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(54) **Title:** CONSTRUCTION PANEL HAVING IMPROVED FIXING STRENGTH

(57) **Abstract:** A plasterboard comprises a gypsum matrix having particles of agglomerated fibres embedded therein in an amount of at least 1 wt% relative to the gypsum, the gypsum matrix further comprising a polymeric additive, the polymeric additive being present in an amount of at least 1 wt% relative to the gypsum.



CONSTRUCTION PANEL HAVING IMPROVED FIXING STRENGTH

Field of the invention

The present invention relates to panels for use in building construction. In particular, the present invention relates to panels for providing partitions to which items such as sinks, televisions, or radiators may be affixed.

Background to the invention

Light-weight panels such as plasterboard (e.g. gypsum plasterboard), polystyrene board and fibreboard are commonly used to provide partitions within buildings. Their advantages for this application include the fact that they are light and quick to install.

However, in certain cases, such light-weight panels may have the drawback that they are not strong enough to support fixtures (e.g. sinks, televisions, radiators, fire extinguishers, shelves and any other item that requires attachment to the panel). In such cases, the weight of the fixture may cause the fixing means (e.g. screws) to be pulled out of the panel, such that the fixture falls away from the partition.

This problem has previously been addressed by gluing a polymer-based backing lamina to one face of the plasterboard, the backing lamina being e.g. PVC, HDPE, Nylon, polycarbonate, Bakelite, polypropylene, acetal, or fibreglass.

Summary of the invention

It has now been found that by including wood products and a polymeric additive in the plasterboard, the plasterboard may be provided with sufficient ability to retain fixing means that no backing lamina is required.

Therefore, in a first aspect, the present invention may provide a plasterboard comprising a gypsum matrix having particles of agglomerated fibres embedded therein in an amount of at least 1 wt% relative to the gypsum, the gypsum matrix further comprising a polymeric additive, the polymeric additive being present in an amount of at least 1 wt% relative to the gypsum;

wherein

no backing lamina is attached to either face of the plasterboard.

By omitting a backing lamina, it may be possible to provide a panel having adequate fixing strength at a relatively lower cost, due to reduced raw material costs and greater ease of manufacture. Additionally, the panel may be easier to recycle, since the requirement to separate the lamina from the plasterboard may be avoided.

The term "lamina" is intended to cover polymer-based sheets having a thickness of at least 1 mm (for example 2mm), comprising substantially PVC, HDPE, Nylon, polycarbonate, Bakelite, polypropylene, acetal, or fibreglass. The term "lamina" is used herein to refer to a sheet that is attached to a face of a plasterboard, e.g. by gluing, such that there is a defined interface between the plasterboard and the sheet. Thus, the term "lamina" is not intended to refer to objects that are partially or wholly embedded within the plasterboard.

Although no lamina is attached to either face of the plasterboard, the plasterboard may have paper facings on one or both sides thereof. In other cases, the plasterboard may have a mat partially or fully embedded at its surface, for example, a glass fibre mat.

Typically, the particles are present in an amount of at least 2 wt% relative to the gypsum, preferably at least 2.5 wt%. Typically, the particles are present in an amount of less than 10 wt% relative to the gypsum, preferably less than 8 wt%.

The particles may be, for example, wood particles (such as woodchip or fine sawdust particles) or paper particles. Preferably the particles are wood particles. In general, the particles are irregular in shape.

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For the avoidance of doubt, the term “wood particles” is not intended to refer to particles of wood-derived material (such as paper particles) that have been processed to the point where individual fibres are no longer bound by the natural binders present in wood.

10 Typically these particles have a length that is greater than 0.5 mm. In general, these particles have a length that is less than 25 mm, preferably less than 20 mm.

Typically, these particles have a thickness that is less than 4 mm, preferably less than 3 mm. In the case that the particles are paper particles, their thickness is typically less than

15 0.5 mm.

In certain embodiments, the particles may be wood particles and the plasterboard may further comprise glass fibres. In such cases, the glass fibres are preferably present in an amount of at least 1 wt%.

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Typically, the polymeric additive is present in an amount of at least 2 wt% relative to the gypsum, preferably at least 4 wt%.

Typically, wherein the polymeric additive is selected from group comprising polyvinyl
25 acetate, poly vinyl acetate-ethylene co-polymer, polyvinyl pyrrolidone crosslinked with polystyrene sulfonate, polyvinyl alcohol, methyl cellulose, hydroxyethyl methyl cellulose, styrene-butadiene copolymer latex, acrylic ester latex, acrylic copolymer latex, polyester

resin, epoxy resin, polymethyl methacrylate, polyacrylic acid, cationic starch, ethylated starch, dextrin and mixtures thereof.

Preferably, the polymeric additive is one of polyvinyl acetate and starch.

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In certain cases, the starch may be a native starch (that is, an unmodified starch). In other cases, the starch may be a modified starch, for example, an acid-thinned starch.

Most preferably, the polymeric additive is polyvinyl acetate.

10

In a second aspect, the present invention may provide a plasterboard comprising a gypsum matrix having wood particles embedded therein in an amount of at least 2 wt% relative to the gypsum, the gypsum matrix further comprising glass fibres in an amount of at least 1 wt% relative to the gypsum.

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Typically, no backing lamina is attached to either face of the plasterboard.

The term "lamina" is intended to cover polymer-based sheets having a thickness of at least 1 mm (for example 2mm), comprising substantially PVC, HDPE, Nylon, polycarbonate,

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Bakelite, polypropylene, acetal, or fibreglass. The term "lamina" is used herein to refer to a sheet that is attached to a face of a plasterboard, e.g. by gluing, such that there is a defined interface between the plasterboard and the sheet. Thus, the term "lamina" is not intended to refer to objects that are partially or wholly embedded within the plasterboard.

25

Although no lamina is attached to either face of the plasterboard, the plasterboard may have paper facings on one or both sides thereof. In other cases, the plasterboard may have a mat partially or fully embedded at its surface, for example, a glass fibre mat.

In general, the wood particles are irregular in shape.

Typically the wood particles have a length that is greater than 0.5 mm. In general, these particles have a length that is less than 25 mm, preferably less than 20 mm.

5

Typically, the wood particles have a thickness that is less than 4 mm, preferably less than 3 mm.

10 In certain embodiments of the first or second aspects of the invention, the plasterboard has paper facings. These paper facings may comprise both cellulose fibres and glass fibres, as this is thought to improve the fire resistance of the plasterboard. In other cases, the plasterboard may have a mat partially or fully embedded at its surface, for example, a glass mat.

15 In certain embodiments of the first or second aspects of the invention, the gypsum matrix comprises a hydrophobic additive, such as silicone oil or wax.

In certain embodiments of the first or second aspects of the invention, the gypsum matrix may contain a biocide.

20

In certain embodiments of the first or second aspects of the invention, the gypsum matrix may contain an anti-shrinkage agent such as unexpanded vermiculite, microsilica, and/or clay, in order to improve the fire-resistance of the product.

25 Certain embodiments of the first or second aspects of the invention may include foam or lightweight aggregate such as perlite. Such additives are known in the art to produce lower-density boards having acceptable thickness.

Detailed description

The invention will now be described by way of example only.

Gypsum plasterboards were prepared using the following general methodology:

- 5 Stucco and other dry additives (including woodchips) were weighed into a bag and shaken to mix them. Water and wet additives were weighed into a bowl and mixed using an electric mixer for 60 s.

The dry powdered additives were added to the wet additives in the bowl and mixed in with the electric mixer for 30 s.

- 10 The resultant slurry was sandwiched between two sheets of paper liner and allowed to hydrate for 25 minutes measured from the time of mixing. The board was then dried in an oven for 1 hour at 160°C.

The panels had a thickness of 12.5 mm.

15 Example 1

A gypsum plasterboard was prepared from a slurry containing the following ingredients:

- stucco;
- woodchips in an amount of 3wt% relative to the stucco. The woodchips had a maximum dimension in the range 1-20 mm and a thickness of 0.5-3 mm;
- 20 • corn starch (Merifilm from Tate & Lyle) in an amount of 6 wt% relative to the stucco.

Example 2

A gypsum plasterboard was prepared from a slurry containing the following ingredients:

- stucco;
- 25 • woodchips in an amount of 3wt% relative to the stucco. The woodchips had a maximum dimension in the range 1-20 mm and a thickness of 0.5-3 mm;

- polyvinyl acetate (Vinamul 8481) in an amount of 6 wt% relative to the stucco.

Example 3

A gypsum plasterboard was prepared from a slurry containing the following ingredients:

- 5
- stucco;
 - woodchips in an amount of 3wt% relative to the stucco. The woodchips had a maximum dimension in the range 1-20 mm and a thickness of 0.5-3 mm;
 - corn starch (Merifilm from Tate & Lyle) in an amount of 12 wt% relative to the stucco;
 - glass fibres in an amount of 2 wt% relative to the stucco.
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Example 4

A gypsum plasterboard was prepared from a slurry containing the following ingredients:

- stucco;
- woodchips in an amount of 3wt% relative to the stucco. The woodchips had a maximum dimension in the range 1-20 mm and a thickness of 0.5-3 mm;
- 15 • polyvinyl acetate (Vinamul 8481) in an amount of 12 wt% relative to the stucco;
- glass fibres in an amount of 2 wt% relative to the stucco.

Comparative Example 1

20 A gypsum plasterboard was prepared from a slurry containing the following ingredients:

- stucco;
- woodchips in an amount of 3wt% relative to the stucco. The woodchips had a maximum dimension in the range 1-20 mm and a thickness of 0.5-3 mm;
- glass fibres in an amount of 2 wt% relative to the stucco.

25

Comparative example 2

A gypsum plasterboard was prepared from a slurry containing the following ingredients:

- stucco;
- woodchips in an amount of 3wt% relative to the stucco. The woodchips had a maximum dimension in the range 1-20 mm and a thickness of 0.5-3 mm.

5 Screw pull-out strength

Screw pull-out tests were carried out on samples measuring 100mm by 100mm that had been conditioned at a temperature of 23°C and a relative humidity of 50%. A 50mm single thread wood screw was inserted into the sample, passing through a metal load transfer element positioned on the surface of the sample. The load transfer element has a first portion that is configured to lie between the screw head and the surface of the sample, and a second portion that is configured to engage with a testing machine so as to allow a load to be applied to the screw along the axis of the screw. The screw was tightened to a torque of 1Nm.

The specimen was then mounted in a Zwick Universal Testing Machine and a 10N pre-load applied to the screw along the axis of the screw. Subsequently, the load was increased by setting a constant cross-head speed of 10mm/minute until pull out was achieved.

The results are set out in Table 1. These are averages, each taken from 8 samples.

Table 1

Example	Average screw pull-out strength
Example 1	523±88
Example 2	795±93
Example 3	794±82
Example 4	1097±131
Comparative Example 1	336±46
Comparative example 2	177±95

CLAIMS

1. A plasterboard comprising a gypsum matrix having particles of agglomerated fibres embedded therein in an amount of at least 1 wt% relative to the gypsum, the gypsum matrix
5 further comprising a polymeric additive, the polymeric additive being present in an amount of at least 1 wt% relative to the gypsum;
wherein
no backing lamina is attached to either face of the plasterboard.
- 10 2. A plasterboard according to claim 1, wherein the polymeric additive is present in an amount of at least 4 wt% relative to the gypsum.
3. A plasterboard according to claim 1 or claim 2, wherein the particles are present in an amount of at least 2 wt% relative to the gypsum.
- 15 4. A plasterboard according to any one of the preceding claims, wherein the particles are wood particles.
5. A plasterboard according to claim 4, wherein the length of the wood particles is in the
20 range 0.5-25 mm.
6. A plasterboard according to claim 4 or claim 5, wherein the thickness of the wood particles is less than 4 mm.
- 25 7. A plasterboard according to any one of claims 4 to 6, wherein the plasterboard further comprises glass fibres.

8. A plasterboard according to claim 7, wherein the glass fibres are present in an amount of at least 1 wt%.

9. A plasterboard according to any one of the preceding claims, wherein the polymeric additive is selected from group comprising polyvinyl acetate, poly vinyl acetate-ethylene copolymer, polyvinyl pyrrolidone crosslinked with polystyrene sulfonate, polyvinyl alcohol, methyl cellulose, hydroxyethyl methyl cellulose, styrene-butadiene copolymer latex, acrylic ester latex, acrylic copolymer latex, polyester resin, epoxy resin, polymethyl methacrylate, polyacrylic acid, cationic starch, ethylated starch, dextrin and mixtures thereof.

10. A plasterboard according to any one of claims 1-8, wherein the polymeric additive is starch or polyvinyl acetate.

11. A plasterboard according to claim 10, wherein the polymeric additive is polyvinyl acetate.

12. A plasterboard comprising a gypsum matrix having wood particles embedded therein in an amount of at least 2 wt% relative to the gypsum, the gypsum matrix further comprising glass fibres in an amount of at least 1 wt% relative to the gypsum.

13. A plasterboard according to claim 12, wherein no backing lamina is attached to either face of the plasterboard.

14. A plasterboard according to claim 12 or claim 13, wherein the maximum dimension of the particles is in the range 0.5-25 mm.

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2015/053534

A. CLASSIFICATION OF SUBJECT MATTER

INV. B32B5/22 C04B28/14 E04C2/04
ADD.

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)

B32B C04B E04C

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 practicable, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/042060 A1 (UNITED STATES GYPSUM CO [US]) 10 April 2008 (2008-04-10) paragraph [0001] - paragraph [0063]; claims 1-53 -----	1-11
X	WO 2005/060628 A2 (INNOVATIVE CONSTR & BUILD MAT [US]; POLLOCK JACOB FREAS [US]; TAGGE CH) 7 July 2005 (2005-07-07) paragraph [0006] - paragraph [0069]; claims 1-30 -----	1-11
X	US 5 305 577 A (RICHARDS TURNER W [US] ET AL) 26 April 1994 (1994-04-26) column 2, line 62 - column 17, line 7; claims 1-42 ----- -/-	1-11

☒ 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

"Z" document member of the same patent family

Date of the actual completion of the international search

2 February 2016

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Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2015/053534

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.:
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 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:

see additional 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 fees, this Authority did not invite payment of additional fees.
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.:

1-11

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11

A plasterboard comprising a gypsum matrix having particles of agglomerated fibres embedded therein in an amount of at least 1 wt% relative to the gypsum, the gypsum matrix further comprising a polymeric additive, the polymeric additive being present in an amount of at least 1 wt% relative to the gypsum; wherein no backing lamina is attached to either face of the plasterboard.

2. claims: 12-14

A plasterboard comprising a gypsum matrix having wood particles embedded therein in an amount of at least 2 wt% relative to the gypsum, the gypsum matrix further comprising glass fibres in an amount of at least 1 wt% relative to the gypsum.

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2015/053534

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/065319 A2 (INNOVATIVE CONSTR & BUILD MAT [US]; POLLOCK JACOB FREAS [US]; TAGGE CH) 5 August 2004 (2004-08-05) paragraph [0009] - paragraph [0274]; claims 1-77 -----	1,3-8, 10,11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2015/053534

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