

DESCRIPTION

Title of Invention: COOKING DEVICE AND EXOTHERMIC AGENT UNIT

Technical Field

[0001]

The present invention relates to a cooking device equipped with an exothermic agent that generates heat upon reaction with water, and to an exothermic agent unit used in the cooking device.

Background Art

[0002]

Exothermic agents that utilize heat generated by chemical reactions of compounds are capable of heating without the use of an open flame and also exhibit excellent portability. Accordingly, such an agent has conventionally been used for heating food and beverages by placing the exothermic agent in a lunch container or beverage container and initiating the chemical reaction through a predetermined operation performed prior to consumption.

[0003]

One known example of an exothermic agent is one that utilizes a chemical reaction in which calcium oxide reacts with water to form calcium hydroxide. As a heating container that can use calcium oxide as an exothermic agent, for example, Patent document 1 describes a heating container that has a heating unit produced by a specific method.

It is difficult to control the amount of heat generated and the rate of temperature rise of exothermic agents containing calcium oxide as the major component. Thus, as an alternative, exothermic agents containing calcium oxide and aluminum as the major components are also known as exothermic agents whose amount of heat generated and rate of

temperature rise can be controlled by adjusting, for example, the ratio of the components and particle diameters and which can be used to heat food and beverages such as boxed lunches (Patent documents 2 to 5).

[0004]

Specific examples of such containers equipped with an exothermic agent for heating food and beverages include the following.

[0005]

Patent document 6 discloses a heating device that does not require a large force to be applied to an elongated opening tool used during operation, and that can heat food reliably and uniformly. The heating device includes a water bag in which water is sealed within an easily tearable bag body, a support plate having an opening portion at its center, and an exothermic agent bag in which an exothermic agent that generates heat upon contact with water is housed within a water-permeable bag body. The device is characterized by the manner in which the elongated opening tool is wound, and a food-heating container equipped with this heating device is also disclosed. However, the materials, configuration, and the like of the box body, food tray, and lid that constitute the food-heating container, except for the heating device itself, are reported to be the same as those of conventional containers.

[0006]

Patent document 7 discloses a heating device having a small thickness and capable of initiating heat generation in a short time when it is required and exhibiting a sufficiently large amount of heat generated even after long-term storage, as well as a food-heating container capable of heating food to a sufficiently high temperature in a short time. The heating device includes a watertight container in which an exothermic agent that generates heat upon contact with water and an easily tearable water bag are arranged side by side in the longitudinal direction, and whose upper surface is covered with an easily tearable film, and further includes an elongated opening tool. The heating device is characterized in that a region in which an

exothermic agent is housed and a region in which the water bag is housed inside the watertight container are partitioned by a partition plate having a water passage through which water released by opening the easily tearable water bag can flow into the region in which the exothermic agent is housed. The food-heating container includes this heating device. Patent document 7 discloses that the food-heating container includes a box body that houses the heating device at its bottom portion, a food tray, and a lid, and that, in order to uniformly heat the food contained in the food tray, the food tray can be supported by a support member in such a way that a gap is formed to constitute a gas passage. It is also disclosed that a food tray having a flange portion which extends outward from the peripheral portion of the upper opening of the food tray and in which a plurality of holes are provided may be used without employing a support member. However, this support member eliminates the need for holes in the food tray to allow high-temperature steam to pass through, thus resulting in advantage in terms of cost savings. It is also reported that a resin material or paper material may be used as the material of the box body, and it is particularly preferable for the box body to be made of paper. [0007]

Patent document 8 discloses a pull-cord-type chemical heat-generating device that produces an exothermic reaction. This device includes an exothermic agent pack, a water pack, and a heating tray housing a pull cord for rupturing these packs. An opening portion of the heating tray is sealed with a protective sheet. Patent document 8 further discloses a portable food container incorporating this chemical heat-generating device. As a first requirement, the chemical heat-generating device has a completely watertight structure so that the exothermic agent does not absorb moisture. As a second requirement, the device has a structure that completely prevents the powdered exothermic agent from scattering. As a third requirement, the number of required components is minimized, the manufacturing process is simplified, and the costs of materials and manufacturing are reduced. As a fourth requirement, the device is configured such that anyone can easily pull the pull cord to completely and safely rupture the

exothermic agent pack and the water pack. The chemical heat-generating device satisfies all of the first to fourth requirements described above.

[0008]

Patent document 9 discloses a low-cost heating element unit that is easy to assemble, by which the amount of manual work involved in the assembly process can be reduced compared to the conventional one, the occurrence of defective products can be suppressed, and stable quality can be achieved. This heating element unit includes an exothermic agent pouch, a separation plate placed inside a container so as to cover at least a part of the upper surface of the exothermic agent pouch, and a water pouch placed on the upper surface of the separation plate so as to be out of contact with the exothermic agent pouch, in which these components are housed in a container having an opening portion. One end of an opening member is fixed to a first end portion of the separation plate. The opening member extends along the lower surface of the water pouch from the first end portion toward a second end portion of the separation plate. The other end of the opening member is led out of the container such that the number of folds inside the container is zero or one. A sealing sheet for sealing the opening portion is also provided in the heating element unit. Additionally, Patent document 9 discloses a method for manufacturing the heating element unit, as well as a heating container including the heating element unit, a box body, a tray member, and a lid.

Prior Art Documents

Patent documents

[0009]

Patent document 1: JP-A-2010-184039

Patent document 2: JP-B-3467729

Patent document 3: JP-B-3778213

Patent document 4: JP-B-3921550

Patent document 5: JP-B-4008490

Patent document 6: JP-A-2008-089214

Patent document 7: JP-A-2009-248981

Patent document 8: JP-A-2010-068846

Patent document 9: JP-A-2015-077282

Summary of Invention

Technical Problem

[0010]

The various containers described in Patent documents 6 to 9 are mostly characterized by the pull-cord mechanism for activating the exothermic agent, and the box body that houses the exothermic agent in its bottom portion is sometimes described as having a freely-selected shape, or in some cases, no particular mention is made regarding its shape. Also, in typical commercially available food packaging containers (box bodies and food trays), the peripheral portions are often formed in a flat shape in consideration of appearance, because these portions come into contact with the mouth during eating or are touched when the container is held by hand.

[0011]

Meanwhile, in general, the preferred temperature range of food is considered to be about $\pm 25^{\circ}\text{C}$ to $\pm 30^{\circ}\text{C}$ relative to body temperature, and for hot food, a temperature of about 60°C to 65°C is said to be preferred (Yumiko Sato and Sachiko Kobayashi, "Serving Temperatures in Group Meal Services and Temperature Changes During Eating", Bulletin of Wayo Women's University, Vol. 33 (Home Economics Series)).

When it is desired to raise the temperature of food or drink to a temperature suitable for consumption using the exothermic agent described above, in principle, since the amount of heat generated by the exothermic agent is proportional to the amount of the exothermic agent,

the amount of the exothermic agent used only needs to be increased. However, as the amount of the exothermic agent used is increased, the container for accommodating the exothermic agent is also increased in size accordingly, which may cause inconvenience to the user, particularly when the container is used for items such as boxed meals that are held by hand during consumption. Therefore, an exothermic agent that efficiently generates heat with a minimum amount is desired.

Additionally, reducing waste is a crucial element in the efforts toward a decarbonized society. Since the exothermic agent is discarded after use, that is, after completion of the exothermic reaction, an exothermic agent having as high a heat generation efficiency as possible is desired in consideration of environmental impact.

The inventors conducted studies using the exothermic agent described in Patent document 5, which is said to have a high heat generation per unit amount, and found that when the container on which the exothermic agent is placed at its bottom portion has a flat shape in which the peripheral portion of the container is not subjected to shape processing as described above, the container tends to be easily deformed by the heat of water vapor, gaps are formed at the deformed portions, and the water vapor easily flows out of the container through such gaps.

[0012]

Accordingly, it is an object of the present invention to provide a cooking device for safely heating, in a short time, food to be subjected to cooking, such as heating, so as to make the food ready for consumption.

Solution to Problem

[0013]

The inventors have conducted intensive studies to solve the above problems and have found that the following cooking device can solve the above problems, thereby completing the present invention.

[0014]

That is, the present invention provides the following cooking device.

<1> A cooking device, comprising a container body, a food container, a lid, and an exothermic agent unit,

wherein the container body has a bottom portion on which the exothermic agent unit is placeable, has an opening at an upper portion, and has at least one recessed portion in a peripheral portion,

the food container is placed over the container body, is configured to accommodate food to be cooked therein, and has at least one steam hole,

the lid is placed over the food container to thereby form an internal space in the food container, and

the exothermic agent unit includes

an exothermic agent unit container,

an exothermic agent enclosed in a water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide,

a water bag having a tear portion, and

a cord,

wherein the exothermic agent is placed on a bottom portion of the exothermic agent unit container, the water bag is placed on the exothermic agent so that the tear portion is fixed to a first end of the exothermic agent unit container, a first end of the cord is fixed to a second end of the exothermic agent unit container, and a second end of the cord extends from the second end of the exothermic agent unit container toward the first end of the exothermic agent unit container to which the tear portion is fixed, is folded back at the first end of the exothermic agent unit container so as to sandwich the water bag, and reaches the outside of the container body.

<2> The cooking device according to claim 1, wherein one of the at least one recessed portion

provided in the peripheral portion of the container body serves as a guide portion for guiding the second end of the cord of the exothermic agent unit to the outside of the container body.

<3> The cooking device according to <1> or <2>, wherein the exothermic agent comprises:

(A-1) an aluminum metal powder having a particle size distribution in which 70.0% to 80.0% of the powder passes through a 45 μm particle diameter sieve and 20.0% to 30.0% of the powder has a particle diameter of 45 to 75 μm ,

(A-2) an aluminum metal powder having a particle size distribution in which 60% to 70% of the powder passes through a 45 μm particle diameter sieve, 20% to 30% of the powder is on a 45 μm particle diameter sieve, 7% to 10% of the powder is on a 63 μm particle diameter sieve, and 1.0% to 2.0% of the powder is on a 75 μm particle diameter sieve, and

(B) calcium oxide having an average particle diameter of 75 to 150 μm ,

wherein the exothermic agent contains the components (A-1) and (A-2) in a total amount of 60% or more by mass and less than 70% by mass in a mass ratio of (A-1):(A-2) = 1:2 and the component (B) is present in an amount of more than 30% by mass and 40% or less by mass based on the mass of the exothermic agent.

The present invention also provides the following exothermic agent unit that can be suitably used in the cooking device described above and in which deterioration over time is suppressed.

<4> An exothermic agent unit, comprising an exothermic agent unit container, an exothermic agent enclosed in a water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide, a water bag having a tear portion, and a cord, the exothermic agent unit being accommodated in a package made of a water-impermeable film,

wherein the exothermic agent is placed on a bottom portion of the exothermic agent unit container, the water bag is placed on the exothermic agent so that the tear portion is fixed

to a first end of the exothermic agent unit container, a first end of the cord is fixed to a second end of the exothermic agent unit container, and a second end of the cord extends from the second end of the exothermic agent unit container toward the first end of the exothermic agent unit container to which the tear portion is fixed, is folded back at the first end of the exothermic agent unit container so as to sandwich the water bag, and does not extend outside the package made of the water-impermeable film.

Advantageous Effects of Invention

[0015]

According to the cooking device of the present invention, since the amount of heat generated by the exothermic agent can be efficiently used for cooking, such as heating, of the target food, the food can be made ready for consumption in a short time. Furthermore, the cooking device of the present invention can inhibit leakage of water vapor from gaps caused by unintended deformation of the container body, and is safe for a person who eats and drinks.

Brief Description of Drawings

[0016]

FIG. 1 is an exploded perspective view illustrating an example of a cooking device of the present invention.

FIG. 2A-1 is a plan view illustrating an example of a lid 30 used in the cooking device of the present invention.

FIG. 2A-2 is a plan view illustrating an example of a food container 20 used in the cooking device of the present invention.

FIG. 2A-3 is a plan view illustrating an example of an exothermic agent unit container 41 used in the cooking device of the present invention.

FIG. 2A-4 is a plan view illustrating an example of a container body 10 used in the

cooking device of the present invention.

FIG. 2B-1 is a cross-sectional view of the food container taken along line A-A in FIG. 2A-1, line A'-A' in FIG. 2A-2, line A''-A'' in FIG. 2A-3, and line A'''-A''' in FIG. 2A-4.

FIG. 2B-2 is a cross-sectional view of the food container taken along line B-B in FIG. 2A-1, line B'-B' in FIG. 2A-2, line B''-B'' in FIG. 2A-3, and line B'''-B''' in FIG. 2A-4.

FIG. 3A is a perspective view illustrating an example of a food container used in the cooking device of the present invention.

FIG. 3B is a perspective view illustrating another example of a food container used in the cooking device of the present invention.

FIG. 4 is a perspective view illustrating an example of an exothermic agent unit accommodated in a package made of a water-impermeable film according to the present invention.

Description of Embodiments

[0017]

The present invention will be described in detail below.

In the present invention, the term “cooking” refers to concepts the encompasses not only heating and warming pre-cooked food, semi-cooked food, or processed food such as frozen food, chilled food, and retort pouch food to a temperature suitable for consumption, but also concepts such as steaming and boiling unprocessed food, semi-processed food, or processed food such as frozen food, chilled food, and retort pouch food.

[0018]

A cooking device of the present invention will be described with reference to the drawings.

FIG. 1 is an exploded perspective view illustrating an example of the cooking device of the present invention.

FIG. 2A-1 is a plan view illustrating an example of the lid 30 used in the cooking device of the present invention. FIG. 2A-2 is a plan view illustrating an example of the food container 20 used in the cooking device of the present invention. FIG. 2A-3 is a plan view illustrating an example of the exothermic agent unit container 41 used in the cooking device of the present invention. FIG. 2A-4 is a plan view illustrating an example of the container body 10 used in the cooking device of the present invention.

FIG. 2B-1 is a cross-sectional view of the food container 1 taken along line A-A in FIG. 2A-1, line A'-A' in FIG. 2A-2, line A''-A'' in FIG. 2A-3, and line A'''-A''' in FIG. 2A-4. FIG. 2B-2 is a cross-sectional view of the food container 1 taken along line B-B in FIG. 2A-1, line B'-B' in FIG. 2A-2, line B''-B'' in FIG. 2A-3, and line B'''-B''' in FIG. 2A-4.

[0019]

The cooking device 1 of the present invention includes the container body 10, the food container 20, the lid 30, and an exothermic agent unit 40.

The container body 10 has a bottom portion 12 on which an exothermic agent unit can be placed, an opening at an upper portion, and at least one recessed portion 11a in a peripheral portion 11.

The food container 20 is placed over the container body 10, can accommodate food to be cooked therein, and has at least one steam hole 21.

The lid 30 is placed over the food container 20 to thereby form an internal space in the food container 20.

The exothermic agent unit 40 includes an exothermic agent unit container 41, an exothermic agent 42 enclosed in a water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide, a water bag 43 having a tear portion 43a, and a cord 44. In the exothermic agent unit 40, the exothermic agent 42 is placed on the bottom portion of the exothermic agent unit container 41. The water bag 43 is placed on the exothermic agent 42 so that the tear portion 43a is fixed to a first end 41b of the exothermic

agent unit container 41. A first end 44a of the cord 44 is fixed, as a fixed end, to a second end 41a of the exothermic agent unit container 41. A second end of the cord 44 extends, as a free end, from the second end 41a of the exothermic agent unit container toward the first end 41b of the exothermic agent unit container to which the tear portion 43a is fixed, is folded back at the first end 41b of the exothermic agent unit container so as to sandwich the water bag 43, and reaches the outside of the container body 10.

[0020]

Container Body

The container body 10 has the bottom portion 12 on which the exothermic agent unit 40 can be placed, has an opening at the upper portion thereof, and has at least one recessed portion 11a in the peripheral portion 11. Since the container body 10 has at least one recessed portion 11a in the peripheral portion 11 thereof, deformation of the peripheral portion 11 of the container body 10 due to heating by water vapor and formation of a gap between the container body 10 and the food container 20 caused by such deformation can be inhibited, and leakage of water vapor to the outside can be inhibited. That is, the recessed portion 11a provided in the peripheral portion 11 of the container body 10 makes it possible to enhance the fit between the container body 10 and the food container 20 or the lid 30 during use (during the exothermic agent reaction) or after use (after the exothermic agent reaction) of the cooking device of the present invention. The container body 10 has at least one recessed portion 11a in the peripheral portion 11 of the container body 10, and preferably has a plurality (two or more) of recessed portions 11a at any intervals. In FIG. 1, six recessed portions 11a are provided in the peripheral portion 11 of the container body 10, but the present invention is not limited thereto. When two or more recessed portions 11a are provided, the recessed portions can be arranged, for example, at intervals of 3 to 4 cm along the peripheral portion.

As illustrated in FIG. 1 and FIG. 2A-4, the recessed portions 11a are preferably recessed in a vertical direction with respect to the peripheral portion.

[0021]

The second end (free end) of the cord 44 of the exothermic agent unit 40 may be fixed to the outside of the container body 10 through the recessed portion 11a provided in the peripheral portion 11 of the container body 10. That is, one of the at least one recessed portion 11a provided in the peripheral portion 11 of the container body 10 may serve as a guide portion for guiding the second end of the cord 44 of the exothermic agent unit 40 to the outside of the container body 10. The second end (free end) of the cord 44 of the exothermic agent unit 10 may be led out to the outside of the container body 10 and fixed there by forming a hole in any side surface of the container body 10. However, the second end (free end) of the cord 44 of the exothermic agent unit 40 is preferably guided to and fixed on the outside of the container body 10 through the recessed portion 11a provided in the peripheral portion 11 of the container body 10 because water vapor generated by the exothermic agent unit 40 flows out through the hole, friction when the cord is pulled can be reduced, and the labor of forming a hole and passing the cord 44 therethrough can be omitted.

[0022]

When the cooking device 1 of the present invention is used, if the generation of water vapor is concentrated in a particular region, the heating efficiency for the food to be cooked may in some cases be reduced. Accordingly, preferably, the bottom portion 12 of the container body 10 is configured such that the exothermic agent unit 40 is placeable thereon and has a projecting portion 12a whose shape conforms to the shape of the bottom portion of the exothermic agent unit container 41, in order to join the container body 10 and the exothermic agent unit 40.

[0023]

The material of the container body 10 is not particularly limited, and a material ordinarily used for containers for food and beverages can be used. Examples thereof include various resins, metals, glass, ceramics, paper having an inner side subjected to waterproof

treatment, and wood. Among these, various resins are preferred. Examples of the various resins include polyethylene, polypropylene, polystyrene, poly(vinyl chloride), poly(ethylene terephthalate), polycarbonate, nylon, melamine, silicone, and foamed bodies of these resins. The various resins may be used alone, or two or more of them may be used in combination by lamination or the like. Expanded polystyrene is preferred because of its excellent heat resistance and thermal insulation properties, and expanded polystyrene in which the inner side of the container body is laminated with polypropylene is particularly preferred.

[0024]

Food Container

The food container 20 is placed over the container body 10, can accommodate food to be cooked therein, and has at least one steam hole 21 for allowing water vapor generated by a reaction between the exothermic agent and water in the exothermic agent unit 40 to circulate into a space defined by the food container 20 and the lid 30.

[0025]

The steam hole 21 may be provided in a peripheral portion of the food container 20 or in a bottom portion thereof, depending on the type of food to be cooked that is accommodated in the food container 20 and the purpose of cooking. For example, when food, such as cooked rice having a grain size approximately equal to the size of the steam hole 21, is accommodated in the food container 20, no gap is preferably present in the bottom portion of the food container 20, and the steam hole is therefore preferably provided in the peripheral portion of the food container 20.

[0026]

The shape of the steam hole 21 is not particularly limited and can be appropriately determined according to the type of food to be cooked that is accommodated in the food container 20 and the purpose of cooking.

FIG. 3 is a perspective view illustrating an example of the food container 20 used in

the cooking device of the present invention. When food is to be heated in a short time to a temperature suitable for consumption, the steam hole 21 can, as illustrated in FIG. 1, be formed as a cutout having a U-shaped configuration or the like; however, the shape of the cutout is not limited to a U shape and may be any desired curved shape, such as a C shape or a wavy shape. Meanwhile, when low-temperature food is to be heated to a high temperature, the steam hole 21 can, as illustrated in FIGS. 3A and B, be formed as a through-hole having any desired shape, such as a circular hole, an elliptical hole, or a slit.

In order to uniformly heat the food to be cooked, the food container 20 preferably has a plurality of steam holes 21.

[0027]

The shape of the food container 20 is not particularly limited as long as it can accommodate food to be cooked.

For example, instead of forming the side surface in the longitudinal direction as a flat surface, the side surface may be formed, as illustrated in FIG. 1, as a recessed-and-projecting portion 20b having a continuous uneven shape so that the surface area is increased and the heating efficiency of the food to be cooked is improved.

In addition, in the production process, in order to allow a plurality of food containers 20, each accommodating food with the lid 30 placed thereon, to be stacked, projecting portions 20a may be provided at four corners of the bottom portion of the food container 20, and recessed portions 30a may be provided at four corners of the upper surface of the lid 30 described below.

[0028]

The material of the food container 20 can be any material that is normally used for food containers, and specifically, the same materials as those exemplified for the container body 10 can be used. The material of the food container 20 may be the same as that of the container body 10 or may differ from it.

[0029]

Exothermic Agent Unit

The exothermic agent unit 40 includes the exothermic agent unit container 41, the exothermic agent 42 enclosed in a water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide, the water bag 43 having the tear portion, and the cord 44.

The exothermic agent 42 is placed on the bottom portion of the exothermic agent unit container 41, the water bag 43 is placed on the exothermic agent 42, and the tear portion 43a of the water bag 43 is fixed to the first end 41b of the exothermic agent unit container 41. The first end 44a of the cord 44 is fixed, as a fixed end, to the second end 41a of the exothermic agent unit container 41. The second end 41a of the exothermic agent unit container 41, to which the first end 44a of the cord 44 is fixed, and the first end 41b of the exothermic agent unit container 41, to which the tear portion 43a of the water bag 43 is fixed, are located so as to face each other. The second end of the cord 44 extends, as a free end, from the second end 41a of the exothermic agent unit container 41 toward the first end 41b of the exothermic agent unit container 41 to which the tear portion 43a is fixed, is folded back at the first end 41b of the exothermic agent unit container 41 so as to sandwich the water bag 43, and is guided to the outside of the container body 10.

[0030]

Cord

The cord 44 may be any cord which is not particularly limited as long as it has a tensile strength sufficient to rupture the water bag 43.

[0031]

Water Bag

The water bag 43 is a bag body having a tear portion and containing water in an amount determined in accordance with the amount of the exothermic agent. The water bag 43 is preferably a bag body in which water is contained in a resin film having a low water vapor

transmission rate and excellent easy-openability such that it can be easily ruptured by a force applied by pulling the cord 44. As a material of the bag body, materials ordinarily used for water bags that are used together with exothermic agents can be used. Examples of the resin film include uniaxially stretched resin films of, for example, polyethylene, polypropylene, polyester, polyamide, polycarbonate, poly(vinyl chloride), and copolymers thereof. The resin film may be a single-layer film of one type or a multilayer film of two or more types. When the exothermic agent unit is to be stored for a long period of time, a bag body further subjected to aluminum vapor deposition or aluminum-foil lamination may be used in order to reduce the water vapor transmission rate of the water bag 43.

In order to facilitate rupture of the water bag 43 by the cord, a cut may be provided in the tear portion 43a of the water bag 43.

The amount of water contained in the water bag 43 is, for example, 1.0 to 10.0 times, preferably 3.0 to 4.0 times, the mass of the exothermic agent.

[0032]

Exothermic Agent

The exothermic agent contains an aluminum metal powder and calcium oxide. The exothermic agent preferably contains, as major components, an aluminum metal powder and calcium oxide. Here, the term "main components" refers to those in which the total content of the aluminum metal powder and calcium oxide among all components of the exothermic agent is preferably 50% or more by mass, more preferably 70% or more by mass, and still more preferably 85% or more by mass.

[0033]

The particle diameter of the aluminum metal powder contained in the exothermic agent is preferably 3 to 500 μm , more preferably 3 to 250 μm . In the present specification, the term "particle diameter of the aluminum metal powder" refers to a 50% cumulative undersize diameter on a mass basis, measured in accordance with the general rules of sieve analysis test

methods specified in JIS Z 8815. Aluminum metal powders having different particle diameters may be used in combination.

[0034]

The calcium oxide contained in the exothermic agent preferably has a high purity.

[0035]

As the exothermic agent used in the present invention, it is preferable to use the exothermic agent described in Patent document 5, and, specifically, an exothermic agent containing the following components (A-1), (A-2), and (B) in the following composition is particularly preferred.

(A-1) An aluminum metal powder having a particle size distribution in which 70.0% to 80.0% of the powder passes through a 45 μm particle diameter sieve, and 20.0% to 30.0% of the powder has a particle diameter of 45 to 75 μm .

(A-2) An aluminum metal powder having a particle size distribution in which 60% to 70% of the powder passes through a 45 μm particle diameter sieve, 20% to 30% of the powder is on a 45 μm particle diameter sieve, 7% to 10% of the powder is on a 63 μm particle diameter sieve, and 1.0% to 2.0% of the powder is on a 75 μm particle diameter sieve.

(B) Calcium oxide having an average particle diameter of 75 to 150 μm .

The mass ratio (A-1):(A-2) is 1:2, and (A-1) and (A-2) in total accounts for 60% or more by mass and less than 70% by mass, and the component (B) accounts for more than 30% by mass and 40% or less by mass based on the mass of the exothermic agent.

[0036]

The exothermic agent may further contain, in addition to the aluminum metal powder and calcium oxide, an inorganic chloride compound, a metal oxide, a metal hydride, or the like as a reaction accelerator, as long as the effects of the present invention are not impaired. Examples of the reaction accelerator include calcium sulfate, ferrous sulfate, magnesium chloride, sodium sulfite, sodium phosphate, and sodium carbonate. The amount of the

reaction accelerator is preferably less than 50% by mass, more preferably less than 30% by mass, and still more preferably 5% to 10% by mass, based on the total mass of the exothermic agent.

The exothermic agent may be in the form of a powder or pellets.

[0037]

As a material for the outer casing in which the exothermic agent is enclosed, a material having an air permeability of 5 to 90 cc/cm²·sec as measured by the Frazier method is preferred, and a material having an air permeability of 7 to 50 cc/cm²·sec is more preferred. An outer casing having an air permeability within the above range may be used to sufficiently supply water into the outer casing and make it react with the exothermic agent. Examples of materials for the outer casing include nonwoven fabrics and water-permeable films.

[0038]

Examples of a method for producing the exothermic agent include, but are not particularly limited to, a method in which an aluminum metal powder, calcium oxide, and, as required, a reaction accelerator are uniformly mixed at the above-described ratio using a known powder mixer. The resulting mixture (exothermic agent) is then enclosed in the outer casing by using a known powder filling and packaging machine or the like, either in the form of a powder as it is or after being formed into pellets. After the exothermic agent is filled, the opening portion of the outer casing is sealed by a known method, such as heat sealing. The filling ratio of the exothermic agent in the outer casing is preferably 95% or less.

The exothermic agent enclosed in the outer casing may be stored in a moisture-impermeable container. Immediately before producing the exothermic agent unit, the moisture-impermeable container may be opened and the exothermic agent may be placed on the exothermic agent unit container.

Examples of commercially available exothermic agents of this type include "EDYC SUPER HEAT" (registered trademark) manufactured by Pal Corporation.

[0039]

An exothermic agent containing the above components (A-1), (A-2), and (B) in the above composition, or the above commercially available exothermic agent, has an average water vapor temperature of 90°C or higher in a period from 1 to 30 minutes from the start of the reaction with water, as measured by the method described below. Because of this excellent heat generation performance, the exothermic agent is suitably used in the cooking device of the present invention.

[Water Vapor Temperature Measurement Method]

A SUS reaction vessel covered with a heat-insulating material and having a volume of 410 cm³ is used. On the bottom portion of the reaction container, 15 g of the exothermic agent is placed. The reaction vessel is closed with a lid, and then 40 mL of water is added through a water inlet provided in the lid. The water vapor temperature is measured by a K thermocouple disposed on the inner side of the lid so as to be capable of measuring the temperature inside the reaction vessel.

A more specific method for measuring the water vapor temperature can be carried out in accordance with the method described in working examples given below.

[0040]

Exothermic Agent Unit Container

The exothermic agent unit container 41 can have any shape as long as it fits in the bottom portion of the container body 10, and the exothermic agent 42 and the water bag 43 can be placed therein. The volume of the exothermic agent unit container 41 is preferably larger than the total volume of the exothermic agent 42 and the water contained in the water bag 43 so that the exothermic agent 42 can react with a desired amount of water inside the exothermic agent unit container 41. In order to allow the exothermic agent unit container 41 to accommodate the exothermic agent 42 and the water bag 43 and to increase the reaction efficiency of the exothermic agent 41, the bottom portion of the exothermic agent unit container

41, at least a placement surface for the exothermic agent 42, preferably has a planar shape, and the placement surface for the exothermic agent 42 preferably does not have an uneven shape in which water can be non-uniformly distributed when the water bag 43 is ruptured.

Additionally, as long as the placement surface for the exothermic agent 42 has a planar shape, the bottom portion of the exothermic agent unit container 41 may, for example, be provided with a projecting portion 41c extending in a direction parallel to the longitudinal direction or the lateral direction so that the exothermic agent 42 does not move within the exothermic agent unit container 41.

[0041]

The second end 41a of the exothermic agent unit container 41 preferably has a cut formed therein for fixing the first end 44a of the cord 44. For example, a knot for fixing one end 44a of the cord 44 so that the cord does not come off may be formed, for example by tying an overhand knot or the like at the one end 44a of the cord 44 to fix the knot on a lower side of the cut provided at the other end 41a of the exothermic agent unit container 41.

The water bag 43 is fixed to the exothermic agent unit container 41 at its tear portion 43a so that it can be ruptured by a force applied by pulling the cord. The position at which the water bag 43 is fixed is the second end 41b of the exothermic agent unit container 41, which is opposite to the second end 41a at which the first end 44a of the cord 44 is fixed. An example of such method for fixing the water bag 43 include a method in which the tear portion 43a of the water bag 43 is fixed to the second end 41a of the exothermic agent unit container 41 using a stapler, an adhesive, a high-frequency welder, or the like.

[0042]

When the exothermic agent unit container 41 is deformed by a force applied by pulling the cord, the water bag 43 may fail to rupture; therefore, the exothermic agent unit container 41 preferably has an appropriate strength. The material of the exothermic agent unit container 41 is not particularly limited. However, since the exothermic agent unit container 41 comes

into contact with the exothermic agent, the material preferably has heat resistance. In addition, since the exothermic agent unit container 41 comes into contact with water released from the water bag 43 when the water bag 43 is ruptured, the material preferably has water resistance. Specific examples of materials for the exothermic agent unit container 41 include the various resins mentioned above as examples of materials for the container body. In consideration of environmental issues, a resin containing a bioplastic may be used as the material of the exothermic agent unit container 41. As with the container body, the various resins may be used alone, or two or more of them may be used in combination by lamination or the like.

Additionally, a side surface of the second end 41a of the exothermic agent unit container 41, at which the tear portion 43a of the water bag 43 is fixed, is preferably shaped to increase the strength of the exothermic agent unit container. For example, the exothermic agent unit container 41 has reinforcing portions 41d on the side of the second end 41a. As illustrated in FIG. 1, the reinforcing portions 41d may be planar, or may further be formed with ribs.

[0043]

FIG. 4 is a perspective view illustrating an example of an exothermic agent unit accommodated in a package made of a water-impermeable film according to the present invention.

The exothermic agent unit 40 used in the present invention may be pillow-packaged with a water-impermeable film 40a, such as an aluminum film, so as to cover the exothermic agent unit 40, in order to prevent the progress of a chemical reaction of the exothermic agent due to water vapor in the air and deterioration in its performance as an exothermic agent.

That is, the exothermic agent unit 40 of the present invention, as described above, includes the exothermic agent unit container, the exothermic agent enclosed in the water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide, the water bag having a tear portion, and the cord, and may be in the form of a pillow package

in which the exothermic agent unit is accommodated in a package made of a water-impermeable film. Here, the exothermic agent unit of the present invention that is in the form of a pillow package is characterized in that the first end of the cord is fixed to the second end of the exothermic agent unit container, and the second end of the cord extends from the second end of the exothermic agent unit container toward the first end of the exothermic agent unit container to which the tear portion is fixed, is folded back at the first end of the exothermic agent unit container so as to sandwich the water bag, and does not extend outside the package made of the water-impermeable film.

In conventional exothermic agent units, in order to prevent deterioration of the exothermic agent over time, known exothermic agent units include those in which an upper surface of the exothermic agent unit is top-sealed with a water-impermeable film (for example, Patent documents 7 and 9). However, in order to fix the cord to the outside of the container body, the cord has to be led out from the top-sealed portion, so that a small gap is inevitably formed at the top-sealed portion, making it difficult to completely prevent deterioration of the exothermic agent over time. As a result, the period during which the heat generation performance of the exothermic agent remains almost unchanged from its initial performance is limited to about three months, or at most about one year, from production of the top-sealed exothermic agent unit.

Another known exothermic agent unit for preventing deterioration of the exothermic agent over time include one in which the respective components of the exothermic agent unit are sealed in a bag made of a water-impermeable film or the like (for example, Patent document 6). However, since such an exothermic agent unit is placed as it is in a lunch container or the like, the cord is led out to the outside of the bag made of the water-impermeable film, and the bag is not completely sealed. Therefore, as with the top-sealed exothermic agent unit described above, it has been difficult to completely prevent deterioration of the exothermic agent over time.

Accordingly, in conventional exothermic agent units, in order to prevent deterioration of the exothermic agent over time, it is desirable to use the exothermic agent unit in a lunch container or the like immediately after production of the exothermic agent unit. However, it has sometimes been difficult to manage such timing from the viewpoint of manufacturing costs, including inventory control.

In contrast, in the exothermic agent unit of the present invention that is in the form of a pillow package, the cord is confined within the pillow package and is not led out to the outside of the package made of the water-impermeable film; thus, no gap is formed in the pillow package. Therefore, there is no risk that the exothermic agent will deteriorate over time, and even after about five years have elapsed from production of the pillow-packaged exothermic agent unit, the heat generation performance of the exothermic agent remains almost unchanged from its initial performance. Accordingly, in accordance with the order status of boxed lunches or the like, it is only necessary to open the pillow package at an appropriate time, place an exothermic agent unit whose exothermic agent has not deteriorated on the bottom portion of the container body, and fix the cord to the outside of the container body. Thus, the exothermic agent unit of the present invention that is in the form of a pillow package is preferable in terms of both the heat generation performance of the exothermic agent and production costs.

[0044]

Lid

The lid 30 covers the opening portion of the food container 20, prevents water vapor generated by the reaction between the exothermic agent 42 and water from leaking to the outside, and serves to effectively bring food accommodated in the food container 20 to a desired temperature. A lid that is normally used for lunch containers or the like can be used. In order to efficiently perform cooking, such as heating, of the target food, the lid is preferably of a fitting type that does not leave a gap between the lid and the container body 10 or the food container 20. As the fitting lid, any of an outer-fitting lid, an inner-fitting lid, or an inner-and-

outer-fitting lid may be used.

In actual use, depending on the type of food to be accommodated in the food container 20, the food container 20, after the food has been accommodated therein, may be covered with the lid 30 and, for example, stored under refrigeration until it is offered for sale. Therefore, for convenience in storage, the lid 30 may have, at its four corners, the recessed portions 30a that match the shape of the four corners 20a of the food container 20 so that a plurality of food containers 20 can be stacked.

Examples

[0045]

Hereinafter, the present invention will be described in further detail with reference to working examples; however, the present invention is not limited to the examples below.

[0046]

[Exothermic Agent]

An exothermic agent having the following composition was used.

· Exothermic Agent 1

A mixed powder enclosed in a water-permeable outer casing of a nonwoven fabric (manufactured by Unicell Co., Ltd.), said mixed powder containing:

(A-1) an aluminum metal powder having a particle size distribution in which 70.0% to 80.0% of the powder passed through a 45 μm particle diameter sieve and 20.0% to 30.0% had a particle diameter of 45 to 75 μm ,

(A-2) an aluminum metal powder having a particle size distribution in which 60% to 70% of the powder passed through a 45 μm particle diameter sieve, 20% to 30% was on a 45 μm particle diameter sieve, 7% to 10% was on a 63 μm particle diameter sieve, and 1.0% to 2.0% was on a 75 μm particle diameter sieve, and

(B) calcium oxide having an average particle diameter of 75 μm to 150 μm ,

wherein the mass ratio (A-1):(A-2) was 1:2, and, based on the mass of the exothermic agent, (A-1) and (A-2) in total was 60% or more by mass and less than 70% by mass, and component (B) was more than 30% by mass and 40% or less by mass.

[0047]

[Measurement of Water Vapor Temperature of Exothermic Agent]

To determine the heat generation characteristics of the exothermic agent, the temperature of water vapor generated by reaction with water was measured by the following method.

First, 15 g of the exothermic agent was placed on the bottom of a stainless-steel (SUS) reaction vessel having a volume of 410 cm³, and then the reaction vessel was covered with a lid. The lid of the reaction vessel had a water inlet for adding water for the reaction and was equipped, on its inner side, with a K-type thermocouple (digital data logger thermometer, TM-97SD) arranged so as to be able to measure the temperature inside the vessel. In order to avoid the effects of ambient air during the measurement, the reaction vessel was covered with a heat-insulating material. Then 45 mL of water was added through the water inlet to start the reaction between the exothermic agent and water. The time at which the water was added was defined as 0 minutes from the start of the reaction, and thereafter the temperature indicated by the K-type thermocouple was read and recorded every 5 seconds.

The water vapor temperature was measured by the above method, and the average value of the measured temperatures in a period from 1 to 30 minutes from the start of the reaction was calculated. The result was as follows.

Exothermic agent 1: 91.6°C

[0048]

[Cooking Device]

· Cooking device 1 (cooking device having the shape illustrated in FIG. 1)

Container body: An expanded-polystyrene container having an inner side laminated

with polypropylene, outer dimensions of 220 mm × 120 mm × 65 mm, a thickness of 2.0 mm, and a substantially rectangular parallelepiped shape.

Food container: A polypropylene container having outer dimensions of 220 mm × 120 mm × 45 mm, a substantially rectangular parallelepiped shape, and a total of four U-shaped steam holes (cuts) in peripheral portions along the short sides (two on each short side).

· Cooking device 2 (for comparative example)

A cooking device identical to the above cooking device 1 except that the container body does not have any recessed portion in its peripheral portion.

[0049]

[Measurement of Temperature in Food Container]

Using the cooking device and the exothermic agent in each of the examples described below, 400 mL of water as an item to be cooked was placed in the food container, an exothermic agent unit including 30 g of the exothermic agent and 80 mL of water in the water bag was placed on the bottom of the container body, the cord was pulled to initiate the reaction of the exothermic agent, and the temperature of the water, as the item to be cooked, was measured with a K-type thermocouple (digital data logger thermometer, TM-97SD). In order to simulate actual use and to equalize the temperature before testing, the cooking device including the test water was stored in a refrigerator for 2 hours before measurement and then used for the test. The reaction between the exothermic agent and water was started by pulling the cord, and thereafter the temperature indicated by the K-type thermocouple was read and recorded every 5 seconds for 20 minutes from the start of the reaction.

For each measurement, the temperature was measured at two locations. The temperature measurement results were evaluated in terms of a temperature change ΔT from the initial temperature at the start of the reaction, and an average value of the results measured at the two locations was calculated.

The time required for ΔT to reach its maximum value (ΔT_{max}) was calculated.

Among the factors for preventing food poisoning, the Ministry of Health, Labour and Welfare recommends, as a guideline for heating food, that "the central portion of the food should be heated at 75°C or higher for at least 1 minute". Therefore, in consideration of the fact that the temperature measurement positions were not at the center of the food container and in order to use, as an index, the time during which the temperature at the measurement positions reached 80°C or higher, with the temperature at the standard state SATP taken as 25°C, the duration for which ΔT was 55°C or greater ($\Delta 55^\circ\text{C}$ -or-greater continuous duration) was calculated.

Furthermore, assuming a human body temperature of 36°C and a temperature increase of +25°C as suitable for consumption, the temperature of the food suitable for consumption is regarded as 61°C. Accordingly, taking the temperature at the standard state SATP as 25°C, the time required for ΔT to reach 36°C ($\Delta 36^\circ\text{C}$ reaching time) was calculated.

[0050]

[Comparative Example 1]

Using the cooking device 2 on which the exothermic agent 1 had been placed, the temperature change of 400 mL of water accommodated in the food container portion was measured. The results are presented in Table 1 below.

[0051]

After the temperature change measurement in Comparative Example 1, the food container was removed from the container body and the shape of the container body was checked. It was found that, in particular, the central portion in the longitudinal direction was bent inward. Therefore, with respect to each of the two sides in the longitudinal direction, the dimensional change of the peripheral portion of the container body at the central portion of the side before and after the temperature change measurement was measured, and the dimensional changes were 10.5 mm and 11.0 mm.

[0052]

[Working Example 1]

Using the cooking device 1 on which the exothermic agent 1 had been placed, the temperature change of 400 mL of water accommodated in the food container portion was measured. The results are presented in Table 1 below.

As in Comparative Example 1, after the temperature change measurement, the dimensional change at the central portion of each of the two sides in the longitudinal direction of the container body was measured, and the dimensional changes were 4.00 mm and 0.5 mm.

[0053]

[Table 1]

	Comparative Example 1	Working Example 1	Working Example 2
ΔT_{max} [°C]	66.10	68.20	65.50
ΔT_{max} reaching time [minute]	17.08	15.03	15.33
$\Delta 55^{\circ}\text{C}$ -or-greater continuous duration [minute]	12.75	14.50	12.17
$\Delta 36^{\circ}\text{C}$ reaching time [minute]	3.42	2.92	4.42

[0054]

In Working Example 1 using the cooking device 1 of the present invention, it was found that ΔT_{max} was high and that ΔT_{max} was reached in a short time. In Working Example 1, the $\Delta 55^{\circ}\text{C}$ -or-greater continuous duration was 14.50 minutes; that is, during approximately three quarters of the 20-minute temperature-measurement period, a high-temperature state in which ΔT was 55°C or more from the initial temperature was maintained. The $\Delta 36^{\circ}\text{C}$ reaching time was 2.92 minutes, so that a temperature suitable for consumption was reached within three minutes.

In contrast, in Comparative Example 1 using the cooking device 2, which did not have any recessed portion in the peripheral portion of the container body, deformation of the container body due to the reaction of the exothermic agent was greater than in Working Example 1. In Comparative Example 1, ΔT_{max} was lower by 2.00°C or more than in Working Example

1, the time required to reach $\Delta T_{\max}$ was longer than in Working Example 1, the $\Delta 55^{\circ}\text{C}$ -or-greater continuous duration was shorter than in Working Example 1, and the $\Delta 36^{\circ}\text{C}$ reaching time was longer than in Working Example 1. These temperature characteristics are considered to be due to the fact that deformation of the container body caused a gap to be formed between the food container and the container body, and that, of the steam generated, a larger amount than in Working Example 1 flowed out of the container without being used to heat the food.

From the above, it has been found that the cooking device of the present invention can efficiently use the steam generated by the reaction of the exothermic agent for heating the target food, can maintain a high temperature for a long period of time, and can also quickly reach a temperature suitable for consumption.

[0055]

[Working Example 2]

As a temperature achieved when a conventional container was used, $\Delta T_{\max}$ in Comparative Example 1 was taken as one index. To investigate the extent to which the amount of the exothermic agent could be reduced under the conditions of Working Example 1 while still achieving the same $\Delta T_{\max}$ as in Comparative Example 1, the temperature in the food container was measured in the same manner as in Working Example 1, except that the amount of the exothermic agent was changed.

$\Delta T_{\max}$ comparable to that in Comparative Example 1 was obtained when the amount of the exothermic agent in Working Example 1 was reduced from 30 g to 26 g, and $\Delta T_{\max}$ was 65.50°C .

Thus, it was found that, by using the cooking device of the present invention, substantially the same heating temperature as with the conventional container can be achieved even when the amount of the exothermic agent is reduced by about 13%. Accordingly, with the container of the present invention, the amount of the exothermic agent can be reduced and, consequently, the amount of waste can be reduced.

Industrial Applicability

[0056]

The cooking device of the present invention can use, without waste, the amount of heat generated by the reaction of the exothermic agent with water for cooking, such as heating, of the target food, and is therefore suitably usable for heating, cooking, and keeping warm portable foods, such as boxed lunches.

Reference Signs List

[0057]

- 1 cooking device
- 10 container body
- 11 peripheral portion
- 11a recessed portion
- 12 bottom portion
- 12a projecting portion
- 20 food container
- 20a projecting portion
- 20b recessed-and-projecting portion
- 21 steam hole
- 30 lid
- 30a recessed portion
- 40 exothermic agent unit
- 40a water-impermeable film
- 41 exothermic agent unit container
- 41a second end of exothermic agent unit container
- 41b first end of exothermic agent unit container

- 41c reinforcing portion
- 42 exothermic agent
- 43 water bag
- 43a tear portion
- 44 cord
- 44a first end (fixed end) of cord

CLAIMS

[Claim 1] A cooking device, comprising a container body, a food container, a lid, and an exothermic agent unit,

wherein the container body has a bottom portion on which the exothermic agent unit is placeable, has an opening at an upper portion, and has at least one recessed portion in a peripheral portion,

the food container is placed over the container body, is configured to accommodate food to be cooked therein, and has at least one steam hole,

the lid is placed over the food container to thereby form an internal space in the food container, and

the exothermic agent unit includes

an exothermic agent unit container,

an exothermic agent enclosed in a water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide,

a water bag having a tear portion, and

a cord,

wherein the exothermic agent is placed on a bottom portion of the exothermic agent unit container, the water bag is placed on the exothermic agent so that the tear portion is fixed to a first end of the exothermic agent unit container, a first end of the cord is fixed to a second end of the exothermic agent unit container, and a second end of the cord extends from the second end of the exothermic agent unit container toward the first end of the exothermic agent unit container to which the tear portion is fixed, is folded back at the first end of the exothermic agent unit container so as to sandwich the water bag, and reaches the outside of the container body.

[Claim 2] The cooking device according to claim 1, wherein one of the at least one recessed portion provided in the peripheral portion of the container body serves as a guide portion for guiding the second end of the cord of the exothermic agent unit to the outside of the container body.

[Claim 3] The cooking device according to claim 1 or 2, wherein the exothermic agent comprises:

(A-1) an aluminum metal powder having a particle size distribution in which 70.0% to 80.0% of the powder passes through a 45 μm particle diameter sieve and 20.0% to 30.0% of the powder has a particle diameter of 45 to 75 μm ,

(A-2) an aluminum metal powder having a particle size distribution in which 60% to 70% of the powder passes through a 45 μm particle diameter sieve, 20% to 30% of the powder is on a 45 μm particle diameter sieve, 7% to 10% of the powder is on a 63 μm particle diameter sieve, and 1.0% to 2.0% of the powder is on a 75 μm particle diameter sieve, and

(B) calcium oxide having an average particle diameter of 75 to 150 μm ,

wherein the exothermic agent contains the components (A-1) and (A-2) in a total amount of 60% or more by mass and less than 70% by mass in a mass ratio of (A-1):(A-2) = 1:2 and the component (B) is present in an amount of more than 30% by mass and 40% or less by mass based on the mass of the exothermic agent.

[Claim 4] An exothermic agent unit, comprising an exothermic agent unit container, an exothermic agent enclosed in a water-permeable outer casing and containing at least an aluminum metal powder and calcium oxide, a water bag having a tear portion, and a cord, the exothermic agent unit being accommodated in a package made of a water-impermeable film,

wherein the exothermic agent is placed on a bottom portion of the exothermic agent unit container, the water bag is placed on the exothermic agent so that the tear portion is fixed

to a first end of the exothermic agent unit container, a first end of the cord is fixed to a second end of the exothermic agent unit container, and a second end of the cord extends from the second end of the exothermic agent unit container toward the first end of the exothermic agent unit container to which the tear portion is fixed, is folded back at the first end of the exothermic agent unit container so as to sandwich the water bag, and does not extend outside the package made of the water-impermeable film.