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(54) Title: MINERAL FIBRE BATTS

(57) Abstract: A cured mineral fibre batt is provided with a less stiff surface portion by fracturing the bonded mineral fibre network in that portion, for instance by mechanical depthwise compression of the batt after curing the binder.

Mineral Fibre Batts

This invention relates to mineral fibre batts which have variable stiffness properties across their thickness.

A conventional mineral fibre batt comprises a bonded mineral fibre network bonded by a cured bonding agent.

Batts having different stiffness at different levels through the thickness of the batt can be made by laminating, with intermeshing at the lamination face, preformed cured batts having different stiffness. Usually it is better to make the batt by curing a mineral fibre web containing uncured bonding agent and which has variable fibre density through the depth or variable binder concentration through the depth.

The web may be made by, for instance, centrifugal fiberisation of a mineral melt of glass, rock, stone or slag, for instance using one or more cascade spinners or one or more spinning cups.

The production of a cured batt having varying binder concentration through the depth may be achieved as described in EP-A-374112. The production of a batt by curing a web having higher fibre density in one layer than the rest may be achieved by conventional dual density processes. In these the mineral fibres and bonding agent are collected as a web, the upper layer of the web is separated and consolidated and rejoined on to the remainder of the web, and the web is then subjected to curing.

In practice it is always necessary to have some binder throughout the batt in order that it retains coherence during handling and use. When using the conventional bonding agents for mineral fibre batts, the batt is made notably stiff even when the amount of bonding agent is as low as is reasonably satisfactory to achieve minimum coherence of the batt.

For many purposes this stiffness is highly desirable. However there are some instances when the stiffness created by low binder amounts is undesirable and there are other cases where it would be desirable to provide a surface

layer of lower stiffness in a product which has high binder amounts and/or high density and so is, overall, very stiff.

A mineral fibre batt according to the invention has first and second major surfaces and comprises a bonded mineral fibre network which is bonded by a cured bonding agent and which has an inner portion and an outer portion wherein the second surface of the batt is provided by the outer surface of the outer portion, and wherein the outer portion has a depth of at least 5mm and has reduced stiffness due to post-cure compression of the bonded network in the outer portion.

Often the inner portion adjacent the outer portion has the same fibre content type (e.g., average dimensions and chemical type) and distribution, and the same bonding agent and amount, as the outer portion, in which event it is meaningful simply to compare the stiffness of the outer portion with the stiffness of the adjacent inner portion. Sometimes however the adjacent inner portion exhibits also some additional difference, e.g., in fibre content or binder.

The invention includes a method of reducing the stiffness of an outer portion of a bonded mineral fibre network which is bonded by a cured bonding agent by applying mechanical compression.

The bonding agent is usually a conventional bonding agent for mineral fibre batts, for instance a phenolic or other curable thermosetting resin. As a result of applying compression from the second face after curing the bonding agent, a product is formed in which the outer portion is less stiff than the inner portion. This presumably is due to fracturing of the bonded network in the outer portion as a result of the compression after curing the bonding agent.

The compression may be applied across the entire thickness of the batt after bonding, for instance by passing the batt between the nip of a pair of rollers or a sequence of rollers, often having decreasing nip height, or by passing the batt through conveyors having a decreasing

separation. For instance the nip may have depth of 20 to 90%, usually 30 to 70%, of the thickness of the cured batt.

Preferably, however, the height compression is applied predominantly from the second face by passing the bonded and cured batt through a nip between a surface which supports the first face and compression means for temporarily compressing the batt at the second face. This will result in fracturing the bonded network in the bonded outer portion of the second face, leaving the bonded network closer to the first layer substantially unchanged.

The preferred compression means comprise at least one compression-applying roller having a diameter less than the total thickness of the batt and which defines a nip which has a depth of 20 to 90% of the thickness of the batt after curing (giving 10 to 80% temporary height compression). Usually the nip has a depth of at least 30 or 40% of the thickness of the batt and generally not more than 70 or 80% of the height of the batt. For instance it may have a depth of around 55% of the height of the batt, thus giving 45% temporary height compression.

The diameter of the or each compression applying roller must be relatively small in order to concentrate the compression forces in the desired region. The diameter is usually less than 75%, and often less than 50%, of the thickness of the batt. It is usually at least 30mm, and is usually below 75mm, often below 40 or 50mm.

The support surface is preferably substantially planar but it can be a surface with a large radius of curvature and which thus gives substantially the same support as a planar surface. For instance the support can be a planar plate or conveyor or drum of large diameter, e.g., at least 5 times the thickness of the batt.

Preferably the compression means comprise a plurality of parallel, compression applying, rollers each having a diameter less than the thickness of the batt (as explained above) and which define with the substantially planar support a nip which decreases in distance as the batt

enters the nip, and the final, narrowest, nip preferably is within the range described above. Preferably the nip increases in distance as the batt leaves the nip. Preferably each roller, in plan view, overlaps each adjacent roller and preferably each defines a step of 3 to 15, often 5 to 10mm, up (or down) from the next.

When it is desired that the outer portion should be very soft, and thus have a low modulus of elasticity, the binder content is usually relatively low, for instance 0.2 to 1.5%, often around 0.3 to 1 or 1.2%. Also, the fibre density is usually relatively low, for instance 20 to 100kg/m^3, often around 30 to 90kg/m^3. In such products, it is usually then desired for the batt to have a first face of substantially higher density and/or substantially higher binder content, e.g., a density of 100 to 280kg/m^3 and a binder content of 1.5 to 6%. Suitable products are described in our application filed by us even date herewith reference PRL04394WO claiming priority from EPA 01309600.3.

Another instance when it is particularly desirable to utilise the invention is when a batt is to be fixed against a non-planar surface, for instance a surface having surface irregularities with a depth of at least 3mm, and often 5 or 10mm or even 15mm. For instance it is known to be desirable to fit mineral wool batts against brickwork or other stone walls and these often have an irregular surface. In GB-A-1,306,225 it is proposed that a soft glass fibre panel can be applied to such a surface but this tends to be unsatisfactory since irregularities in the surface are then manifested in the wall are then manifested, to some extent, in the first surface of the glass fibre panel. In practice any irregular surface on to which a bonded mineral fibre batt is to be secured is normally given a smoothing coat of plaster so as to provide a flat surface against which the batt can be secured firmly. This is wasteful of materials and time.

The invention provides a solution to this problem because the batt can now be secured firmly to the irregular

surface since the soft outer portion will absorb the irregularities of up to, for instance 15mm, without causing the irregularities to be manifested in the first surface. Typically the batt has a density of 20 to 150, often 50 to 80 or 100, kg/m^3 and a thickness of 20 to 150mm, often 30 to 90mm.

It may have a dual density structure, with the outer portion being in the lower density layer for isntance as described in WO88/00265 or a triple layer, for instance as described in WO00/73600.

In general, the batt may have conventional structure and appearance except for the softened rear outer portion, which is typically 10 to 50mm, often 20 to 40mm, deep.

The softening can be increased by cutting (for instance to the desired depth of the softened portion) a check or other pattern into the outer portion prior to the mechanical compression.

The invention can also be applied to products where the softened portion itself has a relatively high binder content and/or a high fibre density. For instance it can have a binder content of above 1%, typically 2 to 6%, for instance 3 to 4 or 5%. It can have a density of above 100kg/m^3, often at least 160kg/m^3, up to 180 or even 250kg/m^3.

The invention also includes mineral batts having a less stiff outer portion achieved by other methods. Broadly it is often preferred that the mineral fibre network which extends inwardly from the second face (and which may be all the second layer and part of the intermediate layer if present or just all or part of the second layer) has an inner portion and an outer portion wherein the second major face of the batt is provided by the outer face of the outer portion and wherein the outer portion has a depth of at least 5mm and is softer than the inner portion and merges with the inner portion through a transition portion of at least 5mm over which the stiffness increases gradually. Thus there is a softer or less stiff

outer portion which merges gradually with a stiffer inner portion.

Stiffness for the purposes of this invention, can be considered to be modulus of elasticity (EN826), wherein an increasing numerical value for the modulus of elasticity indicates increasing stiffness. Preferably the stiffness of the outer portion is less than 90% of what the stiffness would have been if the network had not been fractured and most preferably it is less than 80% or even less than 70% of the stiffness of what the stiffness would have been if the network had not been fractured. It is usually at least 20%, and generally at least 40%, of what the stiffness would have been if the network had not been fractured.

The low stiffness, outer, portion generally has a depth of at least 10mm and often at least 10%, and preferably at least 20% or even 30% of the total thickness of the batt. The outer portion can constitute as much as, for instance, 70% or even 80% of the thickness of the batt.

In one embodiment, the fibres of the outer portion have dimensions and structure such that the network is softer, for instance by selecting appropriately the fiberising conditions for these fibres, e.g., as described in WO99/51535.

In another embodiment reduction in stiffness of the outer portion and its merging with the higher stiffness inner portion may be achieved by curing the binder so that the binder gives a softer bonded fibre network in the outer portion than the inner portion, for instance by overcuring the outer portion by overheating it during the cure.

Preferably however it is achieved by the application of a softening treatment from the second face inwards after curing the bonding agent, so that the treatment has less effect as the depth from the second surface increases. This softening may be achieved by applying any softening treatment from the outside inwardly, for instance by heating, but preferably is achieved by mechanical compression, as described above.

CLAIMS

1. A method of making a batt having a softened outer surface comprising making a batt comprising a bonded mineral fibre network bonded by a cured bonding agent, and then mechanically compressing the batt depthwise by passing the bonded and cured batt through a nip defining a depth of 20 to 90% of the thickness of the cured batt.

2. A method according to claim 1 in which the compression is applied by passing the bonded and cured batt through a nip between a surface which supports one surface of the batt and compression means for temporarily compressing the batt at the other surface.

3. A method according to claim 2 in which the compression means comprise at least one compression-applying roller having a diameter less than the total thickness of the batt and the support surface is substantially planar.

4. A method according to claim 3 in which the compression means comprise a plurality of parallel, compression-applying, rollers each having a diameter less than the thickness of the batt and which define with the support a nip which decreases in distance as the batt enters the nip.

5. A method according to claim 4 in which the depth of the nip increases in distance as the batt leaves the nip.

6. A mineral fibre batt which has first and second major surfaces and which comprises a bonded mineral fibre network which is bonded by a cured bonding agent and which has an inner portion and an outer portion wherein the second surface of the batt is provided by the outer surface of the outer portion and wherein the outer portion has a depth of at least 5mm and has reduced stiffness due to post-cure compression of the bonded network in the outer portion.

7. A batt according to claim 6 in which the reduced stiffness in the outer portion is due to fracturing of the bonded network in the outer portion.

8. A batt according to claim 6 or claim 7 comprising a first layer bonded by a bonding agent and which extends inwardly from the first surface and one or more intermeshed

layers each comprising a bonded mineral network bonded by a bonding agent and wherein the first face of the batt is the outer surface of an outer layer which has higher density than the other layers.

9. Use of a batt according to any of claims 6 to 8 as insulation fitted against an irregular surface wherein the second face is compressed against the irregular surface and the soft outer portion absorbs the irregularities without causing the irregularities to be manifested in the first surface.

10. A mineral fibre batt which has first and second major surfaces and which comprises a bonded mineral fibre network which is bonded by a cured bonding agent and which has an inner portion and an outer portion wherein the second face of the batt is provided by the outer surface of the outer portion and wherein the outer portion has a depth of at least 5mm and is less stiff than the inner portion and merges with the inner portion through a transition portion of at least 5mm over which the stiffness decreases gradually.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 D04H1/70 D04H13/00 D04H1/00 E04B1/78

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 7 D04H E04B

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)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 415 517 A (TIMMS DONNY L) 15 November 1983 (1983-11-15) column 3, line 65 -column 4, line 14; figure 1	1-3
A	WO 98 12395 A (CRIDLAND IAN ;NOERGAARD LUIS (DK); ROCKWOOL INT (DK)) 26 March 1998 (1998-03-26) the whole document	1-10
A	WO 97 36034 A (ROCKWOOL INT ;FLUMROC AG (CH); WYSS PETER (CH); ZIMMERMANN FREDY ()) 2 October 1997 (1997-10-02) the whole document	1-10

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

[X] Patent family members are listed in 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 document but published on or after the international filing date

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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 February 2003	06/03/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Barathe, R

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INTERNATIONAL SEARCH REPORT

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PCT/EP 02/12615

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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