

PREPARATION METHOD OF GREEN BUILDING MATERIALS, GREEN BUILDING MATERIALS AND COMPOSITE BUILDING MATERIALS CONTAINING GREEN BUILDING MATERIALS

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TECHNICAL FIELD

Embodiments of the present application relate to the technical field of green building materials, in particular to a preparation method of green building materials, green building materials and composite building materials containing the green building materials.

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BACKGROUND

With the rapid development of society and cities, people's living standards are continually improving, but the development also brings about many adverse effects to people, such as environmental pollution, destruction of the ecological environment, and various diseases that endanger people's health, survival and development. Therefore, people advocate protecting the living environment and reducing energy consumption.

Since the reform and opening up, building materials, as the pillar industry of the domestic economy, have developed rapidly, and some major building materials have been recognized worldwide, such as cement and glass, which rank first in the world in annual output. However, the goal of traditional building materials industry is to maximize profits. Traditional building materials industry consumes a lot of resources, ignoring the ecological and environmental benefits and the comprehensive utilization of resources, which has caused serious pollution to the environment and wasted a lot of resources.

SUMMARY

To reduce environmental pollution and save energy consumption, the embodiments of the present application provide a preparation method of green building materials, green building materials and composite building materials containing the green building materials.

To resolve the foregoing technical problem, the embodiments of the present application provide the following technical solutions.

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In a first aspect of the present application, there is provided a preparation method of green building materials, where the green building materials include black soldier fly puparia (commonly known as pupal shells) and plant fibers. In the method, a technician can obtain the black soldier fly puparia and the plant fibers. The technician prepare green building materials from the black soldier fly puparia and the plant fibers.

In an embodiment of the present application, the black soldier fly puparia and plant fibers in the green building materials are natural organic building materials, which are healthy, environmentally friendly, safe, and can effectively reduce the carbon emission in the preparation process of building materials, reduce environmental pollution and reduce energy consumption.

In some embodiments, the obtaining black soldier fly puparia includes: feeding black soldier fly larvae with plant feed, where the plant feed includes food waste; and collecting black soldier fly puparia after the black soldier fly larvae pupate.

In some embodiments, the obtaining plant fibers includes: in a process of feeding the black soldier fly larvae with plant feed, obtaining feed residues left after the black soldier fly larvae have eaten the plant feed, so as to obtain plant fibers in the feed residues.

In some embodiments, the plant feed includes plant feed main materials and plant fiber premixes; and

before the obtaining plant fibers, the method further includes: crushing feed residues of the plant feed main materials to obtain the plant fiber premixes.

In some embodiments, the plant feed includes food waste, and the plant feed includes untreated plant feed and/or pretreated plant feed; when the plant feed includes untreated plant feed, the feeding black soldier fly larvae with plant feed includes: feeding the black soldier fly larvae with the untreated plant feed; and when the plant feed includes pretreated plant feed, the feeding black soldier fly larvae with plant feed includes: pretreating the plant feed, where the pretreatment includes crushing treatment and/or water-oil separation treatment; and feeding the black soldier fly larvae with the pretreated plant feed.

In some embodiments, the obtaining green building materials based on the plant fibers and the black soldier fly puparia includes: drying the plant fibers and the black soldier fly puparia; and crushing the dried plant fibers and black soldier fly puparia to obtain green building materials.

In some embodiments, the obtaining green building materials based on the plant fibers and the black soldier fly puparia further includes: disinfecting the plant fibers and the black soldier fly puparia.

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In a second aspect of the present application, there is also provided green building materials, which are prepared by using the method described in the first aspect.

10 In a third aspect of the present application, there is also provided composite building materials, where according to weight percentage, the composite building materials include: 10-70% of auxiliary building materials and 30-90% of green building materials according to the second aspect.

15 In some embodiments, the auxiliary building materials include at least one of brick, concrete, gypsum board and latex paint.

20 It should be understood that the content described in the summary is not intended to limit critical or significant features of the present disclosure, nor is it intended to limit the scope of the present disclosure. Other features of the present disclosure will be easily comprehensible from the following description.

BRIEF DESCRIPTION OF DRAWINGS

25 In order to describe the technical solutions in the embodiments of the present invention more clearly, the accompanying drawing for describing the embodiments of the present invention is briefly described below. Apparently, the accompanying drawing in the following description shows merely some embodiments of the present invention, and those having ordinary skill in the art may still derive other drawings from the accompanying drawing without creative efforts.

30 FIG. 1 is a flowchart of a preparation method of green building materials provided by some embodiments of the present application.

DETAILED DESCRIPTION

In order to make the objectives, technical schemes and advantages of the present invention more apparent, the present invention is further described in detail in conjunction with the accompanying drawings and embodiments. It should be understood that the specific embodiments described here are only intended to explain the present invention and are not intended to limit the present invention.

It should be noted that, if there is no conflict, various features in the embodiments of the present invention can be combined with each other, which falls within the scope of protection of the present invention. In addition, although the division of functional modules is made in the device schematic diagram and a logical order is shown in the flowchart, in some cases, steps shown or described may be performed in different division of modules in the device schematic diagram or in a different order than the order shown in the flowchart.

Unless otherwise defined, all technical and scientific terms used in this specification shall have the same meanings as commonly understood by those having ordinary skill in the art of the present invention. Terms used in this specification of the present invention are merely for the purpose of describing specific implementations, but are not intended to limit the present invention. As used in the specification, the term “comprise” and similar terms should be understood as non-exclusive inclusion, that is, “including but not limited to”. The term “based on” should be understood as “at least partially based on”. The terms “an embodiment” or “the embodiment” should be understood as “at least one embodiment”. The terms “first,” “second,” etc. may refer to different or identical objects and are used only to distinguish between referenced objects without implying a particular spatial order, time order, importance order, etc. of the referenced objects. The term “**and/or**” used in this specification includes any and all combinations of one or more associated items that are listed.

The carbon emission released by traditional building materials and building operations account for 47% of the global greenhouse gas emission. Both the traditional building materials and existing green building materials need to take into account a large amount of carbon emissions released in a manufacturing process, and an effect of carbon reduction is not obvious. Embodiments of the present application provide a preparation method of green building materials, green building materials and composite building materials containing the green building materials. The green building materials are prepared with natural organic materials, thereby reducing carbon emissions. In order to facilitate readers' understanding of the present application, the following provides descriptions in conjunction with specific embodiments.

For example, FIG. 1 shows a flowchart of a preparation method of green building materials provided by an embodiment of the present application. With reference to FIG. 1, the method includes the following steps:

At step 11, black soldier fly puparia are obtained.

Black soldier fly (*Hermetia illucens*, Diptera: Stratiomyidae), is a saprophytic insect that feeds on animal stools and household wastes. The black soldier fly undergoes five stages in its life: egg stage, larval stage, prepupal stage, pupal stage and adult stage. The whole life cycle takes about 40 days. One generation is completed in about 25 days when environmental conditions are suitable, and is completed in about 7 months in an unfavorable environment.

The larval stage is divided into six instars according to molting times. A size of a newly hatched larva is similar to that of an egg. Larvae at the first instar basically do not feed, while larvae at the second instar begin to feed in large quantities, and larvae at the last instar are called prepupae. With the change of environmental conditions, the larval stage ranges from 7 days to about 7 months. The 5-day-old larvae began to eat more, and enter the prepupal stage 10 days later. Prepupae are dark brown with hardened shells. The pupal stage lasts about 15 days, including prepupal stage and pupal stage. After the fifth instar, the black soldier fly larvae gradually turn black, tend to harden, cease to eat, and enter the prepupal stage. The black soldier flies at the prepupal stage do not need feed, and will migrate from the feed to a dry and hidden place to pupate. After pupation, the black soldier fly pupa is a dark brown coarctate pupa with a hard puparium and is unable to move. The pupa body can be seen when the pupa is cut open. Pupa will eventually become an adult insect.

In some embodiments, the technician can directly collect the black soldier fly puparia as raw materials of green building materials, for example, they can buy black soldier fly puparia from the market.

In some other embodiments, the technician can also obtain the black soldier fly puparia by raising black soldier fly larvae. Specifically, step 11 specifically includes the following steps:

At step 111, black soldier fly larvae are fed with plant feed.

At step 112, black soldier fly puparia are collected after the black soldier fly larvae pupate.

In some embodiments, the technician uses plant feed to feed black soldier fly larvae, and collect black soldier fly puparia after the black soldier fly larvae pupate. Here, the plant feed includes seeds, fruits or tissue parts of plants, specifically fruits and/or vegetables. The plant feed may be food waste or non-food waste. When the plant feed is non-food waste, the plant feed may also be rotten or damaged plant fruits or tissue parts, **such as** rotten fruits, vegetable leaves **and/or** melon rinds **collected in the fruit market**.

Food waste mainly comes from feed processing leftovers and food residues produced by catering service industry, families, canteens of enterprises and institutions, etc. With the rapid development of the domestic economy and the gradual acceleration of urbanization, the amount of food waste is increasing year by year. In large cities and metropolises in the nation, the amount of food waste has reached thousands of tons, and the domestic amount of food waste has reached 10 million tons. If the kitchen is only landfilled, it will occupy a large amount of land. The produced waste leachate and landfill gas also need post-treatment, which consumes a lot of manpower and material resources. Feeding black soldier fly larvae with food waste can not only reduce costs, but also reduce environmental pollution.

The black soldier fly can digest a large amount of food waste and transform it into new insect protein, new microorganism and insect frass organic fertilizer, which can solve the problem that household wastes will affect the environment, air and water quality, and purifies the ecological environment and reduces the burden on the environment with the produced insect protein and fertile micro-ecological organic fertilizer. However, although the black soldier fly has many additional economic values mentioned above, such as dry and crushed black soldier fly larvae being used in pig feed, and black soldier fly feces fertilizer being a high-quality organic fertilizer and soil ameliorant, a large number of puparia produced during the growth of black soldier fly have not been effectively utilized at present. The implementation of the present application can further improve economic values of the black soldier fly by using the black soldier fly puparia as raw materials of green building materials.

In some embodiments, the plant feed includes untreated plant feed and/or pretreated plant feed; and when the plant feed includes untreated plant feed, a breeder can directly use the untreated plant feed (for example, food waste) to feed the black soldier fly larvae.

In some other embodiments, when the plant feed includes pretreated plant feed, prior to step 111, the method further includes:

At step 1101, the plant feed is pretreated, where the pretreatment includes crushing treatment and/or water-oil separation treatment.

At step 1102, the black soldier fly larvae are fed with the pretreated plant feed.

In this embodiment, after collecting the plant feed, the technician can pretreat the plant feed first, and then feed the black soldier fly larvae with the pretreated plant feed. Pretreatment may be, for example, screening and sorting of the collected plant feed to remove inedible impurities. The pretreatment may also be crushing treatment and/or water-oil separation treatment on the plant feed. The crushing treatment may be, for example, grinding or pulverization treatment with a pulverizer. Water-oil separation treatment can separate water and oil from the plant feed (for example, food waste). In this embodiment, the pretreatment on the plant feed can help the black soldier fly eat the plant feed quickly and conveniently.

At step 12, plant fibers are obtained.

Plant fibers are filaments or flocs produced by the combination of cellulose and various nutrients, which have the functions of supporting, connecting, wrapping and filling plants, and widely exist in plant stalks, roots, fruits and shells. As the raw materials of green building materials, plant fibers mainly play a strengthening role.

In some embodiments, to make full use of plant feed, in a process of feeding the black soldier fly larvae with plant feed, the technician may further obtain feed residues left after the black soldier fly larvae have eaten the plant feed, so as to obtain plant fibers in the feed residues. When the black soldier fly larvae eat plant feed, feed residues will contain plant fibers. The feed residues will naturally dry after being placed in the natural environment for 1-2 days. The technician can obtain plant fibers by collecting air-dried feed residues.

In some other embodiments, the plant fibers can be obtained by any suitable other means, for example, processed plant fibers are directly obtained from the market.

In some embodiments, before step 12, the method further includes the following step:

At step 113, feed residues of the plant feed main materials are crushed to obtain the plant fiber premixes.

5 In some embodiments, the utilization of plant feed is further improved. The plant feed includes plant feed main materials and plant fiber premixes; and the plant fiber premixes are obtained by treating (for example, crushing treatment) feed residues left after the black soldier flies have eaten plant feed main materials.

10 Specifically, the technician can use plant feed main materials to feed the black soldier fly larvae. In the process of feeding the black soldier fly larvae, the technician can collect feed residues and treat the feed residues to obtain plant fiber premixes. In the subsequent feeding process, the technician can mix the obtained plant fiber premixes with the plant feed main materials and feed the black soldier fly larvae. In addition, after the black soldier fly larvae eat the mixture of plant
15 feed main materials and plant fiber premixes, the remaining feed residues are feed residues. The technician can also collect feed residues and obtain plant fibers in the feed residues. The technician can continually collect feed residues many times, obtain plant fiber premixes from the feed residues, and then feed the black soldier fly larvae with plant fiber premixes, thus realizing a feeding cycle.

20 At step 13, green building materials are prepared from the black soldier fly puparia and the plant fibers.

In some embodiments, step 13 specifically includes the following steps:

25 At step 131, the plant fibers and the black soldier fly puparia are dried.

At step 132, the dried plant fibers and black soldier fly puparia are crushed to obtain green building materials.

30 In this embodiment, the technician can dry the plant fibers and the black soldier fly puparia, and then crush the dried plant fibers and the black soldier fly puparia to obtain a powdery mixture of the plant fibers and the black soldier fly puparia. The powdery mixture is a green building material.

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In some embodiments, the plant fibers and the black soldier fly puparia may be disinfected before and after being crushed. The disinfection treatment can be, for example, ultraviolet light disinfection.

5 The preparation method of green building materials provided by the embodiment of the present application can use a large amount of food waste to produce green building materials which are non-toxic, non-polluting, non-radioactive and beneficial to environmental protection and human health.

10 A further embodiment of the present application provides green building materials, which include black soldier fly puparia and plant fibers, and are prepared by using the foregoing preparation method of green building materials.

15 A further embodiment of the present application provides composite building materials, where according to weight percentage, the composite building materials include: 30-90% of green building materials and 10-70% of auxiliary building materials provided by the above embodiments. Auxiliary building materials can be non-green building materials. The auxiliary building materials specifically include but are not limited to at least one of brick, concrete, gypsum board and latex paint.

20 The composite building materials provided by the embodiment of the present application include 30-90% of the green building materials. In the embodiment of the present application, most of auxiliary building materials produced through high-temperature production processes are replaced by the green building materials, thus reducing the carbon emission in the conventional preparation processes of building materials and saving energy. In addition, properties of composite
25 building materials can also meet use requirements. Black soldier fly puparia powder in green building materials can also effectively eliminate formaldehyde.

30 Finally, it should be noted that the above embodiments are only used to illustrate the technical solution of the present invention and are not intended to limit the present invention. In the concept of the present invention, the technical features of the above embodiments or different embodiments may also be combined, the steps may be carried out in any order, and there are many other variations of the different aspects of the present invention as described above, which are not provided in detail for brevity. Although the present invention has been described in detail with reference to the foregoing embodiments, those of ordinary skill in the art will understand that
35 modifications can be made to the technical schemes described in the aforementioned

embodiments, or equivalent replacements can be made to some of the technical features in the embodiments; and these modifications or replacements do not make the essence of the corresponding technical schemes deviate from the scope of the technical schemes of the embodiments of the present invention.

CLAIMS

1. A preparation method of green building materials, wherein the green building materials comprise black soldier fly puparia and plant fibers, and the method comprises:

- 5 obtaining black soldier fly puparia;
 obtaining plant fibers; and
 preparing green building materials from the black soldier fly puparia and the plant fibers.

2. The method of claim 1, wherein the obtaining black soldier fly puparia comprises:

- 10 feeding black soldier fly larvae with plant feed, wherein the plant feed comprises food waste; and
 collecting black soldier fly puparia after the black soldier fly larvae pupate.

3. The method of claim 2, wherein the obtaining plant fibers comprises:

- 15 in a process of feeding the black soldier fly larvae with plant feed, obtaining feed residues left after the black soldier fly larvae have eaten the plant feed, so as to obtain plant fibers in the feed residues.

4. The method of claim 3, wherein the plant feed comprises plant feed main materials

- 20 and plant fiber premixes; and
 before the obtaining plant fibers, the method further comprises:
 crushing feed residues of the plant feed main materials to obtain the plant fiber premixes.

5. The method of any one of claims 1 to 4, wherein the plant feed comprises food waste,

- 25 and the plant feed comprises untreated plant feed and/or pretreated plant feed;
 when the plant feed comprises untreated plant feed, the feeding black soldier fly larvae with plant feed comprises:
 feeding the black soldier fly larvae with the untreated plant feed; and
 when the plant feed comprises pretreated plant feed, the feeding black soldier fly larvae
30 with plant feed comprises:
 pretreating the plant feed, wherein the pretreatment comprises crushing treatment and/or water-oil separation treatment; and
 feeding the black soldier fly larvae with the pretreated plant feed.

6. The method of any one of claims 1 to 4, wherein the obtaining green building materials based on the plant fibers and the black soldier fly puparia comprises:

drying the plant fibers and the black soldier fly puparia; and

crushing the dried plant fibers and black soldier fly puparia to obtain green building

5 materials.

7. The method of claim 6, wherein the obtaining green building materials based on the plant fibers and the black soldier fly puparia further comprises:

disinfecting the plant fibers and the black soldier fly puparia.

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8. Green building materials, wherein the green building materials are prepared by using the method of any one of claims 1 to 7.

9. Composite building materials, wherein according to weight percentage, the composite building materials comprise:

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30-90% of green building materials as described in claim 8; and

10-70% of auxiliary building materials.

10. The composite building materials according to claim 9, wherein the auxiliary building materials comprise at least one of brick, concrete, gypsum board and latex paint.

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