METHOD AND APPARATUS FOR MANUFACTURING SPONTANEOUSLY DISSOLVED DISPOSABLE CONTAINER

Abstract: Disclosed is a method for manufacturing a disposable container. In the above method, a rice straw powder 78-95wt%, a rice powder 4-17wt%, and dextrin 1-5wt% are mixed. The mixture containing the rice straw powder, the rice powder, and the dextrin are first sterilized. The sterilized mixture is compression-molded to form a container. The container is coated with a bran wax, and the bran wax-coated container is first dried. The first dried container is secondly sterilized and dried at a temperature range of 90-120 °C for 30-60 minutes.
METHOD AND APPARATUS FOR MANUFACTURING SPONTANEOUSLY
DISSOLVED DISPOSABLE CONTAINER

Technical Field

The present invention relates to a method and apparatus for manufacturing an environment friendly disposable container, and more particularly, to a method and apparatus for manufacturing an environment friendly disposable container which is completely and spontaneously dissolvable.

Background Art

Recently, with the developments of outdoors dinner cultures, there are being frequently used disposable containers for containing foods, which allow an intake of foods after carrying the foods and a sanitary carrying. As these disposable containers, there are a lunch box, a cooling skewer, a toothpick, etc., and they are widely being used even in public restaurants at the present.

Packing containers, disposable table wares, etc., are goods that are used in mass in the daily life of the moderns. Especially, due to a private sanitation or conveniences, disposable table wares, table ware packing dishes, etc., form a main stream in means for putting or
packing foods. Polypropylene or the like is mainly being used as material for manufacturing these disposable containers or foods packing dishes but these plastic material-based table wares or packing dishes are not proper for foods containers originally. This is because they exhaust toxic substances when high temperature heat is applied to. However, many manufacturers disregard these contamination problems because of their low manufacturing costs. Also, customers still uses them because of conveniences in using them and disusing them after use. To this end, these products still have a potential danger capable of doing considerable harm to the users' health.

Further, plastic material-based disposable table wares or foods receiving containers are causing serious environmental contamination.

Furthermore, in case that foods put in lunch boxes or on trays made from these synthetic resins are used as the stock feed, there occurs a disadvantage in that these lunch boxes or trays should be taken away. If these lunch boxes or trays are not taken away, there exists a danger in that they do domestic animals harm.

Moreover, although these disposable articles such as the lunch boxes, trays, or the like are taken away from there uses, these materials are not dissolved with ease
within soil due to the peculiar properties of these materials, environmental contamination may be caused. To make matters worse is that a part of the disposable articles that are generally used at the present contains a component that do harm to the human body.

To solve the aforementioned problems, there is disclosed a method for manufacturing a spontaneously dissolved and disposable food container with a vegetable fiber as a raw material in Korean Patent Publication No. 2000-67282 on November 15, 2000. In the patent, there is prepared a mixture in which a vegetable fiber 60 - 73wt% in 50 - 200 meshes, a soybean 20 - 30wt%, a starch 2 - 4wt%, a salt 1 - 5wt%, a caking agent 3 - 5wt%, water 2 - 3wt% are mixed. The prepared mixture is compressed and mixed until a spontaneously generated heat is maintained in a temperature range of 80 - 90. After that, the compressed mixture is extruded in a palette shape and is then again extruded in a plate shape. The extruded plate is compress-molded by a compression molding machine and thereby the disposable food container is manufactured.

Since the foregoing technology manufactures the disposable food container by extruding the mixture containing vegetable raw material in a palette shape, extruding the previously extruded workpiece in a plate
shape, compress-molding the twice extruded workpiece using a compression-molding machine, there are drawbacks in that the manufacturing process is complicated and the raw material is wasted in a portion other than a portion made as the container.

Also, according to Korean Patent Publication No. 2001-16110 which is a technology related with a disposable container and was published on March 5, 2001, a powder of a vegetable stem and a grain powder are mixed at a ratio of 70:30, an edible glue is added to the mixture, and the final mixture is made in a roll stock. The roll stock is molded into a container through an upper mold and a lower mold. Here, since the inner surface of the upper mold is coated with a coating material, the molded disposable container is made in a state in which its surface is coated with the coating material when it is separated from the upper mold.

However, since the aforementioned technology manufactures the disposable container after the roll stock is made from the mixture of the vegetable raw materials, there are drawbacks in that the manufacturing process is complicated and the raw material is wasted in a portion other than a portion made as the container.

Further, according to Korean Patent Publication No.
1998-30457 which is a technology related with a disposable container and is published on July 25, 1998, a foaming agent and a dye, and an animal protein as a texture intensifier are mixed with wheat flour and the mixture is kneaded. The kneaded mixture is introduced into a mold having a small dish-like shape and is then baked and cooled. After that, the molding is coated with a waterproof paint, paper, aluminum thin film, PE film, or wax paper.

However, the foregoing technology has drawbacks in that it uses a high priced wheat flour as one of the raw materials, and an environmental contamination may be caused due to the coated film which is not decomposed with ease, such as the paper, aluminum thin film, PE film, and wax paper.

**Disclosure of the Invention**

Accordingly, the present invention is to solve the aforementioned problems and drawbacks and it is a first object of the invention to provide a method for manufacturing a completely and spontaneously decomposed and environment friendly disposable container by manufacturing the container using a grain husk.

It is a second object of the invention to provide a method for manufacturing a disposable container that does
not harm to the human body.

It is a third object of the invention to provide a process for molding a disposable container and an apparatus for manufacturing the disposable container, capable of accomplishing the above objects.

To accomplish the first and second objects of the invention, there is a method for manufacturing a disposable container. The method comprises the steps of: mixing a rice straw powder 78 - 95wt%, a rice powder 4 - 17wt%, and dextrin 1 - 5wt%; first sterilizing the mixture containing the rice straw powder, the rice powder, and the dextrin; compression-molding the sterilized mixture to form a container; coating the container with a bran wax and first drying the bran wax-coated container; and second sterilizing and second drying the first dried container at a temperature range of 90 - 120 °C for 30 - 60 minutes.

According to another aspect of the invention, there is provided a method for manufacturing a disposable container. The method comprises the steps of: stirring dextrin 1 - 5 wt% and water 20 - 30wt%, and fumigating the stirred mixture at a temperature range of 90 - 130 °C; first adding rice powder 4 - 19wt% to the fumigated mixture, second stirring the rice power and the fumigated mixture, second adding rice straw powder 50 - 75wt% to the second
stirred mixture, and third stirring the rice straw powder and the second stirred mixture; compression-molding the third stirred mixture containing the dextrin, the rice powder, and the rice straw powder to form a molding; first drying the molding; coating the dried molding with a bran wax and second drying the coated molding; and sterilizing the bran wax-coated molding.

Preferably, in the above method, the dextrin is 3.4wt%, the water is 25.2wt%, the rice powder is 16.8wt%, and the rice straw powder is 54.6wt%.

According to still another aspect of the invention, there is provided a method for manufacturing a disposable container. The method comprises the steps of: positioning a plate-shaped inner mold at a lower face of a spacing part of a lower mold; introducing a molding raw material into the spacing part of the lower mold; pushing an upper mold into the spacing part of the lower mold, and compressing the molding raw material to mold the molding raw material into a container shape; removing a pressure applied to the upper mold and lifting the upper mold; pushing the inner mold up from the lower face of the spacing part such that the molded container is separated from the lower mold; and introducing air into the inner mold through the air inlet such that the molded container is separated from the inner
mold.

To accomplish the third object of the invention, there is provided an apparatus for manufacturing a disposable container. The apparatus comprises: an upper mold; a lower mold having a spacing part for receiving the upper mold, the spacing part including a hole formed in a lower face thereof; and an inner mold established within the spacing part of the lower mold and movable upward and downward, said inner mold including an upper face in a plate shape, and a push stick established below the plate-shaped upper face and having an air inlet for introducing air therethrough.

**Brief Description of the Drawings**

15 The above object, other features and advantages of the present invention will become more apparent by describing the preferred embodiment thereof with reference to the accompanying drawings, in which:

FIG. 1 is a schematic view showing a status of when raw material is introduced into a mold;

FIG. 2 is a schematic view showing a status of when the introduced raw material is compressed by an upper mold;

FIG. 3 is a schematic view showing a status of when the upper mold is lifted off after the introduced raw
material is compressed by the upper mold;

FIG. 4 is a schematic view of a status of when a molding object is separated from a lower mold using an inner mold; and

FIG. 5 is a schematic view showing a status in which the molding object is separated from the inner mold by blowing air through an air inlet.

**Best modes for carrying out the Invention**

Hereinafter, the invention is in detail described through preferred embodiments.

**Embodiment 1**

A rice straw powder 76.5g, a rice powder 3.4g, and dextrin 0.85g are uniformly mixed. The mixture is first sterilized at a temperature of 130 °C, for 30 minutes. The sterilized mixture is compression-molded and dried to form a circular container having a thickness of 2.5mm, a weight of 85g, and a volume of 500mP, and a rectangular container having a thickness of 2.5mm, a weight of 85g, and a volume of 600mP. After the completion of the drying, the containers are coated with bran wax glue, PB-03. Afterwards, the containers are secondly sterilized and dried at a temperature of 120 °C for 30 minutes.
The bran wax glue, "PB-3" used in the first embodiment, is manufactured by a Chinese company called Beijing Eastern Acrylic Chemical Technology Co., Ltd. The Beijing sanitary communicable disease control center made an experiment to verify the effect of PB-3 on mice and proved PB-3 nonpoisonous.

Nonpoisonous and spontaneously dissolved disposable container of the present invention is manufactured by the following process.

A rice straw powder 76 - 95wt%, a rice powder 4 - 17wt%, and dextrin 0.9 - 5wt% are uniformly mixed. The rice straw powder is tangled with each other to render a container rigid. The rice straw powder is spontaneously dissolved within a short period. The manufactured container has an advantage in that it is reused as the feed of domestic animals after dissolved.

The mixture is first sterilized at a temperature of 130 °C, for 30 minutes. The sterilized mixture is compression-molded and dried to form a circular container having a thickness of 2.5mm, a weight of 85g, and a volume of 500m³, and a rectangular container having a thickness of 2.5mm, a weight of 85g, and a volume of 600m³. After the completion of the drying, the containers are coated with a bran wax glue, PB-03. Afterwards, the containers are
secondly sterilized and dried at a temperature of 120 °C for 30 minutes.

By mixing the rice straw powder, the rice powder, and the dextrin at the aforementioned ratio, and compression-molding the mixture in the shape of container, the rigid container showing an optimum strength is made.

Since the dextrin is easily dissolved in water, dissolution speed of the container is increased. Also, since the container contains sugar such as amylase, diastase, etc., the sugar helps to dissolve the container by microbes, complements the crumbly rice straw components, and allows the mixture to be manufactured as a rigid container.

If the dextrin is added at a ratio of less than 0.9wt%, the manufactured container is apt to be fragile. If the dextrin is added at a ratio of greater than 5wt%, the manufactured container is apt to be deformed.

After the rice straw powder, the rice powder, and the dextrin are uniformly mixed at the aforementioned ratio, the mixture is first sterilized at a temperature range of 90 - 130 °C for 30 - 90 minutes. If the allowed temperature range and time range are not satisfied, the manufactured container has a black and accordingly it looks like burned. Also, since the manufactured container does not have a
sufficient strength, the container is deformed with ease in its shape. Accordingly, the first sterilizing step should be carried out within the aforementioned temperature range and time range. In particular, if the temperature is too high within the allowed temperature range, the first sterilizing step is carried out at a time as short as possible within the allowed time range, while if the temperature is too low within the allowed temperature range, the first sterilizing step is carried out at a time as long as possible within the allowed time range.

After the first sterilizing step is completed, the mixture is compression-molded in a desired shape of container.

The compression-molding to the container may be carried out by the general method for compression-molding a disposable container but is preferably carried out by a manufacturing apparatus and a molding process of the present invention described below.

After the molding process is completed, the molded container is coated with a bran wax and is then dried. The bran wax is extracted from rice bran and is sometimes called wheat bran. The bran wax is mainly comprised of glycerol commonly contained in elucic acid, linoleic acid, and palmitic acid, and it has the same composition as a
general grain oil. The bran wax serves as glue. Since the bran wax is harmless to the human body and is dissolvable in natural state, it do not harm to the environment. Since the coated bran wax provides the molded container with waterproof function, a water leakage is not generated during use of the container and an invasion of bacteria is prevented. The bran wax is added by 0.1 - 3wt% with respect to the total weight of the container.

After the bran wax is coated and dried, the container is secondly sterilized at a temperature range of 90 - 120 °C for 30 - 60 minutes. After that, the container is secondly dried such that the bran wax is rigid. The second drying step also prevents that the container is deformed in the shape, for instance, twisted or distorted, due to the second sterilizing step.

**Embodiment 2**

Water of 30 ml is added to dextrin powder of 4g and the water and the dextrin powder are then stirred to be in a gel status. The gel mixture is fumigated at a temperature range of 90 - 130 °C and thereby it becomes a paste status.

The dextrin in the paste status is mixed with rice powder of 20g in 40 meshes and they are stirred. Rice straw powder of 65g in 40 meshes is mixed with the mixture
containing the dextrin and the rice powder and they are stirred.

It is noted that if the dextrin in the paste status and the rice straw powder are simultaneously mixed and stirred, the rice powder and the rice straw powder are tangled or a portion where the rice power or the rice straw powder is deficient is generated, and thereby the whole density and strength of the container are not uniform.

The molding raw material of the mixture stirred like the above is supplied into a mold and is compression-molded under a pressure ranged from 22 tons to 25 tons per one container to form disposable containers.

If the container is molded at a pressure less than the allowed pressure range, the surface of the container is rough, and the strength of the container is lowered, while if the container is molded at a pressure greater than the allowed pressure range, the surface roughness of the container is good and the strength of the container is enhanced.

An amount of moisture contained in the compression-molded container is approximately 25wt% as the container is extracted from the molding machine. Therefore, the extracted container is dried under natural air such that the moisture content is 9wt% or less, or is dried in a
heating furnace at a temperature range of 20 - 40°C by blowing air into the heating furnace.

The dried container is again coated with a coating agent for moistureproofing, waterproofing, and oilproofing, and is then dried by blowing heated air having a temperature ranged from 80 °C to 120°C such that the coating agent is rigid. The coating agent used in the second embodiment is an improved product of the PB-3 used in the first embodiment and is made by the Chinese Beijing Eastern Acrylic Chemical Technology Co., Ltd.

After that, the container is subject to a sterilization using infrared rays for 4 minutes.

**Embodiment 3**

The present embodiment describes an apparatus used in the molding process for manufacturing the container of the present invention, and the molding process.

FIG. 1 is a schematic view showing a status of when the molding raw material is introduced into a mold.

As shown in FIG. 1, the apparatus used in the molding process for manufacturing the container of the present invention includes an upper mold 10, a lower mold 30, and an inner mold 20. The upper mold 10 and the lower mold 30 are similar in their structures to those used in general
molding processes. However, the lower mold 30 has a space for receiving the inner mold 20. Also, the lower mold 30 has a lower hole 31 which penetrates the lower face thereof from a central portion of the space.

The inner mold 20 is inserted within the lower mold 30. This inner mold 20 is in a structure in which a bottom face of a molding container 42 is supported by the inner mold 20. A pushing bar 21 is arranged below the inner mold 20. The pushing bar 21 is provided with an air inlet formed in the pushing bar 21 along its length direction, for introducing air therethrough.

Next, there is described a process for molding the container of the present invention.

In order to mold the container of the present invention, as shown in FIG. 1, the inner mold 20 is placed on the bottom of the lower mold 30. A proper amount of the molding raw material is supplied into a space defined by the lower mold 30 and the inner mold 20. Here, the molding raw material 41 is one prepared by the methods mentioned in the first and second embodiments.

FIG. 2 is a schematic view showing a status of when the supplied molding raw material is compressed by the upper mold 10.

As shown in FIG. 2, by compressing the molding raw
material 41 by pressing the upper mold 10, a molding object 42 is formed between an inner wall defined by the lower mold 30 and the inner mold 20, and an outer wall of the upper mold 10.

FIG. 3 is a schematic view showing a status of when the upper mold is lifted off after the introduced raw material is compressed by the upper mold.

As shown in FIG. 3, the pressure applied to the upper mold 10 is removed, and the upper mold 10 is lifted off. At this time, the molding object 42 is adhered to the inner wall defined by the lower mold 30 and the inner mold 20. Since the molding object 42 is not in a completely solidified status, if the molding object 42 is forcibly separated from the lower mold 30 by applying an external power, the molding object 42 may be deformed in its shape.

FIG. 4 is a schematic view of a status of when the molding object is separated from the lower mold 30 using the inner mold 20.

As shown in FIG. 4, an elevating unit (not shown) equipped in the inner mold 20 pushes and elevates the inner mold 20 upward using a pushing bar 21 coupled to a lower surface of the inner mold 20, so that the molding object 42 is separated from the lower mold 30. At this time, since the molding object 42 is not in a completely solidified
status, if the molding object 42 is forcibly separated from
the inner mold 20, the molding object 42 may be deformed in
its shape.

FIG. 5 is a schematic view showing a status in which
the molding object is separated from the inner mold by
blowing air through the air inlet.

As shown in FIG. 5, air 51 is blown into the lower
side of the molding object 42 through the air inlet 22
formed in the pushing bar 21 from an air-compressor (not
shown), so that the non-solidified molding object 42 is
separated from the surface of the inner mold 20 without any
deformation in its shape.

[Test of molding container of the invention]

Compressive strength tests, decomposition ability
tests, water-resistant ability tests, load-resistant
ability tests, and appearance inspections were carried out
for the disposable containers manufactured by the
aforementioned methods of the present invention.

Compressive strength

When glass plate was placed on the containers and a
load of 10Kg was applied, the containers were not deformed.
Decomposition ability

Each of the manufactured containers was divided into two pieces, and the divided two pieces were dipped in water at room temperature. After elapse of 48 hours, the two pieces were transformed into a glue-like substance. The containers are dissolved within 24 hours in water in which microbes and bacteria live such as river, lake, rice paddy, etc.

Water-resistant ability (Rule in appendix A2 among QB/2341)

When water maintained at a temperature of 95 °C or more, is contained in the manufactured containers, the water is leaked in the containers after the elapse of 24 hours.

Load-resistant ability

The manufactured containers were not deformed under a load of 10Kg or more.

Sanitary standards

The containers are matched with the national food packing sanitation standards, and understanding indexes obtained by inspecting and measuring the sanitary prevention degree of epidemics are as follows:

1. Pb 0.0002mg/ m³
2. cadmium, bacteria stock, colon bacilli,
pseudomonas aeruginosa, green-yellow staphylococci, streptokicocci were not detected.

- total numbers of fungi colony is less than 10 CFU/cm².

Also, the manufactured containers were not deformed within 12 hours in warm water of 90°C or more, and can be preserved during 1 year to 2 years in the packing status.

**Industrial Applicability**

As described above, the disposable containers manufactured by the present invention do not harms to the human bodies, and are spontaneously dissolved with ease. Also, since the recovered containers can be used as feed of domestic animals or fertilizer as they ferment, there is no environmental contamination.

Further, the disposable containers of the present invention have superior water-resistant ability and strength during theirs uses.

Furthermore, since the disposable containers are formed not by first processing the raw material in a plate form or a roll form prior to carrying out the molding process and then molding the plate form or roll form of raw material but by directly compression-molding the raw material introduced into the mold by a necessary amount,
there is an effect in that the raw material is saved.

Moreover, according to the manufacturing process and apparatus of the present invention, the manufactured containers are not deformed, so that yield in manufacturing the containers is enhanced, and mass production becomes possible within a relatively short period.
Claims

1. A method for manufacturing a disposable container, the method comprising the steps of:
   mixing a rice straw powder 78 - 95wt%, a rice powder 4 - 17wt%, and dextrin 1 - 5wt%;
   first sterilizing the mixture containing the rice straw powder, the rice powder, and the dextrin;
   compression-molding the sterilized mixture to form a container;
   coating the container with a bran wax and first drying the bran wax-coated container; and
   second sterilizing and second drying the first dried container at a temperature range of 90 - 120 °C for 30 - 60 minutes.

2. A method for manufacturing a disposable container, the method comprising the steps of:
   stirring dextrin 1 - 5 wt% and water 20 - 30wt%, and fumigating the stirred mixture at a temperature range of 90 - 130 °C;
   first adding rice powder 4 - 19wt% to the fumigated mixture, second stirring the rice powder and the fumigated mixture, second adding rice straw powder 50 - 75wt% to the
second stirred mixture, and third stirring the rice straw powder and the second stirred mixture;

compression-molding the third stirred mixture containing the dextrin, the rice powder, and the rice straw powder to form a molding;

first drying the molding;

coating the dried molding with a bran wax and second drying the coated molding; and

sterilizing the bran wax-coated molding.

3. The method of claim 2, wherein the dextrin is 3.4wt%, the water is 25.2wt%, the rice powder is 16.8wt%, and the rice straw powder is 54.6wt%.

4. An apparatus for manufacturing a disposable container, the apparatus comprising:

an upper mold;

a lower mold having a spacing part for receiving the upper mold, the spacing part including a hole formed in a lower face thereof; and

an inner mold established within the spacing part of the lower mold and movable upward and downward, said inner mold including an upper face in a plate shape, and a push stick established below the plate-shaped upper face and
having an air inlet for introducing air therethrough.

5. A method for manufacturing a disposable container, the method comprising the steps of:

5 positioning a plate-shaped inner mold at a lower face of a spacing part of a lower mold;

introducing a molding raw material into the spacing part of the lower mold;

pushing an upper mold into the spacing part of the lower mold, and compressing the molding raw material to mold the molding raw material into a container shape;

removing a pressure applied to the upper mold and lifting the upper mold;

pushing the inner mold up from the lower face of the spacing part such that the molded container is separated from the lower mold; and

introducing air into the inner mold through the air inlet such that the molded container is separated from the inner mold.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 B65D 65/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>A</td>
<td>US 5783126 A (E. Khashoggi Industries,) 21 JULY 1998 See the whole document</td>
<td>1, 4, 5</td>
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<tr>
<td>A</td>
<td>US 5389322 A (Doo-hyun Kim) 14 FEBRUARY 1995 See the whole document</td>
<td>1, 2</td>
</tr>
<tr>
<td>A</td>
<td>US 5993720 A (Kabushiki Kaisha Hosokawa Yoko; Kabushiki Kaisha Polymer Systems,) 30 NOVEMBER 1999 See the whole document</td>
<td>4, 5</td>
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Date of the actual completion of the international search

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