(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 520 892 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.03.2025 Bulletin 2025/11

(21) Application number: **23196152.5**

(22) Date of filing: **08.09.2023**

(51) International Patent Classification (IPC):
E04F 15/18 *(2006.01)* ***E02D 27/02*** *(2006.01)*
E04B 1/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E04F 15/18; E04B 1/0007; C10B 53/02;
C10B 57/14

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(71) Applicant: **Saint-Gobain Denmark A/S**
2300 Copenhagen S (DK)

(72) Inventor: **RASMUSSEN, Mona Ammitzbøll**
2300 København S (DK)

(74) Representative: **AWA Denmark A/S**
Strandgade 56
1401 Copenhagen K (DK)

(54) **A LOAD BEARING SUB-FLOOR INSULATION LAYER COMPRISING A GRANULAR PRODUCT, A SUB-FLOOR CONSTRUCTION, AND A METHOD OF PRODUCING A LOAD BEARING SUB-FLOOR INSULATION LAYER**

(57) A load bearing sub-floor insulation layer (51) comprises a granular product having a biogenic carbon content of at least 70 % of dry matter.

A sub-floor construction (56) comprises such load bearing sub-floor insulation layer (51).

A method of producing such load bearing sub-floor insulation layer comprises the steps of:
providing a granular product having a biogenic carbon content of at least 70 % of dry matter, such as a granular product comprising biochar having an organic carbon content of at least 70 % of dry matter,
introducing the granular product as a layer to a floor construction (56) at a building site, preferably placing a plate above the granular product, and
compacting, preferably by vibrating, to a level of 5-15% of compaction.

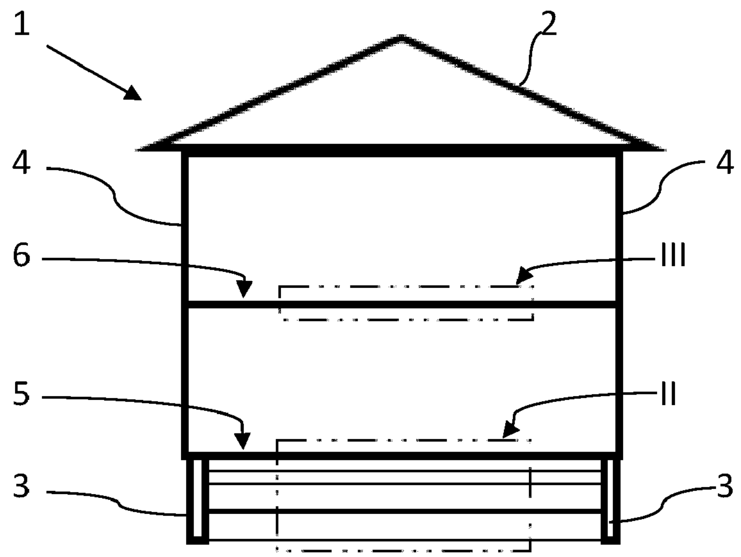

Fig. 1

Processed by Luminess, 75001 PARIS (FR)

(Cont. next page)

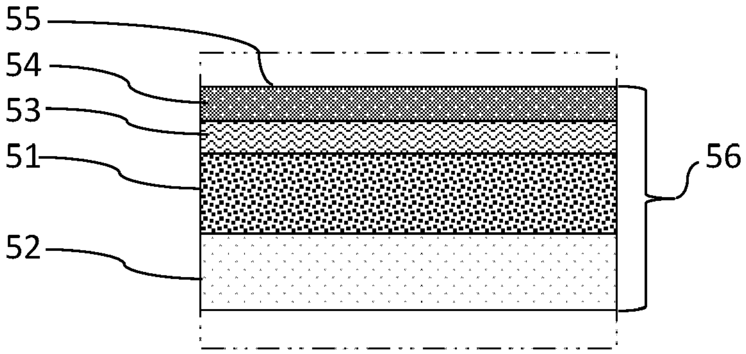

Fig. 2

Description

Technical Field

[0001] The present invention relates to a load bearing sub-floor insulation layer comprising a granular product according to the preamble of claim 1. The invention furthermore relates to a sub-floor construction comprising a load bearing sub-floor insulation layer, and to a method of producing a load bearing sub-floor insulation layer.

Background Art

[0002] The climate crisis is evolving, and the building industry is a huge contributor to climate change, with almost 40% of the greenhouse gasses heating the planet originating from the built environment - almost 30% come from heating and cooling buildings with fossil energy and approximately 10% comes from the building material production with cement and concrete as a main source.

[0003] The current initiatives to diminish climate impact from buildings is mainly focused on insulating to prevent energy losses, reducing greenhouse gas (GHG) emissions from the production of building materials, and on increasing the use of biomass instead of fossil fuels in the energy system. All approaches are necessary, but as some of the building parts needs to be materials which are non-combustible and/or non-biodegradable - some GHG emissions will prevail many efforts of reduction. Therefore, carbon removal technologies in the building industry are necessary in order to get to a net-zero emission scenario soon.

[0004] Also, the science has through significant research, led by UN's IPCC, Intergovernmental Panel on Climate Change, concluded that carbon sink solutions have to be developed fast in order to remove excess CO_2 from the atmosphere. Such carbon sink solutions could preferably prevent biomass carbon from re-entering the atmosphere when burnt or biodegraded, as biomass on a yearly basis through photosynthesis takes up vast amounts of CO_2 - up to 3 times more than human fossil activities emit in 2021.

[0005] As biogenic wood and fossil charcoal still is burnt in vast amounts for energy purposes it is crucial to find other ways to hinder these resources in ending up as CO_2-pollution in the atmosphere. In the standard for life cycle analyses EN ISO 14067, there is a definition of the terms biogenic carbon and fossil carbon. Biogenic carbon is derived from biomass - and the biomass being material of biological origin, excluding material embedded in geological formations, such as fossil carbon contained in coal, oil, natural gas, and peat.

[0006] Biochar is defined by the International Biochar Initiative, as a solid material obtained from thermochemical conversion of biomass in an oxygen-limited environment. The biogenic carbon content can vary depending on biomass feedstock and the nature of the thermochemical process. According to "European Biochar Certificate guidelines version 10.3" (EBC (2012-2023) 'European Biochar Certificate - Guidelines for a Sustainable Production of Biochar.' Carbon Standards International (CSI), Frick, Switzerland. (http://european-biochar.org). Version 10.3 from 5th Apr 2022), paragraph 7.1, the organic carbon content of biochar varies between 35% to 95% of dry matter. Carbon stability is indicated by the molar ratio of hydrogen (H) to organic carbon (Corg). Lower values of this H/Corg ratio are correlated with greater carbon stability, so the molar H/Corg ratio must be less than 0,7. The organic carbon content of biomass is often around 50% and found in different quantities in the plant cell wall components: Lignin, Cellulose and Hemicellulose.

[0007] In WO 2010/012275 A2 it is described how biomass pellets pyrolyzed at two stages of decreasing temperature in the ranges of 650 °C to 820 °C and 450 °C to 520 °C, respectively, will be subject to a mechanical post treatment and be turned into a grainy or pulverized form, after which it can, among other uses, be used as an insulation material by introducing the crushed product to a void with stable outer plates between studs or treated with a bonding agent like cement or hardening glue or shaped by compression moulding.

[0008] From US 2022/0106789 A1 it is learned that a sandwich wall element can consist of relatively thin outer plates bonded firmly to one another through an insulation layer of carbon with a binding agent such as cement, lime, geopolymer, resins or foams. If the outer plates are self-supporting the coal-based material can be loose beads, as in WO 2010/012275 A2. If any water vapour condensates inside the biochar insulation, then due to high adsorption capacity of the biochar, there is no occurring and consequential leakage of condensation water to the interior of the wall, hence this prevents mould formation inside the building.

[0009] It is common to provide a ground floor insulation made of granulated inorganic mineral material such as lightweight expanded clay serving both as water controlling agent and insulation. As learned from NL 1000540 C2 the inorganic clay mineral is a suitable building material when there are wet conditions in the construction.

[0010] From several expanded clay producing companies, it can be learned that the clay is dug out of the ground and heated to more than 1000 °C in a rotary kiln by using fossil fuels, through which it expands and leaves a rich variety of pores and by that insulation properties with lambda of approx. 90 mW/m^2K. The expanded clay is placed as the lower part of the ground floor insulation layer in a thickness of at least 150 mm and with the lower layer of 75 mm serving as a capillary-breaking layer preventing groundwater from interfering with the further floor construction.

[0011] It is also common to use expanded or extruded polystyrene (EPS or XPS) plates as ground floor insulation. As these materials still are produced directly of fossil fuels the production supports further extraction of fossil fuel from underground reservoirs and at the end-of-life burning of the products this will convey the fossil CO_2 to the atmosphere. The plates are, when laid out in the building process, hard to fit firmly together, so it is either time consuming and/or with a risk of cold bridges, to use this kind of rigid insulation plates.

[0012] As can be derived from the above, there is still room for improvement of the load bearing sub floor insulation of buildings as regards to the carbon footprint and material efficiency in the manufacturing and mounting of the prior art.

Summary of Invention

[0013] It is an object of this invention to provide a load bearing sub-floor insulation layer comprising a granular product having an overall reduced carbon footprint.

[0014] Further objects are to provide a sub-floor construction having an overall reduced carbon footprint and a method of producing a load bearing sub-floor insulation layer having an overall reduced carbon footprint.

[0015] According to a first aspect the first of the above objects is met by a load bearing sub-floor insulation layer comprising a granular product, wherein said granular product has a biogenic carbon content of at least 70 % of dry matter. Especially the granular product may comprise biochar having an organic carbon content of at least 70 % of dry matter, preferably between 70 % and 95 % of dry matter. The size of the granules in the granular product is preferably at least 4 mm grain size in order to reduce capillary suction

[0016] Surprisingly, such granular product has proved to be able to provide for a layer having a strength allowing it to be used as a load bearing in layer in a sub-floor construction.

[0017] Such (granular) products are according to the above-mentioned "European Biochar Certificate guidelines version 10.3" e.g. obtainable from thermochemical conversion of wood and nutshells.

[0018] In general, using a granular product having a biogenic carbon content as an insulation layer in a building provides a carbon sink because said biogenic carbon content will be kept in the construction of the building. Further, the granular product having a biogenic carbon content will substitute a material having a large carbon footprint as discussed above. Thus, the present invention provides a reduced carbon footprint.

[0019] In an embodiment the granular product is pyrolyzed lignocellulosic biomass granules, preferably produced of a biomass with a lignin content of 15-40% lignin, preferably 18-35% lignin, and more preferably 25-35% lignin.

[0020] Using pyrolyzed lignocellulosic biomass based on a biomass with a lignin content the lignin assists providing for the strength of the product to provide for load bearing properties.

[0021] In an embodiment the granular product is pyrolyzed wood-pellets.

[0022] As such wood-pellets is a known product that is easy to produce and equipment for and standards around producing wood-pellets are known. Thus using wood-pellets as a starting material for pyrolyzing provides in a convenient way for obtaining a granular product as intended.

[0023] In an embodiment the granular product is produced of a waste biomass from woody building materials, waste biomass from production of woody building materials or wasted pallets of woody materials.

[0024] In this way good use may be made of waste material to capture the carbon contents thereof and avoid that said carbon contents is transformed into CO_2.

[0025] In an embodiment the granular product is produced at a pyrolysis temperature of 200-550 °C, preferably 200-450 °C, more preferably 250-400 °C, even more preferably 400 °C +/- 20 °C.

[0026] Lignin starts degrading/evaporating at temperatures above 550 °C and below this temp it is charred. The charred lignin assists in providing to the strength of the product providing for load bearing capabilities allowing the product to be used as a load bearing sub-floor insulation layer.

[0027] In an embodiment the granular product is coated with a water repelling agent. The water repelling agent may be at least one of: pyrolysis oil, preferably obtained from pyrolysis of the granular product, and a fluid silicon infusion.

[0028] Hereby it is avoided that the granular material absorbs water that might be present and that might reduce the insulation properties of the product or the durability of the product.

[0029] In an embodiment the granular product is mixed with an inorganic granular product.

[0030] Hereby it is possible to adjust the overall properties of the load bearing sub-floor insulation layer. Also the end-of-life scenario of such mixed product will rather be direct circular use rather than burning the organic granular product with the not wanted result of releasing CO2. A circular use of resources further prohibits use of virgin resources.

[0031] In an embodiment the load bearing sub-floor insulation layer has a compressive strength in a perpendicular direction of above 20 kPa, preferably between 30-300 kPa, more preferably 250-280 kPa.

[0032] Hereby intended load bearing capabilities reflecting properties of the current sub-floor insulation products may be obtained. Plate products often declares compressive strength between 30-80 kPa whereas granular light weight aggregates can withstand compressive strengths in the range 250-300 kPa.

[0033] According to a second aspect an object is met by a sub-floor construction comprising a load bearing sub-floor insulation layer according to the invention as presented above.

[0034] In an embodiment a carrying layer, such as solid ground or a building construction of floor separation, is provided below the load bearing sub-floor insulation layer.

[0035] Thus, a load bearing sub-floor insulation layer according to the invention may be used e.g. at the foundation of a building and between different floors of a building.

[0036] In an embodiment a concrete floor slab is provided above the load bearing sub-floor insulation layer.

[0037] When using a load bearing sub-floor insulation layer comprising combustible material, such as biochar, provisions may be needed to ensure safety against fire. Providing a concrete floor slab above the load bearing sub-floor insulation layer will provide such safety. Further, such concrete floor slab may enhance the overall load bearing capability of a floor comprising the sub-floor construction.

[0038] In a further embodiment a plate, such as a vibrating and casting plate, is provided between the concrete floor slab and the load bearing sub-floor insulation layer.

[0039] Such vibrating and casting plate may provide for distributing impact forces of an instrument used for vibrating and/or compacting the granular product during installation and may allow for casting concrete on top of the layer of granular product without the concrete penetrating into the layer of granular material. Further the plate enhances the sound absorption and/or sound penetration of the construction, as a diversity of materials prohibits propagation of acoustic resonance in the construction.

[0040] In a third aspect an object is obtained by a method of producing a load bearing sub-floor insulation layer according to the invention, comprising the steps of: providing a granular product having a biogenic carbon content of at least 70 % of dry matter, such as a granular product comprising biochar having an organic carbon content of at least 70 % of dry matter, preferably between 70 % and 95 % of dry matter, introducing the granular product as a layer to a floor construction at a building site, preferably placing a plate above the granular product, and compacting, preferably by vibrating, to a level of 5-15% of compaction, preferably of 7-13% of compaction, and further preferably of 10% of compaction.

[0041] In an embodiment the method, prior to the step of introducing the granular product to a floor construction, comprises the steps of: collecting a lignocellulosic biomass, granulating, heating, and pelletizing said lignocellulosic biomass, introducing the pelletized lignocellulosic biomass into a pyrolysis kiln to be pyrolyzed at a temperature of 200-550 °C, preferably 200-450 °C, more preferably 250-420 °C , even more preferably 400 °C +/- 20 °C, immediately after pyrolyzation separating the pelletized lignocellulosic biomass from the pyrolysis gasses, quenching and cooling with water, drying, and preferably adding a water repellent.

Brief Description of Drawings

[0042] In the following, the invention will be described in further detail with reference to the schematic drawings in which:

Fig. 1 is a cross-section of a building;

Figs. 2 is an enlargement of the detail indicated by II in Fig. 1; and

Fig. 3 is an enlargement of the detail indicated by III in Fig. 1.

Description of Embodiments

[0043] Fig. 1shows a cross-section of a building 1 having floors comprising sub-floor constructions comprising load bearing sub-floor insulation layers according to the present invention.

[0044] Thus, the building 1 comprises a roof 2, a foundation 3, walls 4, a ground floor 5, and a storey partition 6.

[0045] In an embodiment according to the present invention, i.e. in the embodiment shown in the figures, the ground floor 5 comprises, cf. Fig. 2, a first sub-floor insulation layer 51 positioned on solid ground 52 as a carrying layer, a first plate 53 constituting a vibrating and casting plate, and a first concrete floor slab 54. An upper surface of the first concrete floor slab 54 provides a first floor surface 55. The solid ground 52, the first sub-floor insulation layer 51, first plate 53, and first concrete floor slab 54 together provides a first sub-floor construction 56.

[0046] Further, in an embodiment according to the present invention, i.e. in the embodiment shown in the figures, the storey partition 6 comprises, cf. Fig. 3, a second sub-floor insulation layer 61 positioned on a building construction of floor separation or simply a floor separation 62 as a carrying layer, a second plate 63 constituting a vibrating and casting plate, and a second concrete floor slab 64. An upper surface of the second concrete floor slab 64 provides a second floor surface 65. The floor separation 62, the second sub-floor insulation layer 61, second plate 63, and second concrete floor slab 64 together provides a second sub-floor construction 66.

[0047] The first floor surface 55 and the second floor surface 65, respectively, may be covered by carpets, floor panels, etc. as it is generally known in the art.

[0048] The two sub-floor insulation layers, i.e. first sub-floor insulation layer 51 and second sub-floor insulation layer 61, are according to the present invention load bearing sub-floor insulation layers comprising a granular product, wherein said granular product has a biogenic carbon content of at least 70 % of dry matter. In the present embodiment the granular product comprises biochar having an organic carbon content of at least 70 % of dry matter, preferably between 70 % and 95 % of dry matter.

[0049] In the present embodiment the granular product is pyrolyzed lignocellulosic biomass granules, preferably produced of a biomass with a lignin content of 15-40% lignin, preferably 18-35% lignin, and more preferably 25-35% lignin.

[0050] In the present embodiment the granular product is pyrolyzed wood-pellets. Further in the present embodiment the granular product is produced of a waste biomass from woody building materials, waste biomass from production of woody building materials or wasted pallets of woody materials.

[0051] In the present embodiment the granular product is produced at a pyrolysis temperature of 200-550 °C, preferably 200-450 °C, more preferably 250-400 °C, even more preferably 400 °C +/- 20 °C.

[0052] Lignin starts degrading/evaporating at temperatures above 550 °C and below this temp it is charred. The charred lignin assists in providing to the strength of the product providing for load bearing capabilities allowing the product to be used as a load bearing sub-floor insulation layer. Accordingly, the pyrolysis of the granular material used in the sub-floor insulation layers 51 and 61 may be performed in a furnace or kiln in which the initial temperature around 800 °C and the temperature is subsequently lowered when the pyrolysis process is actually started. At the end of the pyrolysis process the temperature is preferably below 550 °C.

[0053] In the present embodiment the granular product is coated with a water repelling agent. The water repelling agent may be at least one of: pyrolysis oil, preferably obtained from pyrolysis of the granular product, and a fluid silicon infusion.

[0054] In an embodiment the granular product may be mixed with an inorganic granular product.

[0055] In the present embodiment the load bearing sub-floor insulation layers 51, 61 each have a compressive strength in a perpendicular direction, i.e. a load carrying capacity, of above 20 kPa, preferably between 30-300 kPa, more preferably 250-280 kPa.

[0056] For constructing the first sub-floor construction 56 or the second sub-floor construction 66, respectively, a granular product as mentioned above is provided and placed as a layer on top of the respective carrying layer, i.e. on top of the solid ground 52 or the floor separation 62. The first plate 53 and the second plate 63, respectively, is positioned on top of the respective layer of granular product. The first and the second plate 53, 63 provides for distributing impact forces of an instrument used for vibrating and/or compacting the granular product. Thus the layers of granular product are compacted by means of an instrument, preferably a vibrating instrument, as it will be known to the skilled person for compacting layers of granular materials in general, thereby compacting the layers of granular material to a level of 5-15% of compaction, preferably of 7-13% of compaction, and e.g. of 10% of compaction to provide the load bearing first and second sub-floor insulation layers 51 and 61, respectively.

[0057] Subsequently, concrete is cast on top of the respective sub-floor insulation layers 51 and 61 and the first plate 53 and second plate 63, respectively. Due to the first and second plate 53, 63, the concrete will not penetrate into the layers of granular material.

[0058] Surprisingly, a granular product having a biogenic carbon content of at least 70 % of dry matter, as outlined above in different embodiments, has proved to be able to provide for a layer having a strength allowing it to be used as a load bearing in layer in a sub-floor construction like the above first and second sub-floor construction 56 and 66.

List of Reference Numerals

[0059]

1 building
2 roof
3 foundation
4 walls
5 ground floor
6 storey partition

51 first sub-floor insulation layer
52 solid ground (carrying layer)
53 first plate (vibrating and casting plate)
54 first concrete floor slab
55 first floor surface
56 first sub-floor construction

61 second sub-floor insulation layer
62 floor separation (carrying layer)
63 second plate
64 second concrete floor slab
65 second floor surface
66 second sub-floor construction

Claims

1. A load bearing sub-floor insulation layer (51; 61) comprising a granular product,
characterized in that
said granular product having a biogenic carbon content of at least 70 % of dry matter.

2. The load bearing sub-floor insulation layer (51; 61) according to claim 1, wherein the granular product comprises biochar having an organic carbon content of at least 70 % of dry matter, preferably between 70 % and 95 % of dry matter.

3. The load bearing sub-floor insulation layer (51; 61) according to claim 1 or 2, wherein the granular product is pyrolyzed lignocellulosic biomass granules, preferably produced of a biomass with a lignin content of 15-40% lignin, preferably 18-35% lignin, and more preferably 25-35% lignin.

4. The load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims, wherein the granular product is pyrolyzed wood-pellets.

5. The load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims, where-

in the granular product is produced of a waste biomass from woody building materials, waste biomass from production of woody building materials or wasted pallets of woody materials.

6. The load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims, wherein the granular product is produced in a pyrolysis temperature of 200-550 °C, preferably 200-450 °C, more preferably 250-400 °C, even more preferably 400 °C +/- 20 °C.

7. The load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims, wherein the granular product is coated with a water repelling agent.

8. The load bearing sub-floor insulation layer (51; 61) according to claim 7, wherein the water repelling agent is at least one of: pyrolysis oil, preferably obtained from pyrolysis of the granular product, and a fluid silicon infusion.

9. The load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims, wherein the granular product is mixed with an inorganic granular product.

10. The load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims, having a compressive strength in a perpendicular direction of above 20 kPa, preferably between 30-300 kPa, more preferably 250-280 kPa.

11. A sub-floor construction (56; 66) comprising a load bearing sub-floor insulation layer (51; 61) according to any one of the preceding claims.

12. The sub-floor construction (56; 66) according to claim 11, wherein a carrying layer (52; 62), such as solid ground or a building construction of floor separation, is provided below the load bearing sub-floor insulation layer (51; 61).

13. The sub-floor construction (56; 66) according to claim 11 or 12, wherein a concrete floor slab (54; 64) is provided above the load bearing sub-floor insulation layer (51;61).

14. The sub-floor construction (56; 66) according to claim 13, wherein a plate (53; 63), such as a vibrating and casting plate, is provided between the concrete floor slab (54; 64) and the load bearing sub-floor insulation layer (51; 61).

15. A method of producing a load bearing sub-floor insulation layer (51; 61) according to any one of claims 1 to 10, comprising the steps of:

providing a granular product having a biogenic carbon content of at least 70 % of dry matter, such as a granular product comprising biochar having an organic carbon content of at least 70 % of dry matter, preferably between 70 % and 95 % of dry matter,
introducing the granular product as a layer to a floor construction (56, 66) at a building site, preferably placing a plate above the granular product, and
compacting, preferably by vibrating, to a level of 5-15% of compaction, preferably of 7-13% of compaction, and further preferably of 10% of compaction.

16. The method according to claim 15, said method, prior to the step of introducing the granular product to a floor construction (56; 66), comprising the steps of

collecting a lignocellulosic biomass,
granulating, heating, and pelletizing said lignocellulosic biomass,
introducing the pelletized lignocellulosic biomass into a pyrolysis kiln to be pyrolyzed at a temperature of 200-550 °C, preferably 200-450 °C, more preferably 250-420 °C , even more preferably 400 °C +/- 20 °C,
immediately after pyrolyzation separating the pelletized lignocellulosic biomass from the pyrolysis gasses, quenching and cooling with water, drying, and preferably adding a water repellent.

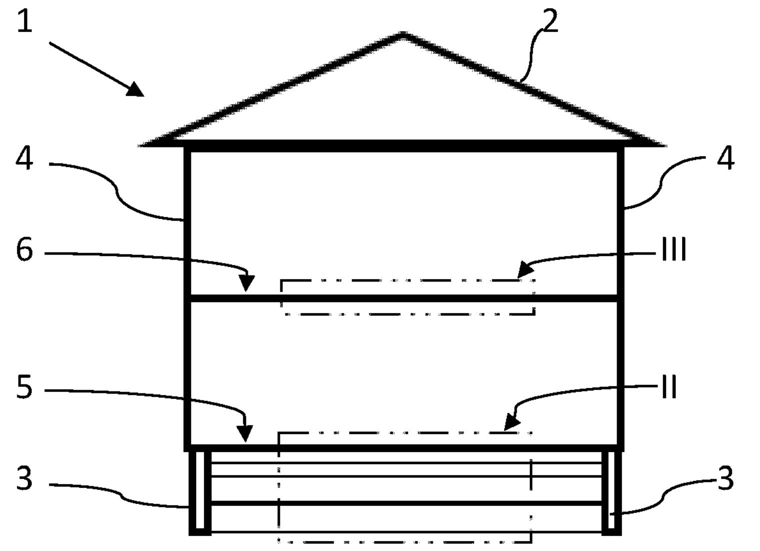

Fig. 1

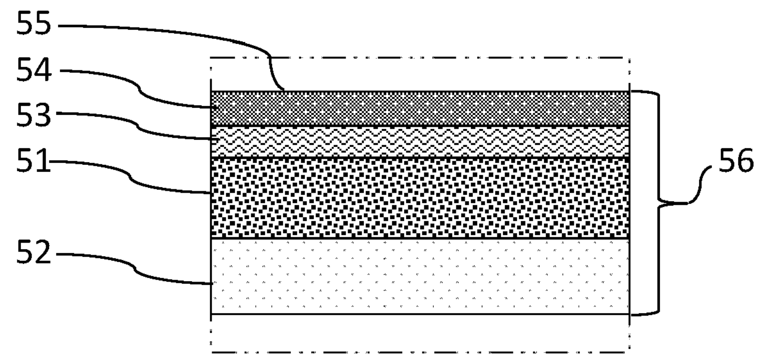

Fig. 2

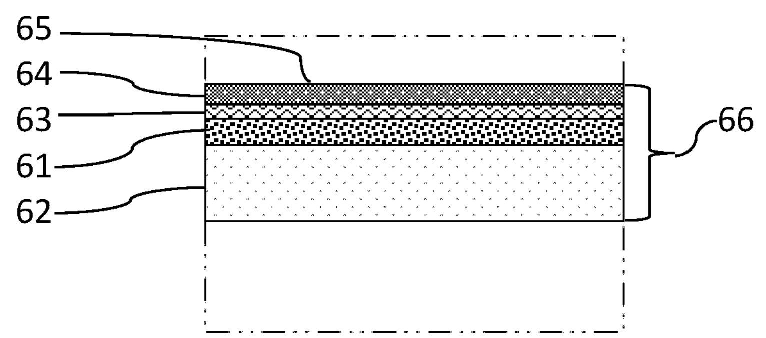

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 19 6152

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	NL 1 000 540 C2 (LAMON BEDRIJFSHYGIENE B V [NL]) 11 December 1996 (1996-12-11) * the whole document * -----	1-16	INV. E04F15/18 E02D27/02 E04B1/00
A,D	US 2022/106789 A1 (KUSE KOLJA [DE] ET AL) 7 April 2022 (2022-04-07) * the whole document * -----	1-16	
A	KR 2015 0028656 A (4EN INC [KR]) 16 March 2015 (2015-03-16) * the whole document * -----	1-16	
A	CUTHBERTSON DOUGLAS ET AL: "Biochar from residual biomass as a concrete filler for improved thermal and acoustic properties", BIOMASS AND BIOENERGY, vol. 120, 1 January 2019 (2019-01-01), pages 77-83, XP093015600, AMSTERDAM, NL ISSN: 0961-9534, DOI: 10.1016/j.biombioe.2018.11.007 * the whole document * -----	1-16	TECHNICAL FIELDS SEARCHED (IPC)
A	WO 2023/283284 A1 (CARBON TECH HOLDINGS LLC [US]) 12 January 2023 (2023-01-12) * the whole document * -----	1-16	E04F E02D E04B C10B C04B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 February 2024	Fournier, Thomas

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 19 6152

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-02-2024

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
NL 1000540	C2	11-12-1996	NONE			
US 2022106789	A1	07-04-2022	CA	3125687	A1	09-07-2020
			CN	113728143	A	30-11-2021
			DE	202019000008	U1	29-05-2019
			EP	3953538	A1	16-02-2022
			JP	2022516659	A	01-03-2022
			US	2022106789	A1	07-04-2022
			WO	2020141185	A1	09-07-2020
KR 20150028656	A	16-03-2015	NONE			
WO 2023283284	A1	12-01-2023	AU	2022308659	A1	22-02-2024
			CA	3226129	A1	12-01-2023
			US	2023012217	A1	12-01-2023
			WO	2023283284	A1	12-01-2023

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- WO 2010012275 A2 **[0007] [0008]**
- US 20220106789 A1 **[0008]**
- NL 1000540 C2 **[0009]**