLAIMS

1. A method of making a flexible cementitious material by mixing a flexibilising agent in the form of a natural or synthetic elastomeric polymer in the

form of an aqueous dispersion or a latex with cement and subjecting the material to pressure in a non-destructive manner after setting of the cement, whereby the flexibility of the material is increased.

- 5 2. A method according to claim 1, wherein an additional dessicant is included in the mix.
3. A method according to claim 2, wherein the mixture comprises, by weight, 15 to 28% latex, 20 to 30% additional dessicant, 45 to 55% cement and up to 6% of other ingredients.
- 10 4. A method according to claim 2, wherein the mixture comprises by weight, 22% latex, 50% cement, 24% additional dessicant and 4% of other ingredients.
- 15 5. A method according to claim 2, 3 or 4, wherein the additional dessicant is silica gel, a calcium sulphate, barium or calcium oxide, calcium chloride, an orthoester, a molecular sieve or quicklime.
6. A method according to any preceding claim, wherein the compression is performed by rolling.
- 20 7. A method according to any preceding claim, wherein the mixture is initially cured for 20 to 40 days in conditions of relative humidity of 90 to 100% prior to the compression.
- 25 8. A method according to claim 7, wherein the compression operation follows a subsequent period of 5 to 10 days under ambient conditions.
9. A method according to any one of claims 1 to 6, wherein the mix is initially cured for 28 days in conditions of relative humidity of 90 to 100% and compressed after a further period of 7 days under ambient conditions.
- 30 10. A method according to any preceding claim, wherein the mixture additionally includes at least one of light oils, stabilisers, antioxidants and surfactants.
- 35 11. A method according to any preceding claim including an accelerator or retarder in the mixture.
12. Methods of making flexible cementitious materials substantially as hereinbefore described.
- 40 13. Flexible cementitious materials made by the method of any preceding claim.

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