Title: RESIN COMPOSITION USED IN MANUFACTURING FUNCTIONAL RESIN ARTICLES

Abstract: Disclosed is a resin composition used in manufacturing functional resin articles. The composition comprises resin and at least one additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate (Bambusae Caulis in Liquamen), silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder. The composition serves such functions as high yield, antibacterial activity and deodorization so that it may be useful in manufacturing an agricultural film, a package film, a storage container, etc.
RESIN COMPOSITION USED IN MANUFACTURING

FUNCTIONAL RESIN ARTICLES

FIELD OF THE INVENTION

The present invention relates to a resin composition used in manufacturing resin articles that have functionality such as high yield, antibacterial activity and deodorization.

BACKGROUN OF THE INVENTION

There are many kinds of resin articles such as a film, a fiber, a molded product, a pipe, and parts of machine.

Up to date, many attempts have been made to provide functionality to resin articles. Recently, a Korean Laid-open Patent Publication No. 10-2004-0077880, published on September 7, 2001, discloses a functional resin composition having antioxidation activity that comprises antioxidant having more than two alcoholic hydroxyl groups. Another Korean Laid-open Patent Publication No. 10-2001-0078131, published on August 20, 2001, provides a resin composition having functionality such as deodorization and anti-microbial activity, which comprises substances such as catechin isolated from a plant, fine lamellar mineral, and a ceramic substance. Still another Korean Laid-open Patent Publication No. 10-2000-0024493, published on May 6, 2000, discloses a resin composition having functionality such as salt tolerance, heat resistance, waterproof property, antiseptic activity, anti-insect activity and insulation property, which comprises a lacquer substance.
The present invention has been made in order to provide functionality such as high yield, antibacterial activity and deodorization to resin articles, like the above-mentioned inventions.

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DETAILED DESCRIPTION OF THE INVENTION

TECHNICAL THEME

Therefore, an object of the present invention is to provide a resin composition used in manufacturing a functional resin article having high yield, antibacterial activity, deodorization and the like.

Other objects or aspects of the present invention are presented hereinafter.

15 TECHNICAL SOLUTION

In an aspect, the present invention relates to a resin composition for manufacturing functional resin articles.

As shown in the following Examples and Test Examples, the present inventor manufactured a film by using resin and, as additives, bamboo charcoal powder, bamboo smoke distillate (or Bambusae Caulis in Liquamen), silica powder prepared by incorporating bamboo smoke distillate into silica, and/or zeolite powder, and then has become to discover that the produced film showed superior effects in production yield, antibacterial activity, deodorization, and freshness maintenance.

25 The present invention is provided on the basis of the aforementioned
experimental results.

Therefore, the functional resin composition of the present invention is characterized in comprising resin and at least one additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder.

As used herein, the term "resin article" means, as an article manufactured by using resin as a main ingredient, any resin article that the functionality defined below can be applied to or expressed from, and includes a food container, an agricultural film and a packing film.

Preferably, the resin article of the present invention indicates a film article in that the following Examples and Test Examples disclose manufacture of a film and its experimental results. The term "film" used herein means a thin and flat article, and includes a sheet-shaped article, a strip-shaped article and a tape-shaped article.

Meanwhile, as used herein, the term "functionality" is defined to means high yield, antibacterial activity, deodorization and/or freshness maintenance.

As long as the term "functionality" is defined as mentioned above, if any resin composition comprises resin and at least one additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder, and may be used for manufacturing a resin article having or requiring high yield, antibacterial activity, deodorization and/or freshness maintenance, it should be understood that the term "resin composition" used herein includes such any resin composition.

In the meantime, as used herein, the term "additive" means an ingredient in the resin composition of which the amount is substantially lower than that of resin and is, however, sufficient to show the aforementioned functionality. The expression
“substantially lower amount” may be defined to be an amount that does not exceed the conventional ratio of an additive to resin in any resin composition.

One skilled in the art may determine the ratio of an additive to resin suitable for manufacturing resin articles having the aforesaid functionality without undue experimentation, based on common knowledge in the prior art and the following Examples and Test Examples, although the functionality is expressed differently in the resin articles.

For example, in case that the resin composition of the present invention is used to manufacture an agricultural film, at least one additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder is preferred to be comprised in an amount of 1-70 weight parts based on 100 weight parts of resin. The reason is that the functionality may not be expressed when the amount of the additive is less than 1 weight part, whereas higher than 70 weight parts of the additives may deteriorate physical or chemical property such as transparency, mechanical strength and the like, required for an agricultural film.

Therefore, any resin composition should be considered to be within the scope of the present invention irrespective of the ratio of additives to resin, insofar as the resin composition comprises, as additives, bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica and/or zeolite powder, and may be used to manufacture the aforesaid functional resin article.

Meanwhile, as used herein, the term “bamboo charcoal powder” means any charred solid powder that is prepared by applying high temperature heat directly or indirectly to bamboo irrespectively of its species or its preparation method.
Thus, any charred solid powder, prepared from bamboo belonging to Order *Branniales*, Family *Gramineae* according to taxonomy, should be considered to be within the scope of the present invention, irrespectively of the species or its specific preparation method, i.e. irrespectively of whether or not the used bamboo belongs to *Phyllostachys*, *Arundinaria*, *Sasa* or *Pseudosasa*, and irrespectively of whether or not any specially designed carbonizing furnace or another heat transfer medium is used or cooling time is changed.

The term “bamboo smoke distillate” generally means transparent reddish brown liquid prepared by condensing smoke generated during bamboo carbonization, and then settling down and aging, filtrating and purifying, or distilling the condensate.

Smoke generated during bamboo carbonization, leaved after condensation, is separated into three layers. The upper layer is a light oil layer comprising terpin oil, the middle layer is a crude bamboo smoke distillate layer, and the lower layer is a tar layer. Commercially available bamboo smoke distillate is prepared by settling down and aging, filtrating and purifying, or distilling the crude bamboo smoke distillate.

The bamboo smoke distillate is strong acid (pH = 2.8–3.1), and comprises, as a main ingredient, organic acids such as acetic acid and formic acid, and further comprises phenols and the like.

As used herein, the term “bamboo smoke distillate” is preferred to be the aforementioned one (i.e. one obtained by settling down and aging, filtrating and purifying, or distilling the crude bamboo smoke distillate). However, bamboo smoke distillate purified by any methods from the crude bamboo smoke distillate, or even the crude bamboo smoke distillate *per se* may also satisfy the object of the present invention.

Thus, considering that the bamboo smoke distillate is prepared from the crude
bamboo smoke distillate and that the prepared bamboo smoke distillate shows the aforementioned functionality, one skilled in the art would expect and would easily become to discover that the crude bamboo smoke distillate shows the aforementioned functionality even though the degree of its functionality may be different from that of the bamboo smoke distillate, based on the common knowledge in the art and the following Examples and Test Examples.

Further, although the bamboo smoke distillate may show different degree of the aforementioned functionality depending on the method for purifying the crude bamboo smoke distillate, one skilled in the art would expect that any bamboo smoke distillate purified from the crude bamboo smoke distillate has probability of showing the aforementioned functionality irrespective of its purifying method, and would easily detect the bamboo smoke distillate having the aforementioned functionality, insofar as based on the common knowledge in the art and the following Examples and Test Examples.

Therefore, as used herein, the term “bamboo smoke distillate” should be considered to has the meaning to include the crude bamboo smoke distillate *per se* and any bamboo smoke distillate purified from the crude bamboo smoke distillate as well as bamboo smoke distillate prepared by settling down and aging, filtrating and purifying, or distilling the crude bamboo smoke distillate.

Meanwhile, the silica powder prepared by incorporating bamboo smoke distillate into silica means silica powder obtained by incorporating bamboo smoke distillate into silica and grinding the resultant silica. In this case, the term “silica” means natural silica (diatomite) or synthetic silica (silicon dioxide), and preferably means natural silica.

Likewise, as used herein, the term “zeolite” means natural zeolite or synthetic
zeolite (alumina silicate), and preferably means natural zeolite.

Meanwhile, in view of the aforementioned functionality, a resin composition of the present invention preferably comprises two additives, more preferably three additives and still more preferably all the additives, selected from bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder.

Most preferably, a resin composition of the present invention may comprise, as additives, bamboo charcoal powder, silica powder prepared by incorporating bamboo smoke distillate into natural silica, and natural zeolite powder.

As shown in the following Examples and Test Examples, one or more additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder is preferred to be present in the resin composition in an amount of 5-65 weight parts, more preferably 8.9-59 weight parts, based on 100 weight parts of resin, regardless of how many kinds of the above-mentioned additives are comprised in the resin composition.

Moreover, when the resin composition comprises, as additives, bamboo charcoal powder, silica powder prepared by incorporating bamboo smoke distillate into natural silica, and natural zeolite powder as mentioned in the above, the additives are preferred to consist of 20-70 wt% of bamboo charcoal powder, 6-50 wt% of silica powder prepared by incorporating bamboo smoke distillate into natural silica, and 40-80 wt% of natural zeolite powder, based on the total weight of the above-mentioned additives per se. Advantages of the content ratio may be verified in the following Examples and Test Examples.

Meanwhile, the resin composition of the present invention may comprise any
known resin depending on the kind of a resin article to be manufactured, insofar as the resin restricts the aforementioned functionality that the additives such as bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and/or zeolite powder have.

For example, the resin composition of the present invention may include polyethylene or ethylene-vinyl acetate copolymer (EVA) if used in manufacturing an agricultural film; polyethylene (such as LLDPE and LDPE), polypropylene, ethylene-vinyl alcohol copolymer, ethylene-vinyl acetate copolymer if used in manufacturing a packing film; and ethylene glycol-terephthalate copolymer (PET) if used in manufacturing a container.

Besides the aforementioned resins, illustrative examples of the resins of the present invention include polyvinyl halide-based resin (such as polyvinylchloride, polyvinylidene chloride); homopolymer (such as halogenated polyethylene, halogenated polypropylene); and copolymer (such as vinyl chloride-vinyl acetate copolymer, vinyl chloride-ethylene copolymer, vinyl chloride-propylene copolymer, vinyl chloride-styrene copolymer, vinyl chloride-isobutylene copolymer, vinyl chloride-vinylidene chloride copolymer, vinyl chloride-styrene-acrylonitrile copolymer, vinyl chloride-butadiene copolymer, vinyl chloride-chlorinated propylene copolymer, vinyl chloride-vinylidene chloride-vinyl acetate copolymer, vinyl chloride-maleate copolymer, vinyl chloride-methacrylate copolymer, vinyl chloride-acrylonitrile copolymer, ethylene-propylene copolymer, ethylene-butene copolymer, ethylene-pentene copolymer, ethylene-hexene copolymer, ethylene-heptene copolymer, ethylene-octene copolymer, ethylene-propylene copolymer, ethylene/1-butene copolymer, ethylene/4-methyl-1-penetene copolymer, ethylene-acrylic acid copolymer, and ethylene-methacrylate copolymer.
The resin composition of the present invention further may comprise known additives depending on the kind of a resin article to be manufactured, and illustrative examples of the additives include plasticizer, lubricant, UV stabilizer, antioxidant, antistatic agent, UV absorber, antifogging agent, anti-clouding agent and heat stabilizer.

Examples of plasticizer include low molecular weight polyol-based plasticizer (such as glycerin, ethylene glycol, triethylene glycol, sorbitol), phthalate ester-based plasticizer (such as dioctyl phthalate (DOP), dimethyl phthalate), phosphate ester-based plasticizer, paraffin-based plasticizer, and wax-based plasticizer.

Examples of lubricant include fatty acid-based lubricant (such as stearic acid, oleic acid, palmitic acid) or metal salt thereof, fatty acid amide derived from fatty acid, wax-based lubricant (such as polyethylene wax), liquid paraffin-based lubricant, ester-based lubricant (such as glycerin fatty acid ester), and higher alcohol-based lubricant.

Examples of UV stabilizer include hindered amine compounds (such as 2,2,6,6-tetramethyl-4-piperidyl stearate, 1,2,2,6,6-pentamethyl-4-piperidyl stearate), cresol, melamine, and benzoic acid.

Examples of antioxidant include phenol-based antioxidant (such as 2,6-di-tert-butyl-p-cresol, 2,6-diphenyl-4-octadecyloxyphenol), phosphorous-based antioxidant (such as trisnonylphenyl phosphite, tris(2,4-di-tert-butylphenyl) phosphite), and sulfur-based antioxidant (such as dilauryl thiodipropionate, pentaerythritol tetra(β-dodecyl mercaptopropionate).

Examples of antistatic agent include polyoxyethylene alkylamine, polyglycol ether, non-ionic surfactant, and cationic surfactant.

Examples of UV absorber include benzophenone-based UV absorber (such as 2,4-dihydroxybenzophenon, 2-hydroxy-4-methoxybenzophenone), benzotriazole-based UV absorber (such as 2-(2'-hydroxy-5'-methylphenyl)benzotriazole, 2-(2'-hydroxy-3',5'-
di-tert-butylphenyl)benzotriazole), salicylate-based UV absorber (such as phenyl salicylate, resorcinol monobenzoate, 2,4-di-tert-butylphenyl-3',5'-di-tert-butyl-4'-hydroxybenzoate), substituted oxanilide-based UV absorber (such as 2-ethyl-2'-ethoxyoxanilide, 2-ethoxy-4'-dodecyloxanilide) and cyanoacrylate-based UV absorber (such as ethyl-α-cyano-β,β-diphenylacrylate, methyl-2-cyano-3-methyl-3-(p-methoxyphenyl)acrylate).

Examples of antifoggging agent include non-ionic, anionic, and cationic surfactant, and more specifically sorbitan monostearate, sorbitan monopalmitate, sorbitan monobehenate, glycerin monolaurate, glycerin monostearate, glycerin monopalmitate, diglycerin dilaurate, diglycerin distearate, diglycerin monopalmitate, and triglycerin monostearate.

Fluoride-based or silicon-based anti-clouding agent may be used in the present invention.

Examples of heat stabilizer include tin-based heat stabilizer, lead-based heat stabilizer, calcium-zinc-based heat stabilizer, barium-zinc-based heat stabilizer, and fatty acid-based heat stabilizer.

The functional resin composition of the present invention may comprise at least one aforementioned additive depending on the kind of the resin article to be manufactured. The amount of the additive is not limited to any certain range as long as a desired function of the resin article may be achieved and the physical or chemical property (such as mechanical strength and transparency in case of an agricultural film) required according to the kind of the resin article to be manufactured is not deteriorated.

If the resin article to be manufactured is an agricultural film, the resin composition of the present invention is preferred to include a UV stabilizer in an amount of 0.01-7 weight parts based on 100 weight parts of resin. There may be little
effect of UV stabilization when the amount of the UV stabilizer is lower than 0.01 weight parts, while more than 7 weight parts of the UV stabilizer may deteriorate the transparency of the film.

For the same reason, an antioxidant and an anti-clouding agent are preferred to be present in the resin composition for manufacturing an agricultural film in the amount of 0.01-3 weight parts and 0.1-5 weight parts, respectively, based on 100 weight parts of resin.

Meanwhile, the resin composition of the present invention may be specifically used for manufacturing a functional agricultural film, a functional packing film, or a functional container.

In case that a functional agricultural film is manufactured using the resin composition of the present invention, the manufactured film is useful for increasing production yield.

It should be understood that the functional agricultural film manufactured using the resin composition of the present invention may be applied to any kinds of crops of which the high yield is useful to mankind.

Particularly, such corps may be crops for food, feed or fertilization.

In an embodiment of the agricultural film, the film may be used as a film for green houses.

Meanwhile, in case that a functional packing film or a functional container is manufactured using the resin composition of the present invention, the manufactured film or container may be used for packing, keeping or storing any kinds of articles that require antibacterial activity, deodorization or/and freshness maintenance. Such articles may be an agricultural product, a flowering plant or food.
In another aspect, the present invention relates to a method for manufacturing a functional resin article using the aforementioned resin composition for manufacturing the functional resin articles according to the present invention.

The method of the present invention comprises a step of molding the aforementioned resin composition of the present invention.

As used herein, the term “resin article”, “functional” and “resin composition for manufacturing functional resin articles” have the same meanings as defined above, including those all preferred embodiments.

Meanwhile, a conventional method may be employed in the step of molding the resin composition of the present invention depending on the kind of the resin article to be manufactured. For example, an inflation method, a calendar method, or a T die method may be used to manufacture a functional agricultural film. A blown film extrusion method or a flat die extrusion method may be used in case of a functional packing film, and a blow molding method may be used to prepare a functional container.

Further, an agricultural film or a packing film may be manufactured in form of multi-layered films. The multi-layered films may be manufactured from the functional resin composition according to a conventional method such as a dry lamination method, a heat lamination, a T-die co-extrusion method and an inflation co-extrusion method.

A film of the present invention may have any appropriate thickness according to the kind of the film. However, thin film is preferred when economic and environmental aspects are considered. Specifically, a mono-layered film is preferred to be 10 μm to 120 mm thick, while a multi-layered film is preferred to have a total thickness of 25 to 250 μm.

Meanwhile, the method of the present invention may further comprise a step of melt blending a resin composition prior to the step of molding the resin composition.
The melt blending step may be conducted according to a conventional method, for example, by using Banbury mixer or pressured mixer.

In still another aspect, the present invention relates to a resin article obtained by the above-described method.

All of the related remarks mentioned above are considered to be also effective in connection with the above resin article.

Therefore, a resin article of the present invention should be considered to comprise any resin article prepared by using any functional resin compositions of the present invention. Further, a resin article of the present invention shall be considered to comprise any resin article prepared according to any manufacturing methods of the present invention.

**PECULIAR EFFECT**

The present invention provides a resin composition for manufacturing a functional resin article. Further, the present invention also provides a method for manufacturing a functional resin article and the resin article obtained by the method. The resin article of the present invention has high yield, antibacterial activity, deodorization and freshness maintenance, and thus may be applied to an agricultural film, a packing film or container.

**BEST MODE FOR CARRYING OUT THE INVENTION**
Reference will be now made to the exemplary embodiments illustrated, and specific language will be used herein to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended.

Examples: Manufacturing Functional Resin Articles

Example 1: Manufacturing a Functional Resin Film 1

Master batch was prepared by completely admixing 10 wt% of bamboo charcoal powder, 2 wt% of antifogging agent (sorbitan monostearate), and 1 wt% of HALS(hindered amine light stabilizer)-based UV stabilizer. 60 μm-thick film was prepared according to the inflation method by melt blending 87 wt% of poly ethylene vinyl acetate and 13 wt% of the master batch.

Example 2: Manufacturing a Functional Resin Film 2

Master batch was prepared by completely admixing 8 wt% of bamboo smoke distillate, 2 wt% of antifogging agent (sorbitan monostearate), and 1 wt% of HALS(hindered amine light stabilizer)-based UV stabilizer. 60 μm-thick film was prepared according to the inflation method by melt blending 89 wt% of poly ethylene vinyl acetate and 11 wt% of the master batch.

Example 3: Manufacturing a Functional Resin Film 3

Master batch was prepared by completely admixing 8 wt% of silica powder prepared by incorporating bamboo smoke distillate into natural silica, 2 wt% of
antifogging agent (sorbitan monostearate), and 1 wt% of HALS (hindered amine light stabilizer)-based UV stabilizer. 60 μm-thick film was prepared according to the inflation method by melt blending 89 wt% of poly ethylene vinyl acetate and 11 wt% of the master batch.

Example 4: Manufacturing a Functional Resin Film 4

Master batch was prepared by completely admixing 10 wt% of bamboo charcoal powder, 8 wt% of bamboo smoke distillate, 2 wt% of antifogging agent (sorbitan monostearate), and 1 wt% of HALS (hindered amine light stabilizer)-based UV stabilizer. 60 μm-thick film was prepared according to the inflation method by melt blending 79 wt% of poly ethylene vinyl acetate and 21 wt% of the master batch.

Example 5: Manufacturing a Functional Resin Film 5

Master batch was prepared by completely admixing 10 wt% of bamboo charcoal powder, 8 wt% of silica powder prepared by incorporating bamboo smoke distillate into natural silica, 2 wt% of antifogging agent (sorbitan monostearate), and 1 wt% of HALS (hindered amine light stabilizer)-based UV stabilizer. 60 μm-thick film was prepared according to the inflation method by melt blending 79 wt% of poly ethylene vinyl acetate and 21 wt% of the master batch.

Example 6: Manufacturing a Functional Resin Film 6

Master batch was prepared by completely admixing 10 wt% of bamboo
charcoal powder, 8 wt% of silica powder prepared by incorporating bamboo smoke
distillate into natural silica, 18 wt% of natural zeolite powder, 2 wt% of antifogging
agent (sorbitan monostearate), and 1 wt% of HALS(hindered amine light stabilizer)-
based UV stabilizer. 60 μm-thick film was prepared according to the inflation method
by melt blending 61 wt% of poly ethylene vinyl acetate and 39 wt% of the master batch.

Comparative Example: Preparation of Conventional Resin Film

Master batch was prepared by completely admixing 2 wt% of antifogging agent
(sorbitan monostearate) and 1 wt% of HALS(hindered amine light stabilizer)-based UV
stabilizer without adding additives such as bamboo charcoal powder, bamboo smoke
distillate, silica powder prepared by incorporating bamboo smoke distillate into silica,
and zeolite powder. 60 μm-thick film was prepared according to the inflation method by
using 97 wt% of poly ethylene vinyl acetate and 3 wt% of the master batch.

Test Examples: Experiments for Verifying Effects of Functionality

Test Example 1: Verification of Increase of Production Yield

Plastic green houses were prepared by using the functional resin films of the
aforementioned Examples 1-6 (functional green houses) as well as the conventional
resin film of the Comparative Example (conventional green house).

Strawberry, tomato, cucumber, watermelon, lettuce, melon and grape were
raised in the functional green houses according to a conventional cultivation method.

Further, as a Comparative Test Example, the same corps were also raised in the
conventional green house under the same condition as in functional green houses.

Increases in production yields were calculated in percentage on a basis of the production yield (Kg) of the Comparative Test Example, and the results are shown in the following Table 1.

<table>
<thead>
<tr>
<th>Items</th>
<th>Strawberry</th>
<th>Tomato</th>
<th>Cucumber</th>
<th>Watermelon</th>
<th>Lettuce</th>
<th>Melon</th>
<th>Grape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 1</td>
<td>29%</td>
<td>26%</td>
<td>23%</td>
<td>27%</td>
<td>22%</td>
<td>21%</td>
<td>23%</td>
</tr>
<tr>
<td>Example 2</td>
<td>23%</td>
<td>27%</td>
<td>22%</td>
<td>25%</td>
<td>19%</td>
<td>26%</td>
<td>21%</td>
</tr>
<tr>
<td>Example 3</td>
<td>25%</td>
<td>26%</td>
<td>29%</td>
<td>23%</td>
<td>24%</td>
<td>27%</td>
<td>24%</td>
</tr>
<tr>
<td>Example 4</td>
<td>35%</td>
<td>29%</td>
<td>36%</td>
<td>31%</td>
<td>33%</td>
<td>31%</td>
<td>36%</td>
</tr>
<tr>
<td>Example 5</td>
<td>32%</td>
<td>33%</td>
<td>38%</td>
<td>35%</td>
<td>33%</td>
<td>36%</td>
<td>37%</td>
</tr>
<tr>
<td>Example 6</td>
<td>43%</td>
<td>45%</td>
<td>50%</td>
<td>47%</td>
<td>62%</td>
<td>37%</td>
<td>42%</td>
</tr>
</tbody>
</table>

**Table 1: Increase of Production Yield**

Test Example 2: Verification of Antibacterial Activity

Antibacterial activities were evaluated by using *Escherichia coli* and *Pseudomonas aeruginosa*, and the decreases in the numbers of live bacteria (%) were shown in the following Table 2.

In more detail, functional films of the Examples 1-6 and conventional film of the Comparative Example, which have a dimension of 60 mm x 60 mm, were positioned in sterilized test plates. 0.5 ml of culture media comprising $10^5$/ml of *Escherichia coli* and $10^6$/ml of *Pseudomonas aeruginosa* respectively, were inoculated into the aforementioned test plates, and then the plates were placed at 35 °C for 24
hours.

Live bacteria were counted, and the decreases of the numbers were expressed in percentage as set forth in the following Table 2. A minus sign means an increase of live bacteria.

Table 2: Decrease of Live Bacteria

<table>
<thead>
<tr>
<th>Items</th>
<th>Comp. Ex.</th>
<th>Ex. 1</th>
<th>Ex. 2</th>
<th>Ex. 3</th>
<th>Ex. 4</th>
<th>Ex. 5</th>
<th>Ex. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Escherichia coli</td>
<td>272%</td>
<td>77%</td>
<td>71%</td>
<td>76%</td>
<td>81%</td>
<td>83%</td>
<td>87%</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>226%</td>
<td>67%</td>
<td>73%</td>
<td>73%</td>
<td>84%</td>
<td>84%</td>
<td>90%</td>
</tr>
</tbody>
</table>

Test Example 3: Verification of Deodorization

8 flasks were prepared. The functional films of the Examples 1-6 and conventional film of the Comparative Example were placed in 7 flasks respectively, while any film was not placed in the remaining flask. The films were placed to cover about 70% of the inner surface area of the flask. 4 mL of ammonia was poured into each of the 8 flasks, and evaporated.

After 30 minutes, deodorization percent was calculated according to the following formula by determining the density of the ammonia inside each of 8 flasks using a gas detection method. Deodorization percent for trimethylamine was determined in the same way.

<Formula>

Deodorization percent (%) = \{(C_b - C_s)/C_b\} \times 100%

* C_s: Gas density (ppm) inside the flasks with film
* Cb: Gas density (ppm) inside the flask without film

Table 3: Deodorization percent (%)

<table>
<thead>
<tr>
<th>Items</th>
<th>Comp. Ex.</th>
<th>Ex. 1</th>
<th>Ex. 2</th>
<th>Ex. 3</th>
<th>Ex. 4</th>
<th>Ex. 5</th>
<th>Ex. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>0.2%</td>
<td>24%</td>
<td>25%</td>
<td>31%</td>
<td>32%</td>
<td>39%</td>
<td>54%</td>
</tr>
<tr>
<td>Trimethylamine</td>
<td>0.7%</td>
<td>35%</td>
<td>41%</td>
<td>39%</td>
<td>47%</td>
<td>53%</td>
<td>77%</td>
</tr>
</tbody>
</table>

5 Test Example 4: Verification of Maintaining Freshness

7 cakes of bean curd were packed with films of Examples 1-6 & Comparative Example, respectively. The seven packed cakes were placed at room temperature (25 °C).

Whether or not spoilage happens was determined by smell, and days taken until spoilage happened were provided in the following Table 4.

Table 4: Freshness maintenance (days)

<table>
<thead>
<tr>
<th>Items</th>
<th>Comp. Ex.</th>
<th>Ex. 1</th>
<th>Ex. 2</th>
<th>Ex. 3</th>
<th>Ex. 4</th>
<th>Ex. 5</th>
<th>Ex. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean curd</td>
<td>1.2 days</td>
<td>1.4 days</td>
<td>1.5 days</td>
<td>1.4 days</td>
<td>1.5 days</td>
<td>1.6 days</td>
<td>1.7 days</td>
</tr>
</tbody>
</table>
WHAT IS CLAIMED IS:

1. A resin composition for manufacturing a functional resin article, comprising a resin and at least one additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder.

2. The resin composition of claim 1, wherein the resin article is a film.

3. The resin composition of claim 1, wherein the functional resin article serves at least one function selected from the group consisting of high yield, antibacterial activity, deodorization and freshness maintenance.

4. The resin composition of claim 1, wherein the silica and the zeolite are natural silica and natural zeolite, respectively.

5. The resin composition of claim 1, which comprises at least two additives selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder.

6. The resin composition of claim 1, which comprises at least three additives selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder.
7. The resin composition of claim 1, which comprises bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder.

8. The resin composition of claim 1, which comprises bamboo charcoal powder, silica powder prepared by incorporating bamboo smoke distillate into natural silica, and natural zeolite powder.

9. The resin composition of claim 1, which comprises 5-65 weight parts of at least one additive selected from the group consisting of bamboo charcoal powder, bamboo smoke distillate, silica powder prepared by incorporating bamboo smoke distillate into silica, and zeolite powder, based on 100 weight parts of the resin.

10. The resin composition of claim 1, which comprises 20-70 wt% of bamboo charcoal powder, 6-50 wt% of silica powder prepared by incorporating bamboo smoke distillate into natural silica, and 40-80 wt% of natural zeolite powder, based on the total weight of said additives per se.

11. The resin composition of claim 1, which further comprises at least one agent selected from the group consisting of plasticizer, lubricant, UV stabilizer, antioxidant, antistatic agent, UV absorber, anti-fogging agent, anti-clouding agent and heat stabilizer.

12. The resin composition of claim 1, wherein the resin article is an agricultural film.
13. The resin composition of claim 1, wherein the resin article is a film or a container for packing or containing a product that requires antibacterial activity, deodorization or freshness maintenance.

14. The resin composition of claim 1, wherein the resin article is a film or a container for packing or containing a product that requires antibacterial activity, deodorization or freshness maintenance, and said product is selected from the group consisting of an agricultural product, a flowering plant and food.

15. A method for manufacturing a functional resin article, comprising a step of molding the resin composition according to any of claims 1 to 14.

16. A functional resin article manufactured by the method according to claim 15.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 C08L 23/00, C08L 27/00, C08L 93/00, C08K 3/00, C08J 5/18

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 C08L 23/00, C08L 27/00, C08L 93/00, C08K 3/00, C08J 5/18

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

Korean Patents and applications for inventions since 1975

Japanese Utility models and applications for Utility models since 1975

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

KIPASS, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>KR 2001-104010 A (Sanbo Chemical Co., Ltd.) 24 November 2001</td>
<td>1, 4, 9, 11-16</td>
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<td>JP 09-77907 A (Wataboshi Sangyo KK) 25 March 1997</td>
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</tbody>
</table>

* Further documents are listed in the continuation of Box C.  
"X" see patent family annex.

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Date of the actual completion of the international search

Date of mailing of the international search report

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Korean Intellectual Property Office
520 Dunsan-dong, Seo-gu, Daegu 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

HONG, SUNG RAN

Telephone No. 82-42-481-8146

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