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(54) Titre : OBJETS JETABLES FABRIQUES DE PAILLE OU DE RAFLE DE MAIS
(54) Title: DISPOSABLE OBJECTS MADE FROM CORN COB

(57) Abrégé/Abstract:
The invention includes a method for manufacturing an object from corn cob or straw, such as rice straw and wheat straw by forming a powder and injecting molding the powder into an object by hot press such as a container or a plate. The invention also includes the objects made from the straw or corn cob. It is waterproof, heat resistant, anti corrosive, non-toxic, non-polluting and easy to decompose and is not harmful to the environment.

Abstract

The invention includes a method for manufacturing an object from corn cob or straw, such as rice straw and wheat straw by forming a powder and injecting molding the powder into an object by hot press such as a container or a plate. The invention also includes the objects made from the straw or corn cob. It is waterproof, heat resistant, anti corrosive, non-toxic, non-polluting and easy to decompose and is not harmful to the environment.

Disposable Objects Made From Corn Cob

Field of the Invention

The invention relates to disposable objects made from plant parts, and in particular objects made from corn cob or straw, such as rice straw and wheat straw.

Background of the Invention

Disposable objects, such as utensils (e.g. forks, knives, spoons chopsticks etc.) and containers (e.g. bowls, plates, cups, glasses, pans, saucers, flower pots, boxes (e.g. detergent boxes, coolers), bottles, etc.) are in great demand. At the present time, many disposable products are made from foam. Foam is used because it is inexpensive. Foam products often emit toxic substances during the manufacturing process. When disposed of, the foam products will not decompose and they harm the environment. Other materials, such as plastic, can have the same effect on the environment.

Some products are biodegradable, such as those made from wood fibers. Wood fiber products will decompose naturally, but the raw materials are increasingly in short supply and expensive. Plant husks have been used to make biodegradable products, but husks are also unsatisfactory because they often do not produce a durable, well formed and economical product.

There is a clear need to identify other sources of raw materials for making disposable products. A suitable raw material has to be abundant and inexpensive. It also must be environmentally friendly so that the final product will naturally decompose.

Summary of the Invention

The invention relates to disposable objects made from plant parts, and in particular objects made from corn cob or straw, such as rice straw and wheat straw. The plant parts are in a powder form and held together by a non-toxic binding agent.

Preferably, wheat straw, rice straw or corn cob (or combinations of the foregoing) is cleaned, dried, ground and screened to obtain the grain with a size of about -10 to –90. Other ranges such as about –60 to –120 or +30 to -50 may also be used. Resinous agent is added and blended with the wheat straw, rice straw and/or corn cob. The mixture is dried to less than about 15% moisture and preferably less than about 10% moisture and shaped into products, preferably utensils and containers, such as bowls, plates, cups, chopsticks, flower pots, bottles or boxes. It is preferably shaped in a high pressure (about 240 ton) press at about 90° C to 190° C for about 35 to 45 seconds. Temperature and pressure may be varied and suitable temperatures and pressures would be apparent to a person skilled in the art.

In one embodiment, the composition may be folded over on itself a plurality of times to form a laminated sheet.

This invention preferably utilizes agricultural byproducts which are abundant and inexpensive. Containers of the invention are capable of holding high temperature liquid. They are also easily shaped without cracking. Finally, the containers are naturally biodegradable and environmentally friendly.

The invention relates to a molding composition including: a) corn cob powder or straw powder; and b) a resinous agent; wherein the composition is capable of being shaped into a molded object. In one embodiment, the molding composition includes:

a	resinous agent	about 15% - 45% by weight

b	viscosity reducing agent	about 5% - 20% by weight
c	whitening or coloring agent	about 1% - 15% by weight
d	lubricating agent	about 0.1% - 5% by weight
e	straw powder or corn cob powder	about 50% – 70% by weight by weight;

wherein the composition is capable of being shaped into a molded object.

The composition is preferably shaped by injection molding. The grain size of the powder is preferably about -10 to –90 (#10 - #90 HWR mesh sizes, with an average diameter of 0.1mm to 0.09mm). The corn cob or straw is preferably present in about 50% – 70% by weight. A suitable resinous agent is urea formaldehyde resin. The resinous agent is preferably present in about 15-45% by weight. Suitable straw includes wheat straw, rice straw, canola straw, sunflower straw, cereal straw, *Secale cereale* straw and plant straw.

The composition may further include a viscosity reducing agent. The viscosity reducing agent may be talcum powder. A lubricating agent, such as zinc stearate, may also be used. The composition may further include a whitening agent or a coloring agent, such as the whitening agent rutile titanium dioxide. The coloring agent may be food coloring, dye, or an edible dye.

The composition may further include a viscosity reducing agent in about 5% - 20% by weight, a coloring agent or whitening agent in about 1%-15% by weight and a lubricating agent in about 0.1% - 5% by weight.

In one aspect, the invention is molding composition including:

a	Urea Formaldehyde resin	about 15% - 45% by weight
b	Talcum Powder	about 5% - 20% by weight

c	Rutile Titanium Dioxide	about 1% - 15% by weight
d	Zinc Stearate	about 0.1% - 5% by weight
e	wheat straw powder, rice straw powder	
	or corn cob powder	about 50% – 70%%

the composition is capable of being shaped into a molded object.

The invention also includes a container, sheet or utensil made from a composition of the invention.

Another aspect of the invention is a method of producing a molding composition from straw or corn cob, including:

a) grinding the straw or corn cob into powder;

b) mixing the powder with resinous agent to form a composition suitable for molding.

The invention includes a composition prepared according to the method.

Another aspect of the invention is a method of producing a molded object, including forming a molded object from a molding composition including straw or corn cob and resinous agent. The invention includes a composition prepared according to the method. The invention also includes molded object prepared according to a method of the invention.

The invention includes a method of producing a molded object, including

a) grinding straw or corn cob into powder;

b) mixing the powder with resinous agent to form a composition suitable for molding and

c) forming a molded object from the composition.

The invention also includes molded object prepared according to the method.

The molded object may be formed by shaping the composition between first and second die members.

The method may further include subjecting the container to a second shaping step. The method preferably includes cooling the object.

The method may optionally include applying a surface coating to the object to form a protective and/or esthetic coating and drying the coating.

The composition is preferably shaped by injection molding. In the methods of the invention, the corn cob or plant straw is preferably present in about 50% – 70% by weight. The resinous agent preferably comprises urea formaldehyde resin.

The resinous agent may be present in about 15% - 45% by weight. The straw is preferably selected from the group including wheat straw, rice straw, canola straw, sunflower straw, cereal straw, *Secale cereale* straw and plant straw.

The method may further include a viscosity reducing agent , such as talcum powder. The method may further include a lubricating agent. The lubricating agent preferably includes zinc stearate. The method may also include a whitening agent or a coloring agent. A whitening agent is rutile titanium dioxide. A suitable coloring, dye agent is food coloring or an edible dye.

The method may further include adding to the composition a viscosity reducing agent in about 5% - 20% by weight, a coloring agent in about 1%-15% by weight and a lubricating agent in about 0.1% - 5% by weight. The shaping step is preferably carried out when the composition is approximately 90 to 190 degrees C. The shaping is preferably conducted at a pressure exerted on the product of about 240 tons.

Detailed Description of the Invention

Wheat straw, rice straw, and corn cobs are the preferred raw materials for use in preparation of the compositions and objects of the invention. Many other suitable straws for preparation of objects such as containers and boxes will be apparent to those skilled in the art. The objects are preferably waterproof, heat resistant, non corrosive, non-toxic, non-polluting, easy to decompose and not harmful to the environment. After one or more of these types of plant parts is cleaned, dried, ground into powder, mixed with resinous agent and placed in a high pressure press, it can be formed into the final product. These products can withstand high temperatures and water. The products are also safe to contact food and will decompose after they are discarded.

Part or all of the corn cob may be used. The outer part of the core, the woody component, is preferable because it is hard and dense. The pith and chaff components are softer and lighter and may also be used.

The term "straw" includes all parts of the plant except the grain, seed husk, and roots. Thus, the invention makes use of abundant agricultural by-products which may otherwise be wasted.

Straw and corn cob have little fibrous material so it was previously thought that they were too soft to be useful for forming objects. It was considered that they would suffer cracking or not perform properly in the shaping process. As well, corn cob is often unavailable because after harvest it is broken down and used for fertilizer or feed. Grinding these plant parts into a fine powder was not considered which is shown by the unavailability of equipment to grind these products into a fine powder.

The following example uses corn cobs. The same procedures (with minor modifications that would be apparent to a person skilled in the art) have been applied to

make products from wheat straw and rice straw and can also be used with other straws and plant parts.

The following is a detailed description of a manufacturing process:

a Collect the corn cobs (raw material).

b Clean and rinse the corn cobs.

c Dry the corn cobs (preferably in an oven)

d The corn cobs are put into a grinder and ground to about -80.

e The powder is then put through a screener to screen out larger grain.

f The resinous agent (e.g. urea formaldehyde resin) is blended into the corn cob powder.

g The blending must be thorough in order to obtain the optimal result.

h The blended powder is weighed to obtain the correct amount (the correct amount is variable according to the product desired, but can be determined by a person skilled in the art).

i The powder is placed into a mold preheated to 130° C (preferably from 130 to 165° C). Injection molding is preferred.

j The mold is placed into a 240 ton hydraulic press for about 10 seconds.

k Pressure is released for about 8 seconds.

l Wait for about 12 seconds for the product to cool and set and then take the product out.

When only resinous agent (e.g. urea formaldehyde resin) and powder (e.g. wheat

straw, rice straw or corn cob) are used, the preferred range of resinous agent is about 10 – 45% and the preferred range of powder is about 60 - 90%.

Optionally, one or more of a viscosity reducing agent (e.g. talcum powder), a lubricating agent to allow separation of the product from the mold (e.g. zinc stearate) and a coloring or whitening agent (e.g. whitening agent rutile TiO_2) may be added in step f.

Example of amounts of ingredients for preparation of 5 plates with straw

Composition - %		**Weight**
Wheat Straw Powder	60%	60g
Resinous Agent	25%	25g
Viscosity Reducing Agent	8%	8g
Whitening Agent	4%	4g
Lubricating Agent	3%	3g
TOTAL	**100%**	**100G**

Injection molding is preferred. This can be done by conventional injection molding techniques, for example by shaping the heated composition between first and second die members. The composition may be shaped into many molded objects including utensils, containers, trays and sheets.

Additional shaping steps may be taken. The final product may be finished, for example applying a surface coating such as a coloring or a gloss. The coating may form a protective, waterproofing and/or esthetic coating.

The composition may be altered in order to alter the rate of decomposition. The formula may also be altered to make a product more or less rigid.

Preferred agents and amounts (by weight):

a	Urea Formaldehyde resin	about 15% - 45%
b	Talcum Powder	about 5% - 20%

(preferably $Mg_3(Si_4O_{10})(OH_2)$ or another talcum powder suitable for use with humans or other mammals. $3MgO_4SiO_2H_2O$ may be used where appropriate.)

c	Rutile Titanium Dioxide	about 1% - 15%
d	Zinc Stearate	about 0.1% - 5%

15-45% urea formaldehyde resin may also be used. The urea may be in liquid form or powder form.

The present invention has been described in detail and with particular reference to the preferred embodiments; however, it will be understood by one having ordinary skill in the art that changes can be made thereto without departing from the scope of the invention.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILIEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A molding composition comprising:

a) a powder, the powder comprising ground corn cob; and

b) a resin, the resin thoroughly mixed with the powder in a range of ratios by weight ranging from 1 part resin to 9 parts powder to 4 parts resin to 6 parts powder; wherein the average grain size of the powder is less than 0.1mm.

2. The molding composition of claim 1 further comprising:

a) a viscosity reducing agent;

b) a dye; and

c) a lubricating agent.

3. The molding composition of claim 2, wherein:

a) the resin is about 15% - 43.9% by weight of the total composition;

b) the viscosity reducing agent is about 5% - 20% by weight of the total composition;

c) the dye is about 1% - 15% by weight of the total composition;

d) the lubricating agent is about 0.1% - 5% by weight of the total composition; and

e) the powder is about 50% – 70% by weight of the total composition.

4. The molding composition of any one of claims 1-3, wherein the resin comprises urea formaldehyde resin.

5. The molding composition of claim 3, wherein the viscosity reducing agent comprises talcum powder.

6. The molding composition of claim 3, wherein the lubricating agent comprises zinc stearate.

7. The molding composition of claim 3, wherein the dye comprises a whitening agent.

8. The molding composition of claim 7, wherein the whitening agent comprises rutile titanium dioxide.

9. The composition of claim 3, wherein the dye comprises food coloring, or an edible dye.

10. A container, sheet or utensil comprising the composition of any one of claims 1-9.

11. A method of producing a molding composition from corn cob, comprising:

a) grinding corn cob into a powder with an average grain size of less than 0.1mm;

b) mixing the powder with a resin, the resin thoroughly mixed with the powder in a range of ratios by weight ranging from 1 part resin to 9 parts powder to 4 parts resin to 6 parts powder.

12. A method of producing a molded object, comprising

a) grinding corn cob into a powder; with an average grain size is less than 0.1 mm;

b) mixing the powder with resin in a range of ratios by weight ranging from 1 part resin to 9 parts powder to 4 parts resin to 6 parts powder;

c) forming a molded object from the composition.

13. The method of claim 12, wherein the molded object is formed by shaping the composition between first and second die members.

14. The method of claim 12, wherein the molded object is formed by injection molding.

15. The method of any one of claims 12, 13 and 14 further comprising applying a surface coating to the object to form a protective and/or aesthetic coating and drying the coating.

16. The method of claim 12, wherein the resinous agent comprises urea formaldehyde resin.

17. The method of claim 12, wherein the resinous agent is present in about 15% -45% by weight relative to total composition.

18. The method of claim 12, further comprising adding a viscosity reducing agent in step b).

19. The method of claim 18, wherein the viscosity reducing agent comprises talcum powder.

20. The method of claim 12, further comprising adding a lubricating agent in step b).

21. The method of claim 20, wherein the lubricating agent comprises zinc stearate.

22. The method of claim 12, further comprising adding a whitening agent or a coloring agent in step b).

23. The method of claim 22, wherein the whitening agent comprises rutile titanium dioxide.

24. The method of claim 22, wherein the coloring agent comprises food coloring or an edible dye.

25. The method of any one of claims 12 to 24, wherein the forming step is carried out when the composition is approximately 90 to 190 degrees C.

26. The method of any one of claims 12 to 25, wherein the forming step is conducted at a pressure of about 240 tons.