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(54) Title: CONSTRUCTION ELEMENT

(57) Abstract

The present invention relates to a lightweight cementitious composition comprising a cellulose particulate material, a cementitious material, a cellulose ether, and optionally a cement setting agent. The invention also relates to methods for the manufacture of the cementitious composition and a construction element produced from the cementitious composition. The invention further relates to a lightweight construction element which simulates the appearance of granite and is prepared from a settable mixture of polymer casting resin, raw vermiculite, expanded vermiculite and resin hardener.

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CONSTRUCTION ELEMENT

Field of the Invention

The present invention relates to construction elements. In particular the invention relates to a formulation for producing a lightweight cementitious composition using a cellulose particulate material, methods for the manufacture of the cementitious composition and a construction element produced from the cementitious composition. The invention also relates to a lightweight construction element which simulates the appearance of granite.

Background of the Invention

Cement blocks and panels are commonly used in the construction industry. As a building material, cement blocks and panels are typically heavy making it difficult to lift, move and place the cement blocks or panels when constructing structures. It is therefore desirable to utilise strong lightweight cementitious compositions and concrete for use in construction elements for the building industry which preferably have good acoustic and fire resistant properties, are strong, durable and affordable.

Various methods have been proposed to form cementitious building elements utilising particulate cellulose materials such as sawdust as a component. Often however the addition of cellulose based particulate fillers tend to make poor products due to uneven distribution in the final product of the cellulose based particulate fillers as a result of a tendency of the filler to float in the wet mixture.

Another form of the invention relates to a resin based construction element which simulates the appearance of granite and can be used in building products requiring such an appearance but required to be inexpensive and lightweight.

A requirement accordingly exists for a lightweight construction element which has one or more of the following qualities: strength; substantially non-flammable; attractive; sound and heat insulating; easily handled and worked; and able to be plastered, painted or rendered.

Summary of the Invention

According to an aspect of the present invention there is provided a lightweight cementitious composition comprising:

20-80% by weight of cellulose particulate material;

20-70% by weight of cementitious material;

0.1-1% by weight of cellulose ether; and

0-5% by weight of cement setting agent,

wherein the weight percentages are chosen to total 100%.

The present invention also provides a method for the preparation of a construction element comprising:

a) mixing cellulose particulate material, cementitious material and cellulose ether to form a dry mixture;

b) adding, with mixing to the dry mixture, water and optionally a setting agent to form a wetted cementitious composition; and

c) allowing the wetted cementitious composition to harden to form the construction element.

Still further according to the present invention there is provided a method for the preparation of a construction element comprising:

a) mixing a cementitious material, cellulose ether, water and optionally a setting agent to form a wetted mixture;

b) adding, with mixing to the wetted mixture, cellulose particulate material to form a wetted cementitious composition; and

c) allowing the wetted cementitious composition to harden to form the construction element.

The actual composition of the wetted cementitious compositions of the present invention may be varied depending on whether the wetted composition is allowed to set in a mould, or whether it is pressed into bricks by a block-making machine or clay-extruder machine and cut prior to being allowed to set.

The invention also relates to lightweight construction elements such as panels and blocks when made with the cementitious compositions of the present invention.

According to another aspect of the present invention there is provided a lightweight construction element which simulates the appearance of granite, wherein said element is prepared from a settable mixture of:

20-60% by volume polymer casting resin;

10-60% by volume raw vermiculite;

10-60% by volume expanded vermiculite; and

up to 5% by volume resin hardener,

wherein the volume percentages are chosen to total 100%.

Throughout this specification and the claims which follow, unless the text requires otherwise, the word "comprise", and variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

Detailed Description of the Invention

The construction elements prepared from the cementitious compositions of the present invention are lightweight compared to standard cement and concrete building elements

which makes the elements easier to lift, carry and place when used in construction. The lightweight construction elements are strong and durable and are able to be cut with a normal wood saw and drilled with standard wood drill bits. The construction elements can hold nails or screws as does timber without the need for plugs. The construction elements show no appreciable crumbling or separation of the filler material when cut or drilled with standard carpentry tools.

The cellulose particulate material is preferably sawdust. The sawdust is preferably fresh and is used without having first been dried, heated or kilned. It will be understood that the exact proportions of sawdust used in forming the construction elements vary according to the type of product desired. The present inventor has found that, in general, dry sawdust is not particularly preferred for use in the compositions of the invention due to the high amount of water required to re-hydrate the dry sawdust when preparing the compositions. Such high water content compositions give poor compaction, are slow to set and once set are more susceptible to powder or crumble when worked with standard carpentry tools. The use of fresh sawdust aids in the compression of the cementitious compositions and structural strength of the elements formed therefrom. Panels and bricks so constructed are lightweight and also have very good thermal and acoustical insulating qualities.

Preference for the types of wood the sawdust derives from depends on the method by which the construction elements are formed. Hardwoods such as eucalyptus and oak are preferred for construction elements prepared by block-making machines and extrusion processes. Hardwood sawdust provides good acoustic insulation properties. Preferably, the hardwood sawdust is very fine, being similar to powder.

However, soft woods such as pine are preferred when wet cementitious compositions are set in casts or moulds. In this case, the soft wood sawdust is preferably coarse in pieces of about 2-3 mm.

The cellulose particulate material when used with clay-extrusion and block-compression moulding techniques is preferably present in an amount from about 30-60 wt%, more preferably 40-50 wt%, based on the total weight of the dry formulation.

With casting techniques, the cellulose particulate material is preferably present in an amount from about 20-70 wt%, more preferably 30-55 wt%, even more preferably 40-55 wt%. Also with the casting technique, the particulate material may be part substituted with elastomeric beads such as, preferably, polystyrene beads. The beads are desirably smaller than 0.25 mm but can have a size up to 2 mm. The amount of elastomeric beads can, for example, approach 20 wt% when the cellulose particulate material is in an amount of about 40 wt%, and up to 40 wt% when the cellulose particulate material is in an amount of about 20 wt%.

In one embodiment, it is favourable for the construction elements prepared by the extrusion method to have some of the cementitious material and/or cellulose particulate material replaced by up to 30 wt% of coated fly ash. The fly ash is required to be coated with silicone or glass to assist in creating high viscosity wetted cementitious compositions suitable for extrusion. Many types of fly ash are suitable. One source of fly ash results from the burning of coal in electrical generating facilities and this type of fly ash once coated may be effectively used in the present application. More preferably is naturally occurring volcanic fly ash, which is purified and ground as a white, finely divided powder. The fly ash once coated significantly enhances the quality of the construction elements prepared therefrom. Uncoated fly ash is not preferred as it absorbs large amounts of water from the wetted compositions.

The wetted cementitious composition is a clay-like hard plasticine-type mixture. The mixture is extruded through a die and cut into desired lengths. Elements such as panels and blocks can be made by this method. The addition of silicone coated fly ash gives less dense yet higher strength products. Fly ash may be obtained from various sources including

Harborlite of La Porte, Texas who market the product under the Trade name Microfil Grade F-2.

The term "cement" is used herein in its broadest sense to generally refer to a mixture of clay and limestone that hardens and fastens on setting.

The cementitious material can be any cement but preferably is high strength cement such as Portland cement. High strength cement differs from normal cement in that it is a finer grind which causes it to cure more quickly and have a higher strength when set. When high strength cement is not used it is preferable to add a substantially equal quantity of lime to the cement. With extrusion compression and block-moulding techniques, the cementitious material is preferably present in an amount from about 40-60 wt% based on the total weight of the dry composition.

With casting techniques, the cementitious material is preferably present in an amount of from about 40-60 wt% based on the total weight of the dry formulation.

Cellulose ethers suitable for the present invention include sodium carboxymethyl cellulose, sodium carboxymethyl hydroxyethyl cellulose, hydroxypropyl methyl cellulose, hydroxyethyl methyl cellulose, hydroxyethyl ethyl cellulose, methyl cellulose, methyl ethyl cellulose, hydroxyethyl cellulose and hydroxypropyl cellulose. An example of suitable cellulose ethers are those sold under the trade name Methocel available from the Dow Chemical Company which are hydroxypropyl methyl celluloses. Most preferably the cellulose ether is Methocel 228 (available from the Dow Chemical Company) which is a partially surface treated hydroxypropyl methyl cellulose having a nominal viscosity of 4,000 cps (2% solution at 20°C), and a gel temperature of 65°C. The cellulose ether functions as a glue and results in more even distribution of the particulate material in the final product. The cellulose ether is preferably present in the amount from 0.3-0.45 wt% based on the total weight of the dry formulation.

A setting agent is optional but aids in setting the wet cementitious compositions. Any suitable setting agent may be contemplated. Preferably calcium chloride is used and if present, can be present in an amount up to 2.5 wt% more preferably in the range 0.5-2 wt%, more preferably about 0.7 wt%, based on the weight of the dry formulation.

Water should be clean and preferably be used at a temperature in the range from 10-25°C for good results.

In preparing the construction elements of the invention, the amount of water required to be added to the cementitious compositions depends on the method used to form the elements. For example, in general, the cementitious compositions used in casting are thick slurries, the compositions used in the extrusion method are semi-dry similar to clay whilst the compositions used in the block-making machine are dry-compactable or slightly damp mixtures having a low water content. Therefore for consistency throughout the description and claims, the cementitious compositions to which water has been added are referred to as "wetted" cementitious compositions irregardless of whether the compositions are subsequently cast, extruded or compacted in the preparation of the construction elements.

The actual amount of water required in preparing the wetted compositions of the invention is dependent on the freshness and inherent moisture content of the sawdust used and can readily be determined by those skilled in the art. It will be understood that where the moisture content of the sawdust is low, more water will be required to be added. When the moisture content is high, less water will be required.

The cementitious compositions used in the block-making machine most preferably have a small moisture content. Most of the moisture is derived from the fresh sawdust and its natural moisture content. Typically the amount of water added in preparing the wetted composition for use in the block-making machine is from 50-100 L per cubic metre of total mixture. More water is required in preparing the wetted compositions for use in the clay-

extrusion method and even more water is required in preparing the wetted compositions when casting in moulds.

Construction elements produced from the compositions of the invention can be made with various dyes and pigments if a coloured product is desired. The product can also be plastered, painted, sealed or rendered if required.

It will also be understood that other additives standard in the art may also be incorporated into the cementitious compositions of the present invention. For example it is possible to add sand such as river sand of preferably up to 20 wt%, more preferably from 10-20 wt%. Whilst the addition of river sand makes a heavier and more dense product, it gives better compaction and hence better products when made by a block-making machine or clay-extrusion method.

The density of the set cementitious compositions of the invention are typically in the range of 450-800 kg/m^2, and often from 500-700 kg/m^2 however, it will be understood that depending on the particular qualities desired by the set cementitious compositions and construction elements of the present invention, different densities may be desired. This is often achieved typically by varying the ratio of cellulose particulate material to cement in the cementitious compositions.

Extruded construction elements of the present invention are generally suitable as load-bearing products. Construction elements made by block or casting techniques are generally not suitable for load bearing applications and are often used for making block or paneled walls.

The polymer resins used in the granite-like construction elements are preferably a clear casting resin which are set by a curing agent. The polymer resins are preferably an acrylate

or ester-type resin which are commonly available and well known to those skilled in the art. Preferably the amount of polymer resin is about 33 % by volume.

The resin hardener is any curing agent which is able to cause the polymer resin to set. Preferably the resin hardener is a peroxide such as, for example, methyl ethyl ketone peroxide (MEKP) and is present in about 1 % by volume.

The vermiculite used in the granite-like elements of the present invention are any of the micaceous minerals formed by alteration of common micas. Mica is comprised of hydrous disilicates of aluminium with metal oxides of magnesium and iron.

Vermiculite ore is mined in simple open cut operations usually involving grinding and air separation to delaminate the ore particles and to remove waste rock. The raw vermiculite ore is produced in particle sizes typically from 16 mm down to 0.25 mm, with bulk densities in the region of 1,000 kg / m^3. The raw vermiculite is in the form of thin sheets which form slivers and their uses within the finished material gives a flecked type appearance to the material. The size of the raw vermiculite slivers can be chosen depending on the desired visual effect required. The amount of raw vermiculite in the granite-like construction elements of the present invention are preferably 22-44 % by volume, more preferably about 33 % by volume.

Expanded vermiculite is obtained by an exfoliating process whereby vermiculite is fed through a furnace at about 1,000°C producing concertina shaped granules with a loose bulk density in the range 60-160 kg/m^3. Exfoliated vermiculite is advantageously used in the construction elements of the present invention for its extreme lightness and visual appearance in the finished materials made therefrom. Expanded vermiculite is typically obtained from Australian and South African sources. The South African supply of vermiculite is preferred for use in the construction elements of the present invention however most sources of expanded vermiculite are acceptable. Different grades of vermiculite are available which can be used to create different aesthetic effects including colour in the granite-like materials. Typically the particle size range varies from 0.5-2.0 mm

up to 2.0-6.0 mm, whilst the bulk density of the exfoliated vermiculite is typically from 85 kg/m^3 down to 70 kg/m^3 respectively. Preferably the amount of expanded vermiculite used in the granite-like construction elements is in the amount from 22-44 % by volume, more preferably about 33 % by volume.

The preferred ratio of raw vermiculite to expanded vermiculite is typically about 3:1 by wt%. Preferably, the raw vermiculite and expanded vermiculite form about 60 wt% of the composition with the resin forming about 40 wt%.

The raw vermiculite and expanded vermiculite are homogeneously mixed with a settable resin and resin hardener to form a composition which can be cast into any desired shape or extruded as required. Typically, the mixture is shaped into blocks, bricks or panels. Typically, the mixture is set in the time range of 5 minutes to 2 hours. The setting time depends on the settable resin and curing agents chosen and is also dependent on the amount of curing agent present and the temperature of the mixture. The granite-like construction elements produced by this method can be modified to give different colours and appearances by changing the proportions or types of raw vermiculite or expanded vermiculite used. It is also possible to add various dyes and pigments if a different coloured product is desired.

The invention is further described in and illustrated by the following examples. The examples are not to be construed as limiting the invention in any way.

Examples 1 to 6

Construction element formation method	**Block-making machine**		**Clay-extrusion method**		**Mould**	
Example	1	2	3	4	5	6
Sawdust (kg)	300	350	300	350	300	200
Cement (kg)	400	300	400	300	250	200
Methocel (kg)	2.5	3	2	3	4	4
Microfil (kg)	-	-	50	50	-	-
Polystyrene beads (kg)	-	-	-	-	-	50
Calcium Chloride (kg)	5	5	5	5	8	8
Water (L)	50	70	120	140	200	200
Total Weight (kg)	757.5	728	877	848	762	662

General Method

The dry ingredients are placed in a mixer, preferably in the order listed above. The ingredients are mixed by rotation after which water is added until the desired consistency is obtained. It will be understood that other methods of addition and mixing would also be suitable, such as for example, mixing cementitious material, cellulose ether, water and optionally a setting agent to form a wet mixture and adding cellulose particulate material with mixing to the wet mixture to form a wetted cementitious composition.

The wetted cementitious composition so formed is placed in a block-making machine, clay-extrusion machine or a form depending on the particular ratio of ingredients used and the desired properties of the construction element so produced once set. The wetted cementitious compositions formed in casts may be removed after 8 hours under normal conditions and should be left for up to 14 days to cure prior to use in construction.

Construction elements formed by block-making techniques or the extrusion method are set in 5-20 minutes and should also be left for up to 14 days to cure prior to use.

Examples 7 to 9

Granite Like Construction Element

Example	7	8	9
raw vermiculite (% vol.)	44	22	33
expanded vermiculite (% vol.)	22	44	33
polymer casting resin (% vol.)	33	33	33
resin hardener (% vol.)	1	1	1
Total volume (%)	100	100	100

General Method

The raw vermiculite and expanded vermiculite are homogeneously mixed with the settable resin and resin hardener to form a composition which is cast into any desired shape or extruded as required. The mixture sets within 2 hours.

In the above description, embodiments of this invention have been described, but it is also understood that the invention is capable of other functions. Also, it should be understood that the lightweight, insulating and other desirable properties of the construction elements of the present invention are intended to be generic and should not be regarded as necessarily limiting.

Those skilled in the art will appreciate that the invention described herein is susceptible to variations and modifications other than those specifically described. It is to be understood that the invention includes all such variations and modifications. The invention also includes all of the steps, features, compositions and compounds referred to or indicated in

this specification, individually of collectively, and any and all combinations of any two or more of said steps or features.

The claims defining the invention are as follows:

1. A lightweight cementitious composition comprising:

20-80% by weight of cellulose particulate material;

20-70% by weight of cementitious material;

0.1-1% by weight of cellulose ether; and

0-5% by weight of cement setting agent,

wherein the weight percentages are chosen to total 100%.

2. A lightweight cementitious composition of claim 1, wherein the cellulose particulate material is in an amount from 20-70 wt%.

3. A lightweight cementitious composition of claim 1, wherein the cellulose particulate material is in an amount from 30-55 wt%.

4. A lightweight cementitious composition of claim 1, wherein the cellulose particulate material is in an amount from 40-55 wt%.

5. A lightweight cementitious composition of any one of claims 1 to 4, wherein the cellulose particulate material is sawdust.

6. A lightweight cementitious composition of claim 5, wherein the sawdust is derived from hardwood or soft wood.

7. A lightweight cementitious composition of claim 5 or claim 6, wherein the sawdust is fresh.

8. A lightweight cementitious composition of any one of claims 1 to 7, wherein the cementitious material is in an amount from 40-60 wt%.

9. A cementitious composition of any one of claims 1 to 8, wherein the cementitious material is Portland cement.

10. A cementitious composition of any one of claims 1 to 8, wherein the cementitious material is a mixture of cement and lime.

11. A lightweight cementitious composition of any one of claims 1 to 10, wherein the cellulose ether is in an amount from 0.3-0.45 wt%.

12. A lightweight cementitious composition of any one of claims 1 to 11, wherein the cellulose ether is hydroxypropyl methyl cellulose.

13. A lightweight cementitious composition of any one of claims 1 to 12, wherein the cement setting agent is in an amount from 0.5-2 wt%.

14. A lightweight cementitious composition of claim 13, wherein the cement setting agent is in an amount of about 0.7 wt%.

15. A lightweight cementitious composition of claim 12 or claim 13, wherein the cement setting agent is calcium chloride.

16. A lightweight cementitious composition of any one of claims 1 to 15, which further comprises up to 40 wt% elastomeric beads.

17. A lightweight cementitious composition of claim 16, wherein the elastomeric beads are polystyrene beads.

18. A cementitious composition of any one of claims 1 to 17, which further comprises up to 30 wt% coated fly ash.

19. A cementitious composition of claim 18, wherein the coated fly ash is silicone coated.

20. A cementitious composition of any one of claims 1 to 19, which further comprises up to 20 wt% of sand.

21. A method for the preparation of a construction element comprising:

a) mixing cellulose particulate material, cementitious material and cellulose ether to form a dry mixture;

b) adding, with mixing to the dry mixture, water and optionally a setting agent to form a wetted cementitious composition; and

c) allowing the wetted cementitious composition to harden to form the construction element.

22. A method of claim 21, wherein the wetted cementitious composition further comprises elastomeric beads, coated fly ash or sand.

23. A method for the preparation of a construction element comprising:

a) mixing a cementitious material, cellulose ether, water and optionally a setting agent to form a wetted mixture;

b) adding, with mixing to the wetted mixture, cellulose particulate material to form a wetted cementitious composition; and

c) allowing the wetted cementitious composition to harden to form the construction element.

24. A method of claim 23, wherein the wetted cementitious composition further comprises elastomeric beads, coated fly ash or sand.

25. A method of any one of claims 21 to 24, wherein the wetted cementitious composition is extruded and cut prior to being hardened to form the construction element.

26. A method of any one of claims 21 to 24, wherein the wetted cementitious composition is cast in a mould prior to being hardened to form the construction element.

27. A method of any one of claims 21 to 24, wherein the wetted cementitious composition is block-moulded prior to being hardened to form the construction element.

28. A lightweight construction element prepared from a cementitious composition of any one of claims 1 to 20.

29. A lightweight construction element prepared by a method of any one of claims 21 to 27.

30. A lightweight construction element of claim 28 or claim 29 in the shape of a brick, block or panel.

31. A lightweight construction element which simulates the appearance of granite, wherein said element is prepared from a settable mixture of:

20-60% by volume polymer casting resin;

10-60% by volume raw vermiculite;

10-60% by volume expanded vermiculite; and

up to 5% by volume resin hardener,

wherein the volume percentages are chosen to total 100%.

32. A lightweight construction element of claim 31, wherein the polymer casting resin is in an amount from 25-40 % by volume.

33. A lightweight construction element of claim 31, wherein the polymer casting resin is in an amount of about 33 % by volume.

34. A lightweight construction element of any one of claims 31-33, wherein the raw vermiculite is in an amount from 22-44 % by volume.

35. A lightweight construction element of any one of claims 31-33, wherein the raw vermiculite is in an amount of about 33 % by volume.

36. A lightweight construction element of any one of claims 31-35, wherein the expanded vermiculite is in an amount from 22-44 % by volume.

37. A lightweight construction element of any one of claims 31-35, wherein the expanded vermiculite is in an amount of about 33%.

38. A lightweight construction element of any one of claims 31-37, wherein the resin hardener is in an amount of about 1 % by volume.

39. A lightweight construction element of any one of claims 31-38, wherein the resin hardener is methyl ethyl ketone peroxide (MEKP).

40. A lightweight construction element of any one of claims 31-39 in the shape of a brick, block or panel.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00555

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: C04B 16/02, 18/24, 18/26, 24/02, 24/38

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 C04B 16/02, 18/24, 18/26, 24/02, 24/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT: (CELLULOS: OR SAW(W) DUST)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5047086 A (HAYAKAWA et al.) 10 September 1991 See whole document	1, 8-10, 21, 23, 28-29
X	DE 4218143 A (DEUTSCHE PERLITE GmbH) 15 July 1993 See whole document	1,6,9-10
A	US 5482550 A (STRAIT) 9 January 1996	

[X] Further documents are listed in the continuation of Box C

[X] 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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 August 1999	01 SEP 1999
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	Authorized officer **J. DEUIS** Telephone No.: (02) 6283 2146

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00555

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A,P	WO 98/37032 A (WINDSOR TECHNOLOGIES LIMITED) 27 August 1998	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00555

Box 1 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.:
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:

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 II 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:

See attached sheet.

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. 1 - 30:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/00555

Box

The international application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept. In coming to this conclusion the International Searching Authority has found that there are two inventions:

1. Claims 1-30 are directed to a method and composition of a light weight cementitious construction element wherein, a formulation of cellulose particulate material, a cementitious material, a cellulose ether and cement setting agent are used. The lightweight cementitious construction element comprising the composition above, comprises a first "special technical feature".

2. Claims 31-40 are directed to a lightweight construction element wherein, the element is prepared from a settable mixture of polymer casting resin, raw vermiculite, expanded vermiculite and resin hardener. The lightweight construction element mixture above, comprises a second "special technical feature".

Since the abovementioned groups of claims do not share either technical features identified, a "technical relationship" between the inventions, as defined in PCT rule 13.2 does not exist. Accordingly the International application does not relate to one invention as a single inventive concept.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/00555

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	5047086	EP	340765	JP	1282142
DE	4218143	EP	572933		
					END OF ANNEX