

(12)

(51) International Patent Classification (IPC):
D21H 11/14 (2006.01) **D21H 19/58** (2006.01)
D21H 21/34 (2006.01) **D21H 27/10** (2006.01)
D21H 27/30 (2006.01)

(52) Cooperative Patent Classification (CPC):
D21H 11/14; D21H 19/58; D21H 21/34;
D21H 27/10; D21H 27/30

(22) Date of filing: **01.04.2021**

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[illegible]

FIG. 1

DescriptionCROSS-REFERENCE TO RELATED APPLICATIONS

- 5 **[0001]** The application claims priority to Chinese patent application No. 202010587201.1, filed on June 24, 2020, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

- 10 **[0002]** The present invention relates to the manufacturing and processing technical field of carton boards, in particular to a high-performance environment-friendly kraft liner board, and a preparation method thereof.

BACKGROUND

- 15 **[0003]** Carton boards are the most important raw materials for wrapping cartons. With the improvement of people's living standards and social progress, many high-grade cartons for commodity wrapping need to consume a large number of high-performance carton boards. With the continuous development of China's paper industry, the shortage of fiber raw materials has become a bottleneck issue that restricts sustainable development of the paper industry. Thus, waste paper which is widely applied in carton boards manufacturing enterprises also limits the improvement of product performance.

20 **[0004]** The technical problems need to be solved by the present invention are described as follow:

- [0005]** Currently, kraft liner boards for various wrapping cartons are generally made of waste paper, and without utilizing flame retardant treatment in most cases. However, some high-grade wrapping cartons or special products, such as export products, a small number of high-grade consumer products, flammable and explosive products, military products, require flame retardant wrapping and transportation in particular. Moreover, electric commercial cartons, whether they are ordinary cartons or cartons for wrapping color TVs, refrigerators and other high-grade electrical appliances, the kraft liner boards used among them are generally without flame retardant treatment, it is a hidden danger, fires happen occasionally during transportation or storage of wrapping cartons. With the development of society and the improvement of people's living requirements, it is an inevitable requirement to treat kraft liner boards with flame retardants for wrapping cartons. In the prior art, some wrapping carton products adopt the method of adding plenty of flame retardants in the pulp to get the flame retardant performance, but the added amount is large, the effect is limited, the cost is high, and the physical strength of the products is affected.

[0006] Solving the surface performance, water resistance and strength problems of high-performance carton boards.

- [0007]** Conventionally, kraft liner boards are used to wrap higher-grade products, so they have higher requirements on their quality performance, especially in the process of box making, such as stretching and folding, which requires good folding endurance, tensile strength, and ring crush compression strength. After being made into cartons, good bursting strength and water resistance are required during wrapping and transportation. In order to improve the wrapping effect, the surface requires exquisite printing, so kraft liner boards also require good surface smoothing performance. The prior art mainly adopts surface sizing method to improve the ring crush compression strength and surface water resistance of products, which has many defects: surface sizing can mainly improve the surface strength and partial ring crush compression resistance of the products, but have limited effect on improving the overall physical strength of the products, such as tensile strength, bursting strength and folding endurance, so the physical properties of the kraft liner boards mainly produced by waste paper are restricted. Therefore, a large number of reinforcing agents require to be added in the production process to solve the problems, and the loss is large and the cost is high. Moreover, the usage of surface sizing has a certain effect on improving the surface water resistance and lowering the Cobb value of the product, but it has limited effect on improving the overall water resistance of the kraft liner boards. Furthermore, the usage of surface sizing can improve the surface smoothness of the products to a certain extent, but it is difficult to achieve the effect of high-quality wrapping and printing products.

[0008] Based on above reasons, the present invention is provided.

SUMMARY

- [0009]** Aiming at above problems or defects in the prior art, objects of the present invention are to provide a high-performance environment-friendly kraft liner board, and a preparation method thereof.

55 **[0010]** In order to accomplish the first object, the present invention adopts technical solutions as follows.

[0011] A high-performance environment-friendly kraft liner board, comprising a bottom layer, a top layer and a coating layer, which are arranged successively in an order from bottom to top; wherein: the bottom layer is made of a bottom layer pulp composed of a modified wood powdery pulp and a short fiber pulp; the top layer is made of a top layer pulp

composed of a long fiber pulp and a short fiber pulp; the coating layer is formed through coating a flame retardant styrene-acrylic latex on the top layer; the long fiber pulp and the short fiber pulp are formed through pulping old domestic corrugated boxes; the flame retardant styrene-acrylic latex consists of modified composite flame retardants, a functional modified styrene-acrylic latex and water.

[0012] Further, in the above technical solution, a basis weight of the high-performance environment-friendly kraft liner board is 100-120 g/m², a ring pressure index is 6.7-7.6 mN·m²/g, a frontal water absorption is 30-31 g/m², and a limit oxygen index is 30-33%, a smoothness is 15-16 seconds, a bursting index is 2.4-2.6 kPa·m²/g, and a folding endurance is 15-20 times.

[0013] Further, in the above technical solution, a weight percentage concentration of the flame retardant styrene-acrylic latex is 2.0-5.0%.

[0014] Further, in the above technical solution, a weight ratio of the modified composite flame retardants to the functional modified styrene-acrylic latex is 1:2.5-3.0.

[0015] Further, in the above technical solution, the modified composite flame retardants are prepared through modifying composite flame retardants with a modifier; wherein: the modifier is a silane coupling agent; more preferably, the silane coupling agent is N-(β-aminoethyl)-r-aminopropyltrimethoxysilane.

[0016] Further, in the above technical solution, a weight ratio of the modifier to the composite flame retardants is (0.002-0.01): 1.

[0017] Further, in the above technical solution, the composite flame retardants contain two or more flame retardant elements. For example, the composite flame retardants may be a combination of any two or more of ammonium polyphosphate, polyphosphoester, melamine polyphosphate, zinc borate, aluminum phosphate, aluminum hydroxide, etc., and a ratio of each flame retardant element is not specifically limited.

[0018] Preferably, in the above technical solution, the composite flame retardants consist of two or more flame retardant elements of equal weight.

[0019] Preferably, in the above technical solution, the zinc borate are ultra-fine powders with a particle size of 0.02-0.04 μm.

[0020] Preferably, in the above technical solution, the aluminum hydroxide are ultra-fine powders with a particle size of 0.03-0.05 μm.

[0021] Further, in the above technical solution, a preparation method of the modified composite flame retardants is as follows: mixing the composite flame retardants with the modifier, and stirring evenly.

[0022] Further, in the above technical solution, the functional modified styrene-acrylic latex is prepared through steps of:

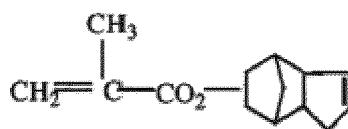
[0023] according to a proportion, adding dicyclopentenyl methacrylate, water, sodium dodecyl sulfate and nonylphenol polyoxyethylene ether into a reactor 1, stirring evenly; adding trimethylene carbonate, after stirring evenly, successively adding acrylic acid, hydroxyethyl acrylate, butyl acrylate and styrene into reaction system, stirring at a constant speed until mixing well; thereafter, heating the reaction system to 70-90°C, adding sodium bicarbonate and a initiator, under stirring condition, a reaction is carried out at constant temperature for 2-4 hours, upon completion of the reaction, cooling to a room temperature, filtering, adjusting a pH value of an obtained product to neutral, and obtaining the functional modified styrene-acrylic latex.

[0024] Further, in the above technical solution, a weight ratio of the dicyclopentenyl methacrylate, the water, the sodium dodecyl sulfate, the nonylphenol polyoxyethylene ether, the trimethylene carbonate, the acrylic acid, the hydroxyethyl acrylate, the butyl acrylate, the styrene, the sodium bicarbonate and the initiator is 1:40-50:0.2-0.3:0.3-0.4:1-1.3:0.2-0.5:4-6: 25-35:25-35:0.2-0.4:0.4-0.6.

[0025] Preferably, in the above technical solution, the initiator is a persulfate salt, and specifically can be any one of ammonium persulfate, sodium persulfate or potassium persulfate.

[0026] Preferably, in the above technical solution, a pH regulator adopts ammonia water.

[0027] Specifically, in the above technical solution, a structural formula of the dicyclopentenyl methacrylate is shown in following formula 1:



formula 1.

[0028] More preferably, in the above technical solution, the dicyclopentenyl methacrylate is prepared through steps of:

[0029] according to a proportion, successively adding methacrylic acid, trifluoromethanesulfonic acid and hydroquinone to a reactor 2, after stirring and mixing well, heating to 78-82°C, adding dicyclopentadiene to the reactor 2, mixing well,

then heating reaction system to 85-90°C, a reaction is carried out at constant temperature for 3-4 hours, upon completion of the reaction, cooling to a room temperature, adding sodium hydroxide (NaOH) into an obtained product, stirring for 1-2 hours, finally washing an obtained mixture, filtering, distilling, and obtaining the dicyclopentenyl methacrylate.

[0030] Most preferably, in the above technical solution, an agitator speed is 100-500 r/min.

[0031] Most preferably, in the above technical solution, a weight ratio of the methacrylic acid, the trifluoromethanesulfonic acid, the hydroquinone, the dicyclopentadiene and the NaOH is 0.8-1.2:0.002-0.004:0.00006-0.0001:1.5-2.0:0.0015-0.002.

[0032] Further, in the above technical solution, a weight percentage concentration of the long fiber pulp is 3.5-4.5%, a weight percentage concentration of the short fiber pulp is 4-5%, and a weight percentage concentration of the modified wood powdery pulp is 3-5%.

[0033] Further, in the above technical solution, in the bottom layer pulp, a weight ratio of the modified wood powdery pulp to the short fiber pulp is 5-10:95-90.

[0034] Further, in the above technical solution, the modified wood powdery pulp is prepared through modifying wood powders with a swelling agent, and the swelling agent is a mixed alkali; a modification method is as follows: after processing the wood powders with a refiner, successively adding the mixed alkali and water, stirring evenly, then heating an obtained mixture to 70-90°C, and a swelling treatment is carried out at constant temperature for 60-90 minutes to form the modified wood powdery pulp.

[0035] preferably, in the above technical solution, the mixed alkali consists of sodium hydroxide and sodium carbonate; wherein: amounts of each raw material are calculated by weight, wood powders: sodium hydroxide: sodium carbonate=1:0.01-0.03:0.01-0.03.

[0036] preferably, in the above technical solution, the water used for the swelling agent modifying wood powders adopts dryer condensed water in a double-stacked paper machine, which is used for preparing products of the present invention.

[0037] Further, in the above technical solution, in the top layer pulp, a weight ratio of the long fiber pulp to the short fiber pulp is 80-90:20-10.

[0038] Further, in the above technical solution, a weight ratio of the top layer pulp to the bottom layer pulp is 40-50:60-50.

[0039] Further, in the above technical solution, a ratio of total weight of absolute dry fibers contained in the bottom layer pulp and the top layer pulp to a weight of the coating layer is 1:0.005-0.015.

[0040] A second object of the present invention is to provide a preparation method for the above high-performance environment-friendly kraft liner board, comprising steps of:

(1) pulping steps

(i) preparation of a long fiber pulp and a short fiber pulp

deflaking old domestic corrugated boxes with a hydropulper, separating dregs at a high consistency, then coarse screening for first level three stages, screen sizing to a long fiber coarse pulp and a short fiber coarse pulp; separating the long fiber coarse pulp for first level three stages, removing dregs; successively fine screening obtained fibers for first level three stages, thickening with a multi-disc thickener, refining with a conical refiner, and finally diluting with water to obtain the long fiber pulp, storing in a machine chest for use; successively fine screening the short fiber coarse pulp for first level two stages and refining with the conical refiner, finally diluting with water to obtain the short fiber pulp, storing in a pulp chest for use;

(ii) preparation of a modified wood powdery pulp

processing wood powders with a refiner, successively adding a mixed alkali and water, stirring evenly, heating an obtained mixture to 70-90°C, and a swelling treatment is carried out at constant temperature for 60-90 minutes, so as to soften fibers appropriately and form the modified wood powdery pulp with a weight percentage concentration of 3-5%;

(2) papermaking steps

[0041] according to a proportion, mixing the modified wood powdery pulp and the short fiber pulp obtained through the step (1) uniformly to form a bottom layer pulp, mixing the long fiber pulp and the short fiber pulp uniformly to form a top layer pulp; then flowing the bottom layer pulp and the top layer pulp on wire respectively, adding retention and drainage aids to the approach flow system, double-folding, laminating, pressing, drying, coating, calendering and reeling to obtain the high-performance environment-friendly kraft liner board.

[0042] Further, in the above technical solution, in the step(i), a first-stage pressure screen of the fine screening for first level three stages adopts a micro-slot width pressure screen to remove binders, and a screen slot width is 0.08-0.12 mm.

[0043] Further, in the above technical solution, in the step(i), a weight ratio of absolute dry long fibers in the long fiber

coarse pulp obtained by screen sizing to absolute dry short fibers in the short fiber coarse pulp is 30-40:70-60.

[0044] Further, in the above technical solution, in the step(i), the long fiber pulp adopts conical refiners in series to refine the pulp, and adopts a long fiber viscous beating technology, and a beating degree is 28-30 °SR.

[0045] Further, in the above technical solution, in the step(i), a weight percentage concentration of the long fiber pulp is 3.5-4.5%, and a weight percentage concentration of the short fiber pulp is 4-5%.

[0046] Further, in the above technical solution, the water in the step (i) and step (ii) both adopts dryer condensed water in a double-stacked paper machine.

[0047] Further, in the above technical solution, the retention and drainage aids in the step (2) consist of two components: cationic polyacrylamide and silica sol, wherein: a weight ratio of absolute dry fibers, cationic polyacrylamide, and silica sol is 1:0.001-0.002:0.001-0.002; the absolute dry fibers refer to total amounts of absolute dry fibers contained in the bottom layer pulp and the top layer pulp.

[0048] Further, in the above technical solution, the coating in the step (2) adopts the metering roller coating technology, specifically, by a metering roller coating method, coating the flame retardant styrene-acrylic latex on the top layer of the kraft liner board obtained through double-folding, laminating, pressing and drying, so as to form a coating layer.

[0049] Compared with the prior art, the beneficial effects of the present invention are described as follows:

(1) The present invention adopts composite flame retardant latex metering roller coating method to add the flame retardants, which is no loss and low cost, moreover, the addition of the flame retardants has no adverse effects on the strength of the paper.

(2) The present invention adopts acrylic acid, hydroxyethyl acrylate, butyl acrylate, styrene as reactive monomers, adopts trimethylene carbonate, dicyclopentenyl methacrylate as functional monomers, and adopts a emulsion polymerization method to prepare the functional modified styrene-acrylic latex, then combines it with the flame retardants to prepare the flame retardant styrene-acrylic latex; thereafter, through coating method to prepare the high-performance environment-friendly kraft liner board. The functional modified styrene-acrylic latex of the present invention can replace or partially replace the reinforcing agent, sizing agent and other auxiliary agents added in the pulp during production of the kraft liner board, so that the product has good overall physical strength and water resistance. Moreover, the present invention adopts the metering roller coating method, which improves the smoothness of the surface of the kraft liner board product, greatly improves the printing effect, and raises the level of the product.

(3) The functional modified styrene-acrylic latex prepared by the present invention is combined with the composite flame retardants containing multiple flame retardant elements to obtain the flame retardant latex, which can fully exert the synergistic flame retardant effect of the multiple flame retardants.

(4) The preparation process of the present invention is advanced, pollution-free and low production cost, moreover, the prepared kraft liner board has good physical strength, water resistance and flame retardancy. Because the kraft box preparation product of the present invention is produced from all waste paper, the process is environment-friendly and the functional modified styrene-acrylic latex is a water-soluble latex without organic solvents, which improves environmental protection.

BRIEF DESCRIPTION OF DRAWINGS

[0050] FIG. 1 is a preparation process flow chart of the high-performance environment-friendly kraft liner board according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0051] The present invention is further illustrated in detail with examples. The examples are implemented on the premise of the technology according to the present invention. Now detailed implementation and specific operation process are given to illustrate the creativity of the present invention, but the protection scope of the present invention is not limited to the following examples.

[0052] Based on the information contained in this application, it is easy for those skilled in the art to make various changes to the precise description of the present invention without departing from the spirit and scope of the appended claims. It should be understood that the scope of the present invention is not limited to the defined processes, properties, or components, because these examples and other descriptions are merely intended to illustrate specific aspects of the present invention. In fact, various changes that can be made to the examples of the present invention by those skilled in the art or related fields are all encompassed in the scope of the appended claims.

[0053] In order to better understand the present invention without limiting the scope of the present invention, all numbers expressing dosages, percentages, and other numerical values used in this application should be understood as modified by the word "about" in all cases. Therefore, unless otherwise specified, the numerical parameters listed in the specification

and the appended claims are approximate values, which may be changed according to the desired properties that are attempted to be obtained. Each numerical parameter should at least be regarded as obtained based on the reported significant figures and through conventional rounding methods.

[0054] The materials and reagents used in the following examples can be obtained from commercial sources unless otherwise specified.

Example 1

[0055] In this example, the method for preparing a high-performance environment - friendly kraft liner board, comprising following steps of:

(1) preparing for a flame retardant styrene-acrylic latex

(a) preparing for a dicyclopentenyl methacrylate

according to a proportion, successively adding methacrylic acid, trifluoromethanesulfonic acid and hydroquinone to a reactor 2 equipped with an agitator, controlling an agitator speed of the agitator to 210 r/min, after stirring and mixing well, heating to 80°C; then adding dicyclopentadiene, controlling a reaction temperature of reaction system to 85°C, a reaction is carried out at constant temperature for 3.5 hours, upon completion of the reaction, cooling to a room temperature, adding NaOH and stirring for 1.5 hours, washing an obtained mixture, filtering, distilling, and obtaining the dicyclopentenyl methacrylate; wherein: the weight ratio of the methacrylic acid, the trifluoromethanesulfonic acid, the hydroquinone, the dicyclopentadiene, and the NaOH is 1:0.0028:0.000095:1.72:0.0018;

(b) preparing for a functional modified styrene-acrylic latex

the functional modified styrene-acrylic latex is prepared through following method, particularly comprising steps of:

according to a proportion, adding dicyclopentenyl methacrylate obtained in the step(a), water, sodium dodecyl sulfate and nonylphenol polyoxyethylene ether into a reactor 1, stirring evenly; adding trimethylene carbonate, after stirring evenly, successively adding acrylic acid, hydroxyethyl acrylate, butyl acrylate and styrene into reaction system, stirring at a constant speed until mixing well; thereafter, heating the reaction system to 80°C, adding sodium bicarbonate and ammonium persulfate, under stirring condition, a reaction is carried out at constant temperature for 4 hours, upon completion of the reaction, cooling to a room temperature, filtering, adjusting a pH value of an obtained product to neutral with aqueous ammonia solution, and obtaining the functional modified styrene-acrylic latex;

wherein: a weight ratio of the dicyclopentenyl methacrylate, the water, the sodium dodecyl sulfate, the nonylphenol polyoxyethylene ether, the trimethylene carbonate, the acrylic acid, the hydroxyethyl acrylate, the butyl acrylate, the styrene, the sodium bicarbonate and the ammonium persulfate is 1:40:0.2:0.3:1:0.2:4:25:25:0.2:0.4;

(c) preparing for the flame retardant styrene-acrylic latex

mixing modifier N-(β-aminoethyl)-r-aminopropyltrimethoxysilane and composite flame retardants at a weight ratio of 0.002:1, stirring evenly, and obtaining modified composite flame retardants; then mixing the modified composite flame retardants and the functional modified styrene-acrylic latex prepared in the step (a) uniformly at a weight ratio of 1:2.5, diluting with water, and obtaining the flame retardant styrene-acrylic latex with a weight percentage concentration of 2.0%; the water adopts dryer condensed water;

wherein: the composite flame retardants consist of zinc borate and aluminum hydroxide with a weight ratio of 1:1; the zinc borate and aluminum hydroxide are both ultra-fine powders, and a particle size of the zinc borate is 0.02-0.04 μm; a particle size of the aluminum hydroxide is 0.03-0.05 μm;

(2) pulping steps

(i) preparation of a long fiber pulp and a short fiber pulp

deflaking old domestic corrugated boxes with a hydropulper, separating dregs at a high consistency, then coarse screening for first level three stages, screen sizing to a long fiber coarse pulp and a short fiber coarse pulp; separating the long fiber coarse pulp for first level three stages, removing dregs; successively fine screening obtained fibers for first level three stages, thickening with a multi-disc thickener, refining with a conical refiner, and finally diluting with water to obtain the long fiber pulp, storing in a machine chest for use; successively fine screening the short fiber coarse pulp for first level two stages and refining with the conical refiner, finally diluting

with water to obtain the short fiber pulp, storing in a pulp chest for use; the water used in this step all adopts dryer condensed water in a double-stacked paper machine;

wherein: a first-stage pressure screen of the fine screening for first level three stages adopts a micro-slot width pressure screen to remove binders, and a screen slot width is 0.08-0.12 mm;

a weight ratio of absolute dry long fibers in the long fiber coarse pulp obtained by screen sizing to absolute dry short fibers in the short fiber coarse pulp is 40:60;

the long fiber pulp adopts conical refiners in series to refine the pulp, and adopts a long fiber viscous beating technology, and a beating degree is 28 °SR;

a weight percentage concentration of the long fiber pulp is 3.5%, and a weight percentage concentration of the short fiber pulp is 5%;

(ii) preparation of a modified wood powdery pulp

processing wood powders with a refiner, successively adding a mixed alkali and water, stirring evenly, heating an obtained mixture to 70°C, and a swelling treatment is carried out at constant temperature for 60 minutes, so as to soften fibers appropriately and form the modified wood powdery pulp with a weight percentage concentration of 3%;

wherein: the mixed alkali consists of sodium hydroxide and sodium carbonate; the water adopts dryer condensed water in a double-stacked paper machine;

in the step (ii), amounts of each raw material are calculated by weight, wood powders: sodium hydroxide: sodium carbonate=1:0.01:0.01;

(3) papermaking steps

mixing the modified wood powdery pulp and the short fiber pulp obtained in the step (2) uniformly at a weight ratio of 10:90 to form a bottom layer pulp; mixing the long fiber pulp and the short fiber pulp obtained in the step (3) uniformly at a weight ratio of 80:20 to form a top layer pulp; then flowing the bottom layer pulp and the top layer pulp on wire respectively, adding retention and drainage aids to the approach flow system, double-folding, laminating, pressing, drying, coating, calendering and reeling to obtain the high-performance environment-friendly kraft liner board;

wherein: a weight ratio of the top layer pulp to the bottom layer pulp is 40:60;

the retention and drainage aids consist of two components: cationic polyacrylamide and silica sol, a weight ratio of absolute dry fibers, cationic polyacrylamide, and silica sol is 1:0.001:0.001; the absolute dry fibers refer to total amounts of absolute dry fibers contained in the bottom layer pulp and the top layer pulp;

the coating process adopts the metering roller coating technology, specifically, by a metering roller coating method, coating the flame retardant styrene-acrylic latex on the top layer of the kraft liner board obtained through double-folding, laminating, pressing and drying, so as to form a coating layer;

a ratio of the total weight of the absolute dry fibers contained in the bottom layer pulp and the top layer pulp to a weight of the coating layer is 1:0.005.

Example 2

[0056] In this example, the preparation method of a high-performance environment - friendly kraft liner board, comprising following steps of:

(1) preparing for a flame retardant styrene-acrylic latex

(a) preparing for a dicyclopentenyl methacrylate

according to a proportion, successively adding methacrylic acid, trifluoromethanesulfonic acid and hydroquinone to a reactor 2 equipped with an agitator, after stirring and mixing well under 100 r/min condition, heating to 78°C; then adding dicyclopentadiene into the reactor 2, mixing well, heating reaction system to 90°C, a reaction is carried out at constant temperature for 3 hours, upon completion of the reaction, cooling to a room temperature, adding NaOH into an obtained product, stirring for 1h, finally washing an obtained mixture, filtering, distilling, and obtaining the dicyclopentenyl methacrylate; wherein: the weight ratio of the methacrylic acid, the trifluoromethanesulfonic acid, the hydroquinone, the dicyclopentadiene, and the NaOH is 0.8:0.002:0.00006:1.5:0.0015;

(b) preparing for a functional modified styrene-acrylic latex

the functional modified styrene-acrylic latex is prepared through following method, particularly comprising steps of:

according to a proportion, adding dicyclopentenyl methacrylate obtained in the step(a), water, sodium

dodecyl sulfate and nonylphenol polyoxyethylene ether into a reactor 1, stirring evenly; adding trimethylene carbonate, after stirring evenly, successively adding acrylic acid, hydroxyethyl acrylate, butyl acrylate and styrene into reaction system, stirring at a constant speed until mixing well; thereafter, heating the reaction system to 70°C, adding sodium bicarbonate and ammonium persulfate, under stirring condition, a reaction is carried out at constant temperature for 3 hours, upon completion of the reaction, cooling to a room temperature, filtering, adjusting a pH value of an obtained product to neutral with aqueous ammonia solution, and obtaining the functional modified styrene-acrylic latex;

wherein: a weight ratio of the dicyclopentenyl methacrylate, the water, the sodium dodecyl sulfate, the nonylphenol polyoxyethylene ether, the trimethylene carbonate, the acrylic acid, the hydroxyethyl acrylate, the butyl acrylate, the styrene, the sodium bicarbonate and the ammonium persulfate is 1:45:0.25:0.35:1.2:0.3:5:30:30:0.3:0.5;

(c)preparing for the flame retardant styrene-acrylic latex

mixing modifier N-(β-aminoethyl)-r-aminopropyltrimethoxysilane and composite flame retardants at a weight ratio of 0.005:1, stirring evenly, and obtaining modified composite flame retardants; then mixing the modified composite flame retardants and the functional modified styrene-acrylic latex prepared in the step (a) uniformly at a weight ratio of 1:2.8, diluting with water, and obtaining the flame retardant styrene-acrylic latex with a weight percentage concentration of 3.5%; the water adopts dryer condensed water in a double-stacked paper machine; wherein: the composite flame retardants consist of ammonium polyphosphate, polyphosphoester and zinc borate with a weight ratio of 1:1:1; the zinc borate are ultra-fine powders, and a particle size of the zinc borate is 0.02-0.04 μm;

(2) pulping steps

(i) preparation of a long fiber pulp and a short fiber pulp

deflaking old domestic corrugated boxes with a hydropulper, separating dregs at a high consistency, then coarse screening for first level three stages, screen sizing to a long fiber coarse pulp and a short fiber coarse pulp; separating the long fiber coarse pulp for first level three stages, removing dregs; successively fine screening obtained fibers for first level three stages, thickening with a multi-disc thickener, refining with a conical refiner, and finally diluting with water to obtain the long fiber pulp, storing in a machine chest for use; successively fine screening the short fiber coarse pulp for first level two stages and refining with the conical refiner, finally diluting with water to obtain the short fiber pulp, storing in a pulp chest for use; the water used in this step all adopts dryer condensed water in a double-stacked paper machine;

wherein: a first-stage pressure screen of the fine screening for first level three stages adopts a micro-slot width pressure screen to remove binders, and a screen slot width is 0.08-0.12 mm;

a weight ratio of absolute dry long fibers in the long fiber coarse pulp obtained by screen sizing to absolute dry short fibers in the short fiber coarse pulp is 30:70;

the long fiber pulp adopts conical refiners in series to refine the pulp, and adopts a long fiber viscous beating technology, and a beating degree is 30 °SR;

a weight percentage concentration of the long fiber pulp is 4.0%, and a weight percentage concentration of the short fiber pulp is 4.5%;

(ii)preparation of a modified wood powdery pulp

processing wood powders with a refiner, successively adding a mixed alkali and water, stirring evenly, heating an obtained mixture to 90°C, and a swelling treatment is carried out at constant temperature for 70 minutes, so as to soften fibers appropriately and form the modified wood powdery pulp with a weight percentage concentration of 4%;

wherein: the mixed alkali consists of sodium hydroxide and sodium carbonate; the water adopts dryer condensed water in a double-stacked paper machine;

in the step (ii), amounts of each raw material are calculated by weight, wood powders: sodium hydroxide: sodium carbonate=1:0.02:0.02;

(3) papermaking steps

mixing the modified wood powdery pulp and the short fiber pulp obtained in the step (2) uniformly at a weight ratio of 5:95 to form a bottom layer pulp; mixing the long fiber pulp and the short fiber pulp obtained in the step (3) uniformly at a weight ratio of 90:10 to form a top layer pulp; then flowing the bottom layer pulp and the top layer pulp on wire respectively, adding retention and drainage aids to the approach flow system, double-folding, laminating, pressing, drying, coating, calendering and reeling to obtain the high-performance environment-friendly kraft liner board; wherein: a weight ratio of the top layer pulp to the bottom layer pulp is 50:50;

the retention and drainage aids consist of two components: cationic polyacrylamide and silica sol, wherein: a weight ratio of absolute dry fibers, cationic polyacrylamide, and silica sol is 1:0.0015:0.0015; the absolute dry fibers refer to total amounts of absolute dry fibers contained in the bottom layer pulp and the top layer pulp;
 the coating process adopts the metering roller coating technology, specifically, by a metering roller coating method,
 coating the flame retardant styrene-acrylic latex on the top layer of the kraft liner board obtained through double-folding, laminating, pressing and drying, so as to form a coating layer;
 a ratio of the total weight of the absolute dry fibers contained in the bottom layer pulp and the top layer pulp to a weight of the coating layer is 1:0.01.

Example 3

[0057] In this example, the preparation method of a high-performance environment - friendly kraft liner board, comprising following steps of:

(1) preparing for a flame retardant styrene-acrylic latex

(a) preparing for a dicyclopentenyl methacrylate

according to a proportion, successively adding methacrylic acid, trifluoromethanesulfonic acid and hydroquinone to a reactor 2 equipped with an agitator, after stirring and mixing well under 500 r/min condition, heating to 82°C; then adding dicyclopentadiene into the reactor 2, mixing well, heating reaction system to 85°C, a reaction is carried out at constant temperature for 4 hours, upon completion of the reaction, cooling to a room temperature, adding NaOH into an obtained product, stirring for 2 hours, finally washing an obtained mixture, filtering, distilling, and obtaining the dicyclopentenyl methacrylate; wherein: the weight ratio of the methacrylic acid, the trifluoromethanesulfonic acid, the hydroquinone, the dicyclopentadiene, and the NaOH is 1.2:0.004:0.0001: 2.0:0.002;

(b) preparing for a functional modified styrene-acrylic latex

the functional modified styrene-acrylic latex is prepared through following method, particularly comprising steps of:

according to a proportion, adding dicyclopentenyl methacrylate obtained in the step(a), water, sodium dodecyl sulfate and nonylphenol polyoxyethylene ether into a reactor 1, stirring evenly; adding trimethylene carbonate, after stirring evenly, successively adding acrylic acid, hydroxyethyl acrylate, butyl acrylate and styrene into reaction system, stirring at a constant speed until mixing well; thereafter, heating the reaction system to 85°C, adding sodium bicarbonate and ammonium persulfate, under stirring condition, a reaction is carried out at constant temperature for 2 hours, upon completion of the reaction, cooling to a room temperature, filtering, adjusting a pH value of an obtained product to neutral with aqueous ammonia solution, and obtaining the functional modified styrene-acrylic latex;

wherein: a weight ratio of the dicyclopentenyl methacrylate, the water, the sodium dodecyl sulfate, the nonylphenol polyoxyethylene ether, the trimethylene carbonate, the acrylic acid, the hydroxyethyl acrylate, the butyl acrylate, the styrene, the sodium bicarbonate and the ammonium persulfate is 1:50:0.3:0.4:1.3:0.5:6:35:35:0.4:0.6;

(c) preparing for the flame retardant styrene-acrylic latex

mixing modifier N-(β-aminoethyl)-r-aminopropyltrimethoxysilane and composite flame retardants at a weight ratio of 0.01:1, stirring evenly, and obtaining modified composite flame retardants; then mixing the modified composite flame retardants and the functional modified styrene-acrylic latex prepared in the step (a) uniformly at a weight ratio of 1:3.0, diluting with water, and obtaining the flame retardant styrene-acrylic latex with a weight percentage concentration of 5%; the water adopts dryer condensed water in a double-stacked paper machine;
 wherein: the composite flame retardants consist of ammonium polyphosphate, polyphosphoester and melamine polyphosphate with a weight ratio of 1:1:1;

(2) pulping steps

(i) preparation of a long fiber pulp and a short fiber pulp

deflaking old domestic corrugated boxes with a hydropulper, separating dregs at a high consistency, then coarse screening for first level three stages, screen sizing to a long fiber coarse pulp and a short fiber coarse pulp; separating the long fiber coarse pulp for first level three stages, removing dregs; successively fine screening obtained fibers for first level three stages, thickening with a multi-disc thickener, refining with a conical refiner, and finally diluting with water to obtain the long fiber pulp, storing in a machine chest for use; successively fine screening the short fiber coarse pulp for first level two stages and refining with the conical refiner, finally diluting with water to obtain the short fiber pulp, storing in a pulp chest for use; the water used in this step all adopts dryer condensed water in a double-

stacked paper machine;

wherein: a first-stage pressure screen of the fine screening for first level three stages adopts a micro-slot width pressure screen to remove binders, and a screen slot width is 0.08-0.12 mm;

a weight ratio of absolute dry long fibers in the long fiber coarse pulp obtained by screen sizing to absolute dry short fibers in the short fiber coarse pulp is 35:65;

the long fiber pulp adopts conical refiners in series to refine the pulp, and adopts a long fiber viscous beating technology, and a beating degree is 30 °SR;

a weight percentage concentration of the long fiber pulp is 4.5%, and a weight percentage concentration of the short fiber pulp is 5%;

(ii) preparation of a modified wood powdery pulp

processing wood powders with a refiner, successively adding a mixed alkali and water, stirring evenly, heating an obtained mixture to 80°C, and a swelling treatment is carried out at constant temperature for 90 minutes, so as to soften fibers appropriately and form the modified wood powdery pulp with a weight percentage concentration of 5%; wherein: the mixed alkali consists of sodium hydroxide and sodium carbonate; the water adopts dryer condensed

water in a double-stacked paper machine;

in the step (ii), amounts of each raw material are calculated by weight, wood powders: sodium hydroxide: sodium carbonate=1:0.03:0.03;

(3) papermaking steps

mixing the modified wood powdery pulp and the short fiber pulp obtained in the step (2) uniformly at a weight ratio of 8:92 to form a bottom layer pulp; mixing the long fiber pulp and the short fiber pulp obtained in the step (3) uniformly at a weight ratio of 85:15 to form a top layer pulp; then flowing the bottom layer pulp and the top layer pulp on wire respectively, adding retention and drainage aids to the approach flow system, double-folding, laminating, pressing, drying, coating, calendering and reeling to obtain the high-performance environment-friendly kraft liner board;

wherein: a weight ratio of the top layer pulp to the bottom layer pulp is 45:55;

the retention and drainage aids consist of two components: cationic polyacrylamide and silica sol, wherein: a weight ratio of absolute dry fibers, cationic polyacrylamide, and silica sol is 1:0.002:0.002; the absolute dry fibers refer to total amounts of absolute dry fibers contained in the bottom layer pulp and the top layer pulp;

the coating process adopts the metering roller coating technology, specifically, by a metering roller coating method, coating the flame retardant styrene-acrylic latex on the top layer of the kraft liner board obtained through double-folding, laminating, pressing and drying, so as to form a coating layer;

a ratio of the total weight of the absolute dry fibers contained in the bottom layer pulp and the top layer pulp to a weight of the coating layer is 1:0.015.

The main performance indexes of the high-performance environment-friendly kraft liner board prepared in the examples 1 to 3 are tested. The ring pressure index is tested according to an GB/T2679.8-2016 "Paperboard-Determination of ring crush compression strength"; the frontal water absorption is tested according to an GB/T1540-2002 "Paper and board-Determination of water absorption"; the flame retardancy is tested according to an oxygen index meter ASTM D2863 standard; smoothness is tested according to an GB/T456-2002 "Paper and board-Determination of smoothness" (Bekk method); bursting index is tested according to an GB/T1539-2007 "Paperboard-Determination of bursting strength"; Folding endurance is tested according to an GB/T2679.5-2002 "Paper and board-Determination of folding endurance ". The test results are shown in Table 1.

Table 1 The main performance index test results of the high-performance environment- friendly kraft liner board prepared in Examples 1-3.

Technical indexes	Example 1	Example 2	Example 3
a basis weight (g/m ²)	100	120	110
a ring pressure index (mN·m ² /g)	6.7	7.6	7.2
a frontal water absorption (g/m ²)	30	31	30.6
flame retardancy (a limit oxygen index %)	30	33	32.4
a smoothness (seconds)	15	16	16
a bursting index (kPa·m ² /g)	2.4	2.6	2.55
a folding endurance (times)	15	20	20

Claims

1. A high-performance environment-friendly kraft liner board, comprising a bottom layer, a top layer and a coating layer, which are arranged successively in an order from bottom to top; wherein: the bottom layer is made of a bottom layer pulp composed of a modified wood powdery pulp and a short fiber pulp; the top layer is made of a top layer pulp composed of a long fiber pulp and a short fiber pulp; the coating layer is formed through coating a flame retardant styrene-acrylic latex on the top layer; the long fiber pulp and the short fiber pulp are formed through pulping old domestic corrugated boxes; the flame retardant styrene-acrylic latex consists of modified composite flame retardants, a functional modified styrene-acrylic latex and water;
the functional modified styrene-acrylic latex is prepared through steps of:
according to a proportion, adding dicyclopentenyl methacrylate, water, sodium dodecyl sulfate and nonylphenol polyoxyethylene ether into a reactor 1, stirring evenly; adding trimethylene carbonate, after stirring evenly, successively adding acrylic acid, hydroxyethyl acrylate, butyl acrylate and styrene into reaction system, stirring at a constant speed until mixing well; thereafter, heating the reaction system to 70-90°C, adding sodium bicarbonate and a initiator, under stirring condition, a reaction is carried out at constant temperature for 2-4 hours, upon completion of the reaction, cooling to a room temperature, filtering, adjusting a pH value of an obtained product to neutral, and obtaining the functional modified styrene-acrylic latex.
2. The high-performance environment-friendly kraft liner board, as recited in claim 1, wherein: a basis weight of the high-performance environment-friendly kraft liner board is 100-120 g/m², a ring pressure index is 6.7-7.6 mN·m²/g, a frontal water absorption is 30-31 g/m², and a limit oxygen index is 30-33%, a smoothness is 15-16 seconds, a bursting index is 2.4-2.6 kPa·m²/g, and a folding endurance is 15-20 times.
3. The high-performance environment-friendly kraft liner board, as recited in claim 1, wherein: a weight ratio of the modified composite flame retardants to the functional modified styrene-acrylic latex is 1:2.5-3.0; the modified composite flame retardants are prepared through modifying composite flame retardants with a silane coupling agent.
4. The high-performance environment-friendly kraft liner board, as recited in claim 3, wherein: the composite flame retardants are a combination of any two or more of ammonium polyphosphate, polyphosphoester, melamine polyphosphate, zinc borate, and aluminum phosphate.
5. The high-performance environment-friendly kraft liner board, as recited in claim 5, wherein: the dicyclopentenyl methacrylate is prepared through steps of:
according to a proportion, successively adding methacrylic acid, trifluoromethanesulfonic acid and hydroquinone to a reactor 2, after stirring and mixing well, heating to 78-82°C, adding dicyclopentadiene to the reactor 2, mixing well, then heating reaction system to 85-90°C, a reaction is carried out at constant temperature for 3-4 hours, upon completion of the reaction, cooling to a room temperature, adding sodium hydroxide into an obtained product, stirring for 1-2 hours, finally washing an obtained mixture, filtering, distilling, and obtaining the dicyclopentenyl methacrylate; and the trifluoromethanesulfonic acid, the hydroquinone, the dicyclopentadiene and the NaOH is 0.8-1.2:0.002-0.004:0.00006-0.0001: 1.5-2.0:0.0015-0.002.
6. The high-performance environment-friendly kraft liner board, as recited in claim 5, wherein: a weight ratio of the dicyclopentenyl methacrylate, the water, the sodium dodecyl sulfate, the nonylphenol polyoxyethylene ether, the trimethylene carbonate, the acrylic acid, the hydroxyethyl acrylate, the butyl acrylate, the styrene, the sodium bicarbonate, and the initiator is 1:40-50:0.2-0.3:0.3-0.4:1-1.3:0.2-0.5:4-6:25-35:25-35:0.2-0.4:0.4-0.6.
7. The high-performance environment-friendly kraft liner board, as recited in claim 1, the modified wood powdery pulp is prepared through modifying wood powders with a swelling agent, and the swelling agent is a mixed alkali; a modification method is as follows: after processing the wood powders with a refiner, successively adding the mixed alkali and water, stirring evenly, then heating an obtained mixture to 70-90°C, and a swelling treatment is carried out at constant temperature for 60-90 minutes to form the modified wood powdery pulp; wherein: the mixed alkali consists of sodium hydroxide and sodium carbonate.
8. A preparation method for the high-performance environment-friendly kraft liner board as recited in claim 1, wherein: comprising steps of:

(1) pulping steps

(i)preparation of a long fiber pulp and a short fiber pulp

deflaking old domestic corrugated boxes with a hydropulper, separating dregs at a high consistency, then coarse screening for first level three stages, screen sizing to a long fiber coarse pulp and a short fiber coarse pulp; separating the long fiber coarse pulp for first level three stages, removing dregs; successively fine screening obtained fibers for first level three stages, thickening with a multi-disc thickener, refining with a conical refiner, and finally diluting with water to obtain the long fiber pulp, storing in a machine chest for use; successively fine screening the short fiber coarse pulp for first level two stages and refining with the conical refiner, finally diluting with water to obtain the short fiber pulp, storing in a pulp chest for use;

(ii)preparation of a modified wood powdery pulp

processing wood powders with a refiner, successively adding a mixed alkali and water, stirring evenly, heating an obtained mixture to 70-90°C, and a swelling treatment is carried out at constant temperature for 60-90 minutes, so as to soften fibers appropriately and form the modified wood powdery pulp with a weight percentage concentration of 3-5%;

(2) papermaking steps

according to a proportion, mixing the modified wood powdery pulp and the short fiber pulp obtained through the step (1) uniformly to form a bottom layer pulp, mixing the long fiber pulp and the short fiber pulp uniformly to form a top layer pulp; then flowing the bottom layer pulp and the top layer pulp on wire respectively, adding retention and drainage aids to the approach flow system, double-folding, laminating, pressing, drying, coating, calendering and reeling to obtain the high-performance environment-friendly kraft liner board.

9. The preparation method for the high-performance environment-friendly kraft liner board as recited in claim 8, wherein: the coating in the step (2) adopts a metering roller coating method, coating the flame retardant styrene-acrylic latex on the top layer of the kraft liner board obtained through double-folding, laminating, pressing and drying, so as to form a coating layer.

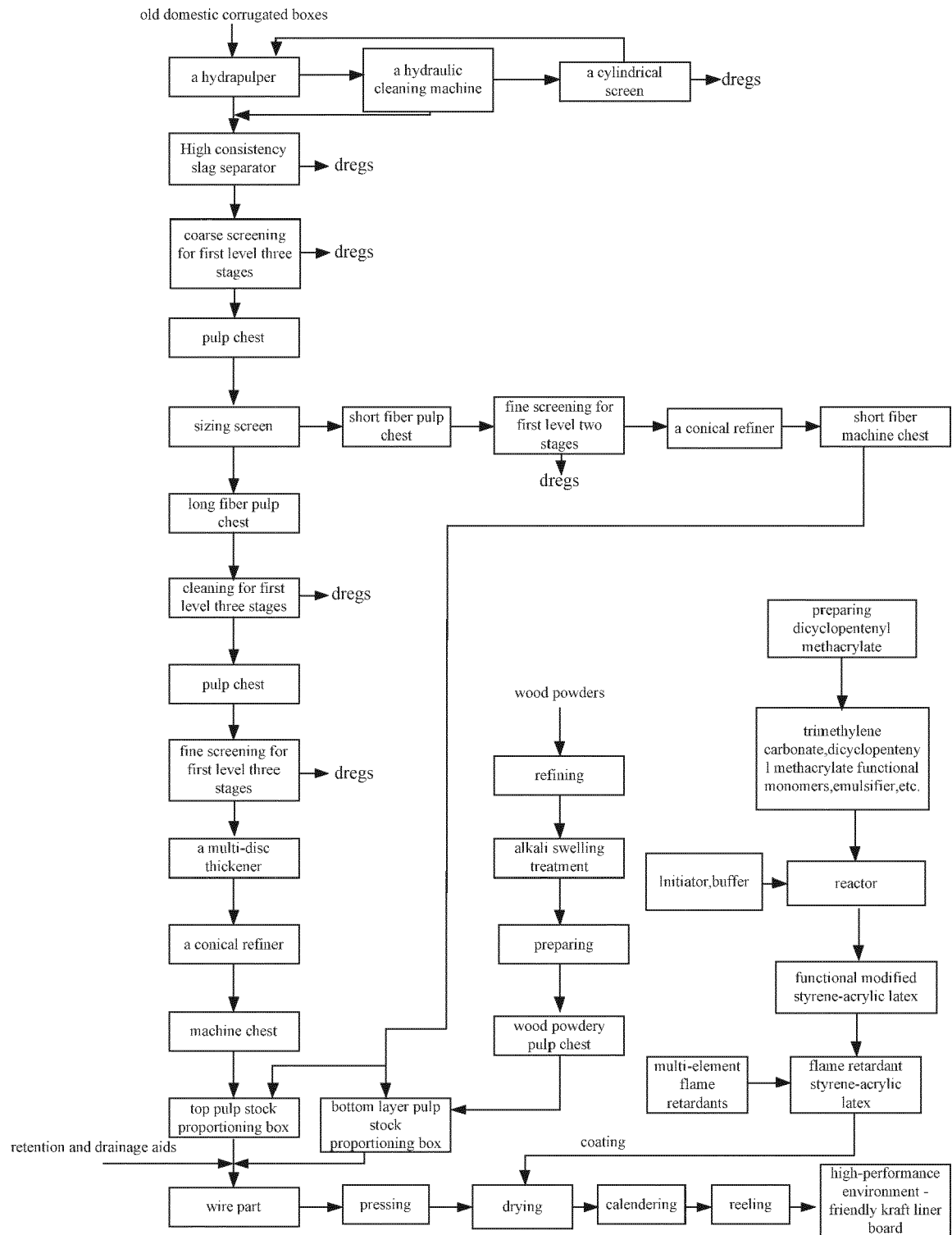


FIG. 1



EUROPEAN SEARCH REPORT

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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