(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 August 2015 (13.08.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/118227 A1

(51) International Patent Classification:
D21H 17/16 (2006.01) *D21H 17/31* (2006.01)
D21H 17/17 (2006.01) *D21H 21/16* (2006.01)
D21H 17/24 (2006.01)

(21) International Application Number:
PCT/FI2015/050075

(22) International Filing Date:
6 February 2015 (06.02.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20145117 6 February 2014 (06.02.2014) FI

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH,

[Continued on next page]

WO 2015/118227 A1

(54) Title: A STABILIZED SIZING FORMULATION

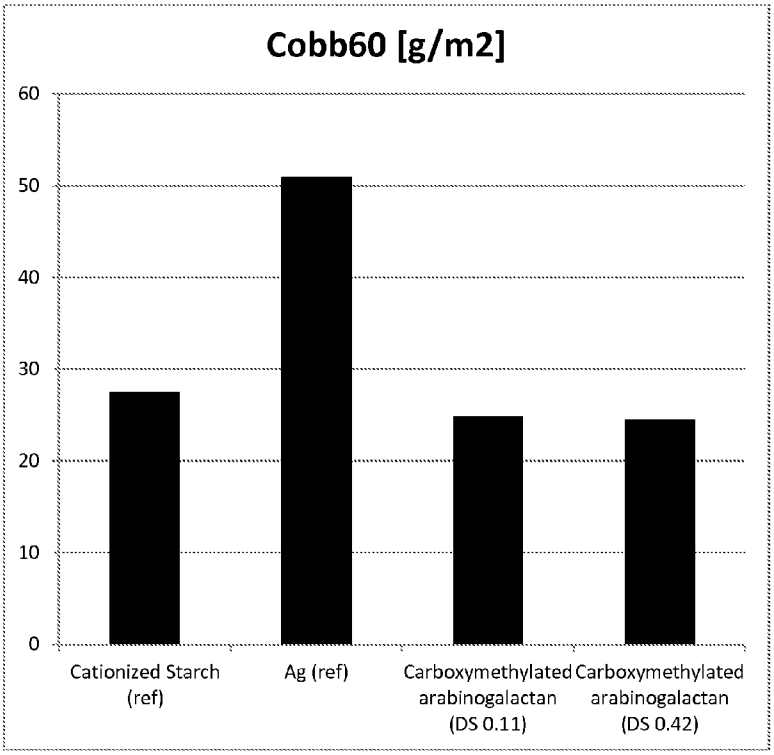


FIG. 2

[Continued on next page]

GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(57) Abstract: The present invention relates to sizing agent formulations, especially to stabilizing a sizing formulation by a modified non-food polysaccharide. The method for preparation of the modified non-food polysaccharide is further provided.

A STABILIZED SIZING FORMULATION

Field of the invention

The present invention relates to papermaking, and especially to a stabilized sizing formulation to be used in the paper manufacture and to a method for sizing paper.

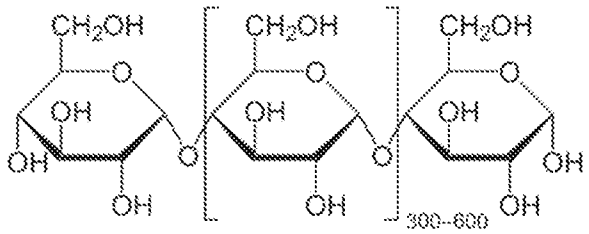
Background art

Sizing makes the native fiber network hydrophobic and thus prevents or reduces the penetration of water or other aqueous liquids into the paper. Sizing prevents the spreading and strike through of ink or printing colors. Papermaking fibers have a strong tendency to interact with water. This property is important for the development of strong interfiber hydrogen bonds, especially during drying, and is also the reason why paper loses its strength when rewetted. A high absorbency is important for certain paper grades such as toweling and tissue. Also corrugated medium paper must be able to absorb to a certain degree to convert properly in the corrugating process. On the other hand such properties are disadvantageous for many paper grades, e.g., liquid packaging, top layer of corrugated board, writing and printing papers, and most specialty papers. The water and liquid absorbency can be reduced by the addition of sizing agents to the paper stock and/or by their application to the paper surface.

Since the 1950s various forms of rosin size in the form of paste, dispersed, fortified formulations, alkyl ketene dimer (AKD) size, alkenyl succinic anhydride (ASA) size, and polymers mainly based on styrene acrylate and styrene maleinate sometimes called polymeric sizing agents (PSAs), have come onto the market. Today, beside starch for paper strength improvement and polymer binders for paper coating, sizing agents are the most important quality-improving additives in the paper manufacturing.

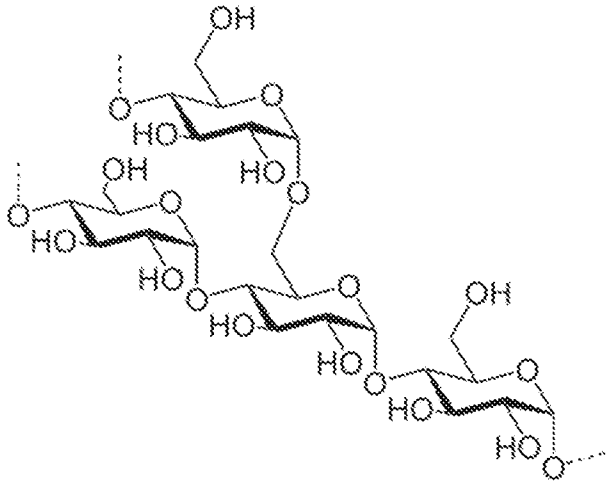
When applied in papermaking an emulsion or a dispersion of the sizing agent is prepared. Among other uses in papermaking, cationized starch is commonly used also as a stabilizing agent of the sizing agent emulsions or dispersions.

Pure starch is a white, tasteless and odorless powder that is insoluble in cold water or alcohol. It consists of two types of molecules: the linear and helical amylose:



(1)

and the branched amylopectin:

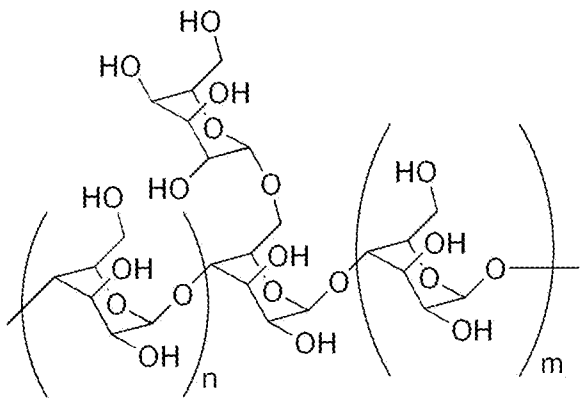


(2)

Depending on the plant origin of starch, it generally contains from 20% to 25% amylose and from 75% to 80% amylopectin by weight.

Starch plays a dominant role amongst chemical additives that are used for the manufacturing and upgrading of paper and board. Starch derivatives are mainly used for dry-strength improvement of paper and board and as binders for pigment coating, and also for wet-end addition for dry-strength improvement as well as improvement of filler and fines retention, and application in surface sizing, pigment coating, and converting adhesives.

Galactomannans are polysaccharides consisting of a mannose backbone with galactose side groups. A segment of galactomannan showing mannose backbone with a branching galactose unit on the top is illustrated below.



(3)

Non-ionic galactomannans such as guar gum have been used in emulsions of ASA sizing agent under controlled conditions. These ASA - guar gum emulsions were subjected to various treatments using a deposition rotor. Typically, the more guar gum is used in the emulsion, the more stable is the emulsion. The use of a further surfactant results in even less deposition, and a smaller average particle size of the emulsion.

In US4606773 an emulsion of alkenyl succinic anhydride (ASA) type of paper sizing agent is prepared using a cationic water-soluble polymer and a cationic starch as an emulsifiers. In the disclosed method a water-soluble polymer is used as an emulsification aid. A cationically modified polymer having a molecular weight ranging between 20.000-750.000 is used in conjunction with water-soluble cationic starch, wherein the cationic starch to polymer weight ratio is between 75:25 to 25:75.

In the application of cationized starch for ASA stabilization typically a ratio from 1:1 to 4:1 of starch to ASA is used. Furthermore, starch used is also an important source of nutrition. Therefore, to develop more sustainable solutions for the future it would be highly advantageous to develop and use sizing agents comprising non-food based chemicals as emulsifiers in papermaking.

Summary of the invention

The object of the present invention is to provide a stable sizing agent formulation for use in paper and paper product manufacture.

A further object of the present invention is to provide a sizing agent formulation the components of which are of non-food origin thus rendering the sizing agent formulation more sustainable in use.

Yet, a further object of the present invention is to provide a more efficient stabilizing agent for use in sizing formulations.

The present invention provides modified derivatives of non-food, anti-nutritional polysaccharides. The modified polysaccharides are successfully used as stabilizers in sizing formulations, especially suitable for paper and paper product manufacture according to the present invention.

Typically starch has been used as stabilizer for the sizing agents. The present invention provides an attractive more sustainable alternative for starch which alternative is of non-food origin. For technical purposes environmentally benign biopolymers should be used instead of nutritionally important starch.

One advantage in replacing starch with a non-food anti-nutritional polysaccharide is that more starch is rendered available for nutritional purposes.

Another advantage of the method and product of the present invention is that the concentration of the non-food polysaccharides required to provide the necessary stabilizing effect for the sizing formulation is remarkably lowered compared to other stabilizers thus providing an enhanced stabilization effect. Therefore, considerably less polysaccharides according to the present invention are needed compared, for example, to the amount of starch required. This may further lower the preparation cost of the sizing agent emulsions, and eventually also the cost for sizing agent formulation.

Yet, another advantage in providing the required stabilizing effect with using less stabilizing agent is that the amount of chemicals needed in subsequent processing may be decreased, as well.

When starch is used as a stabilizer it is not fully retained in the paper. Unretained material will be contained in the eluents of the papermaking process. Therefore, the use of starch will increase the organic load of the wastewater of a papermaking process. When modified non-food polysaccharides, xylan or arabinogalactan, according to the present invention are used the amount of

stabilizer needed is considerably lower lowering the organic load in the wastewaters, as well.

The present invention provides a method for preparation of modified non-food polysaccharides providing an enhanced stabilizing effect in sizing formulation.

The present invention further provides a stabilized sizing formulation and a method for preparation thereof. The use of the formulation is depicted, as well.

Brief description of the figures

Fig. 1 shows sizing results (Cobb60) of stabilized sizing formulations of the present invention comprising a sizing agent and an anionic derivative of xylan.

Fig. 2 shows sizing results (Cobb60) of stabilized sizing formulations of the present invention comprising a sizing agent and an anionic derivative of arabinogalactan.

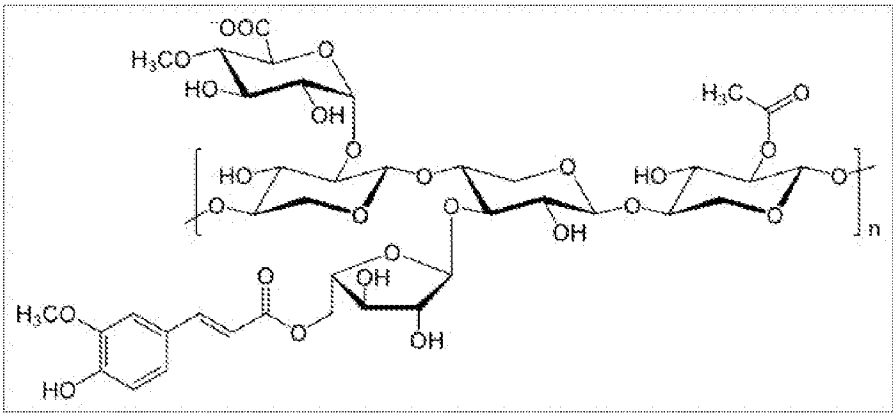
Detailed description

By non-food polysaccharides is meant polysaccharides which fail to provide a source for a nutritional diet. Unlike starch, non-food polysaccharides cannot be used for nutritional purposes.

The non-food polysaccharides include indigestible non-starch polysaccharides (NSP) consisting of long chains of repeating glucose units. However, unlike starches, the glucose units in non-starch polysaccharides are joined by beta-acetal linkage bonds. The beta-acetal linkage cannot be split by the enzymes in the digestive tract. The non-starch polysaccharides include, for example, celluloses, hemicelluloses, gums, pectins, xylans, mannans, glucans and mucilages. Typical NSPs found in wheat are arabinoxylans and cellulose. Preferably, the non-food polysaccharides of the present invention are selected from xylan, arabinogalactan or mixtures thereof.

In one embodiment the stabilized sizing formulation of the present invention comprises a sizing agent and a modified non-food polysaccharide which comprises xylan or arabinogalactan or mixtures thereof.

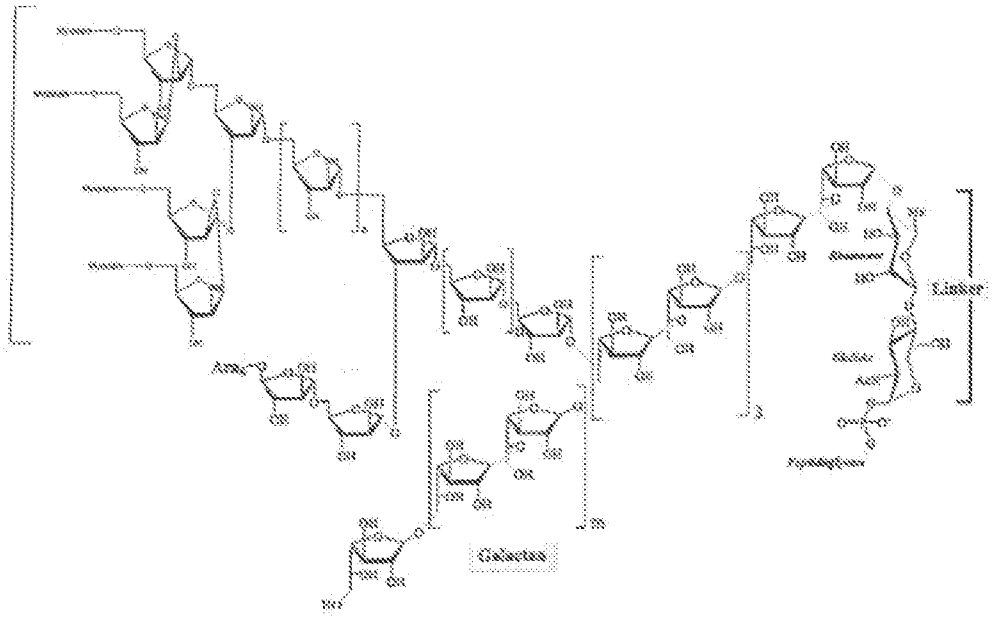
Xylan (CAS number: 9014-63-5) is one example of highly complex polysaccharides that is found in plant cell wall and in certain algae. Xylan is a polysaccharide made from units of xylose which is a pentose sugar. Xylans are almost as ubiquitous as cellulose in plant cell walls and contain predominantly β-D-xylose units linked as in cellulose. The formula of a xylan may be presented as follows:



(4)

wherein n is the number of xylose units.

Another specific example of a non-food polysaccharide is arabinogalactan. It is a biopolymer consisting of arabinose and galactose monosaccharides. Two classes of arabinogalactans are found in nature: plant arabinogalactan and microbial arabinogalactan. In plants, it is a major component of many gums, including gum arabic and gum ghatti. Both the arabinose and galactose exist solely in the furanose configuration. An example of a structure of an arabinogalactan is presented by the following formula:



(5)

An arabinogalactan from wood of the larch tree (Larix laricina) is composed of d-galactose and l-arabinose in a 6:1 molar ratio accompanied by small amounts of d-glucuronic acid. Arabinogalactans are found in a variety of plants but are more abundant in Larix occidentalis (western larch).

In one aspect of the present invention a method for preparation of a modified non-food polysaccharide is provided. The properties of non-food polysaccharides may be modified by functionalizing or derivatizing with varying chemicals. The properties of the modified polysaccharides, such as hydrophobicity and/or plasticization, may be enhanced further by modifying them with esters and/or ether groups into the hemicellulose backbone. Depending on the quality of the substituents, the degree of substitutions, type of backbone, molecular weight of the remaining backbone, solubility and thermal properties can be changed remarkably and the dispersion properties enhanced even further.

The disclosed method comprises modifying the non-food polysaccharide by functionalization using a functionalizing agent which is capable of charging the non-food polysaccharide. The non-food polysaccharides may be modified to exhibit cationic or anionic properties. There are several methods available for carrying out this charging.

The non-food polysaccharide of the present invention is charged by rendering it anionic with a suitable anionization reagent. This method for anionic charging the non-food polysaccharide comprises the steps of

i. providing a suspension of the non-food polysaccharide and an alcohol;

ii. introducing aqueous base solution to the mixture of step i., and stirring the resulting mixture at room temperature;

iii. introducing anionization reagent, such as carboxymethyl reagent, to the mixture of step ii., and stirring the resulting mixture at elevated temperature; and

iv. washing and filtering the resulting anionically charged derivative of the non-food polysaccharide before recovery.

In one embodiment of the present invention the anionic non-food polysaccharide derivative preferably contains carboxymethyl groups with a high degree of substitution. These anionically charged derivatives of non-food polysaccharides are prepared by reaction of the non-food polysaccharide preferably with monochloro acetic acid in varying reaction media. The reaction of monochloro acetic acid with the non-food polysaccharide proceeds more rapidly at higher temperatures than in room temperature.

In a preferred reaction method according to the present invention the anionically charged derivatives of non-food polysaccharides are prepared by reacting the non-food polysaccharide with a carboxymethyl reagent. The non-food polysaccharide is suspended in an alcohol, preferably ethanol. Aqueous base solution is introduced into the suspension and resulting mixture is preferably vigorously stirred at room temperature, preferably at least 1 hour. To this mixture the carboxymethyl reagent is introduced and resulting mixture is stirred at elevated temperature, preferably at least 2 hours. The resulting product is poured to excess amount of water, neutralized and purified by filtration, preferably ultrafiltration (CutOff 1000).

In one embodiment the non-food polysaccharide comprises xylan or arabinogalactan or mixtures thereof.

Preferably, the base is metal hydroxide, more preferably NaOH or KOH, even more preferably NaOH, and most preferably 50% aqueous NaOH solution. The carboxymethyl reagent is preferably monochloro acetic acid. Preferably, the elevated temperature is from 35 to 65 ºC, more preferably from 45 to 55 ºC, such as about 50 ºC.

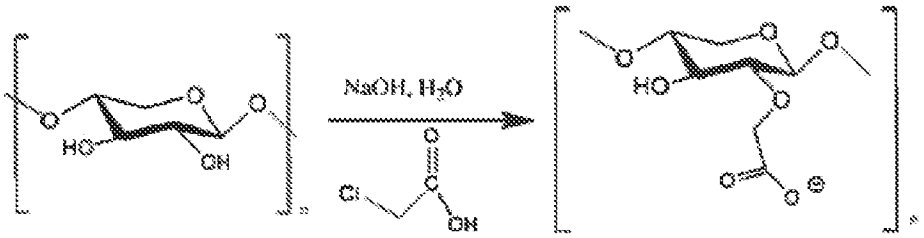
The preferred non-food polysaccharides to be anionized in the present inventtion are xylan and arabinogalactan or a mixture thereof.

The anionization reagents may be selected from commercially available reagents.

In one embodiment xylan is anionized using monochloro acetic acid as anionization reagent. Xylan is suspended into ethanol. 50% aqueous NaOH solution is added to the suspension and resulting mixture is vigorously stirred at room temperature for 1 hour. Monochloro acetic acid is added to the mixture and

stirred at 50 ºC for two 2 hours. The resulting product is poured to excess amount of water, neutralized and purified by filtration.

The reaction mechanism is the following:



In another embodiment arabinogalactan is anionized using monochloro acetic acid as anionization reagent. Arabinogalactan is suspended into ethanol. 50% aqueous NaOH solution is added to the suspension and resulting mixture is vigorously stirred at room temperature for 1 hour. Monochloro acetic acid is added to the mixture and stirred at 50 ºC for two 2 hours. The resulting product is poured to excess amount of water, neutralized and purified by filtration.

Degree of substitution (DS) of the anionically charged derivatives of non-food polysaccharides is dependent on the reagents, reagent ratios and reaction conditions. The degree of substitution may be determined by potentiometric titration know for a skilled person.

The degree of substitution of the anionically charged derivatives of non-food polysaccharides is preferably from 0.03 to 1.0. The degree of substitution in the monochloro acetic acid charged xylan is preferably from 0.03 to 0.60, and more preferably from 0.06 to 0.31, whereas for monochloro acetic acid charged arabinogalactan preferably from 0.03 to 0.60, and most preferably from 0.11 to 0.42.

In another aspect of the present invention a stabilized sizing formulation is provided comprising a sizing agent and an anionically charged non-food polysaccharide.

The sizing agent of the formulation is preferably alkyl ketene dimer (AKD), alkenyl succinic anhydride (ASA) or mixtures thereof. The amount of ASA in the formulation is from 0.5 to 5.0 weight-%, preferably from 1.0 to 3.0% by

weight, more preferably from 1.0 to 2.0% by weight, even more preferably from 1.0 to 1.50% by weight, and most preferably from 1.24 to 1.26% by weight of the formulation.

In one embodiment the stabilized sizing formulation comprises ASA or AKD, and an anionized xylan. The polysaccharide is most advantageously anionized using carboxymethyl reagent, such as monochloro acetic acid, and preferably the degree of substitution is less than 1.0, more preferably from 0.03 to 0.60, and most preferably from 0.06 to 0.31.

In another preferred embodiment the stabilized sizing formulation comprises ASA or AKD, and an anionized arabinogalactan. The polysaccharide is most advantageously anionized using carboxymethyl reagent, such as monochloro acetic acid, and preferably the degree of substitution is less than 1.0, more preferably from 0.03 to 0.60, and most preferably from 0.11 to 0.42.

The amount of charged functionalized non-food polysaccharide to the sizing agent in the stabilized sizing formulation is from 0.05:1 to 0.15:1, preferably from 0.07:1 to 0.13:1, more preferably from 0.09:1 to 0.11:1. These amounts are considerably less than the corresponding amounts of starch required and tested as reference. The amount of starch required to provide the same stabilizing effect was about 20 times more.

The stabilized sizing formulation according to the present invention is preferably in a form of a dispersion, more preferably an emulsion.

In one embodiment the amount of ASA in the sizing emulsion formulation is 1.25% by weight and the amount of xylen anionically modified with carboxymethyl reagent, preferably monochloro acetic acid, to ASA is about 0.1:1.

In another embodiment the amount of ASA in the sizing emulsion formulation is 1.25% and the amount of arabinogalactan anionically modified with carboxymethyl reagent, preferably monochloro acetic acid, to ASA is 0.1:1.

The formulation according to the present invention may further contain typically used, or readily commercially available, emulsifiers or retention aids, such as e.g. Fennopol K 3400 R.

The dosage of the sizing agent formulation according to the present invention to the pulp is preferably from 0.5 to 3 kg/t when the formulation comprises the charged non-food polysaccharide stabilizing agent.

In a further aspect of the present invention a method for preparing the stabilized sizing formulation is provided. The sizing agent and the charged non-food polysaccharide are brought into contact within an aqueous solution whereby a dispersion is formed.

In one embodiment the cationic noon-food polysaccharide is first dissolved into water or an aqueous solvent whereto the sizing agent is subsequently introduced. The mixture is then homogenized. The sizing agent is preferably mixed with an aqueous solution of the charged non-food polysaccharide to ensure efficient mixing.

Preferably, the sizing formulation is formed by homogenizing the aqueous mixture. The homogenization may be carried out in high pressure, preferably at a pressure from 140 to 160 bar.

In a yet further aspect of the present invention use of the stabilized sizing formulation as depicted above is provided for sizing paper and paper products. A preferred dosage amount of the sizing formulation into pulp furnish is from 0.5 to 3 kg/t.

The sizing efficiency of the sizing formulation may be evaluated by preparing handsheets and measuring the Cobb value of the paper product resulting from a manufacturing process utilising the sizing formulation. The Cobb60 value determines the water absorptiveness of sized paper according to ISO 535:1991(E) standard.

Using the stabilized sizing formulation according to the present invention Cobb60 values are lower to the values obtained when using starch as stabilizer. Thus, it is possible to replace starch stabilized sizing formulations with formulations comprising non-food polysaccharides without sacrificing the stabilizing ability or the quality of the final paper product.

It is further noted that the amount of charged modified non-food polysaccharide may be clearly less, possibly 1/10 or even 1/20, than the amount of starch needed, to reach equal results. The amount of the stabilizing agent in the

emulsions of sizing formulations could be significantly lower, such as 1/20 of that compared to starch as a stabilizer. This has a particular effect on the effluent water chemical load and to the post processing and recycling of the effluent.

Hereafter, the present invention is described in more detail and specifically with reference to the examples, which are not intended to limit the present invention.

Examples

Preparation of anionic xylan by carboxymethylating the xylan

Three samples with varying degree of substitution are prepared from the non-food polysaccharide, xylan.

Xylan was suspended in ethanol. 50% aqueous NaOH solution was added to the suspension and reaction mixture was vigorously stirred at room temperature for 1 hour. 80% monochloro acetic acid (MCAOH) was added to the reaction mixture, and temperature of the reaction bath was raised to 50 ºC. After 2 hours resulting product was precipitated from water, filtrated and washed with aqueous ethanol (70%) and finally washed with pure ethanol prior drying.

For specific amounts of reagents, see Table 1 for details. All the reagents are commercially available.

Preparation of anionic arabinogalactan by carboxymethylating the arabinogalactan.

Two samples with varying degree of substitution are prepared from the non-food polysaccharide, arabinogalactan.

Arabinogalactan was suspended in ethanol. 50% aqueous NaOH solution was added to the suspension and reaction mixture was vigorously stirred at room temperature for 1 hour. 80% monochloroacetic acid (MCAOH) was added to the reaction mixture, and temperature of the reaction bath was raised to 50 ºC. After 2 hours resulting product was poured to excess amount of water, neutralized and purified by ultrafiltration (CutOff 1000).

For specific amounts of reagents, see Table 1 for details. All the reagents are commercially available.

Analysis of the synthesized anionic xylans and anionic arabinogalactans

Degree of substitution (DS) of the synthesized anionic xylans and arabinogalactans was measured by potentiometric titration. Degradation temperatures ($T_{10\%}$) of the samples were also measured.

In table 1 are presented degrees of substitutions and degradation temperatures of the synthesized anionic xylans and anionic arabinogalactans.

Table 1.

Sample Code	Non-food polysaccharide (g)	MCAOH (g)	NaOH (g)	Ethanol (g)	DS (potentiometric titration)	Degradation temperature (°C)
CM_X311	Xylan (30 g)	4.5	7	120	0.12	257
CM_X411	Xylan (30 g)	3.0	5	120	0.06	255
CM_X711	Xylan (30 g)	7.5	10	120	0.31	259
CM_Ag111	Arabinogalactan (30 g)	7.5	10	120	0.42	228
CM_Ag211	Arabinogalactan (30 g)	2.0	3	120	0.11	213

Preparation of the stabilized sizing formulations

ASA emulsions are prepared using a kitchen blender with 2 min mixing, after which they are passed through a homogenizer at 150 bar pressure.

Firstly, sizing emulsion is prepared from 1.25% ASA emulsions using anionized xylan from table 1 to ASA ratio of 0.1:1 as stabilizer.

Secondly, sizing emulsion is prepared from 1.25% ASA emulsions using anionized arabinogalactan from table 1 to ASA ratio of 0.1:1 as stabilizer.

As a reference sizing emulsion is prepared also from starch (Raisamyl 50021) and 1.25% ASA emulsion using starch to ASA ratio of 2:1 as stabilizer. Further reference samples are made from 1.25% ASA emulsions using xylan and arabinogalactan without anionization in ratios of 0.1:1 as stabilizers.

Preparation of laboratory handsheets, and sizing results

Laboratory handsheets, 80 g/m^2, are prepared by introducing into 50/50 hardwood/softwood Kraft pulp furnish having a pH 8.5 the stabilized sizing formulations prepared in above example. No fillers are used in the resulting paper processing and the wet end starch amount is 5 kg/t. The stabilized size formulation dosage is 0.75 kg/t. K 3400R (200 g/t) is used as a retention aid.

The results from Cobb60 testing are depicted in figure 1 for anionic xylan stabilized sizing agent formulation, and further depicting the reference sample results for cationic starch and xylan.

The results from Cobb60 testing are depicted in figure 2 for anionic arabinogalactan stabilized sizing agent formulation further depicting the reference sample results for cationic starch and arabinogalactan.

The smaller the Cobb60 number the better the sizing, i.e. the paper product is more hydrophobic and absorbs less water.

Figure 1 shows that the paper sheets wherein anionized xylan is used are more hydrophobic than cationic starch based sizing agent.

Figure 2 shows that the paper sheets wherein anionized arabinogalactan is used are more hydrophobic than cationic starch based sizing agent.

Claims

1. A stabilized sizing formulation, **comprising** a sizing agent and an anionically charged derivative of a non-food polysaccharide which comprises xylan or arabinogalactan or a mixture thereof.

2. The formulation according to claim 1, **wherein** the sizing agent is AKD or ASA or a mixture thereof.

3. The formulation according to claim 1 or 2, **wherein** the anionically charged derivative of the non-food polysaccharide is obtained by modifying the non-food polysaccharide with carboxymethyl reagent.

4. The formulation according to claim 3, **wherein**, the carboxymethyl reagent is monochloro acetic acid.

5. The formulation according to claim 4, **wherein** degree of substitution of the anionically charged derivative of the non-food polysaccharide from 0.03 to 1.0.

6. The formulation according to any one of claims 1-5, **wherein** the non-food polysaccharide is xylan or arabinogalactan or mixtures thereof.

7. The formulation according to any one of claims 1-6, **wherein** said formulation is in a form of a dispersion, preferably an emulsion.

8. The formulation according to any one of the claims 1-7, **wherein** ratio of the anionically charged derivative of the non-food polysaccharide to the sizing agent is from 0.05:1 to 0.15:1.

9. A method for preparing the stabilized sizing formulation of claim 1, **characterized** in that the sizing agent and the anionically charged derivative of the non-food polysaccharide comprising xylan or arabinogalactan or a mixture thereof are brought into contact within a solution whereby a dispersion is formed by homogenization at a pressure from 140 to 160 bar.

10. Use of the stabilized sizing formulation according to any one of the claims 1 to 8 for sizing paper and paper products.

11. The use according to claim 10, **wherein** dosing of the stabilized sizing formulation into pulp is from 0.5 to 3 kg/t.

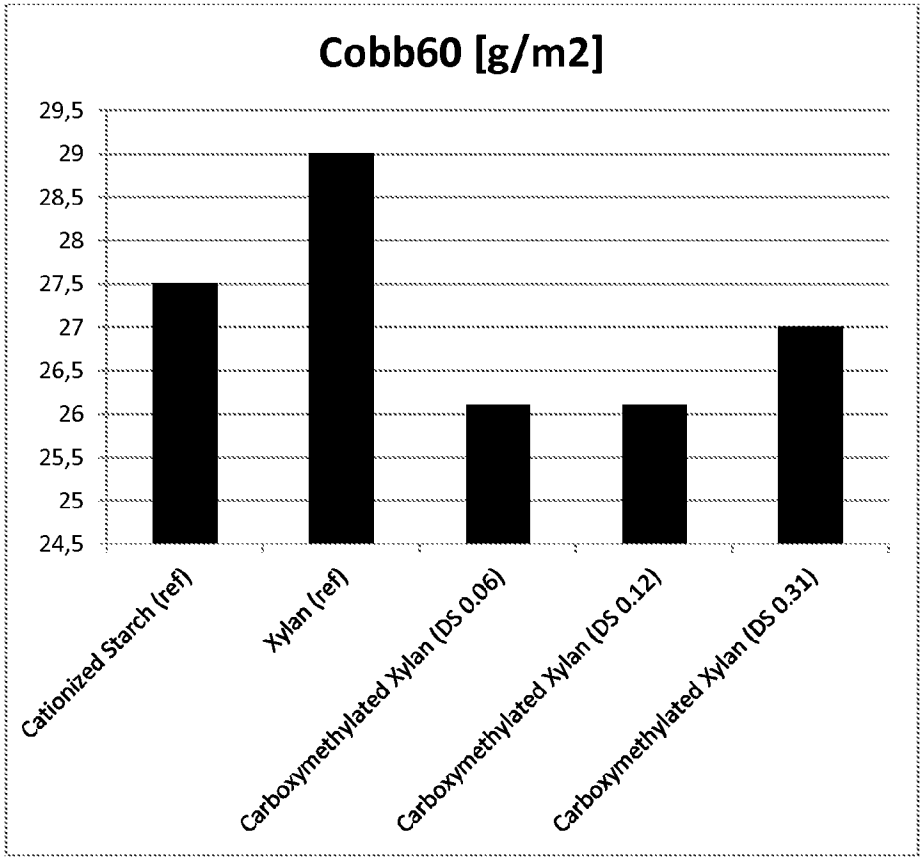
12. A method for preparation of the anionically charged derivative of the non-food polysaccharide of claim 1 comprising functionalizing the non-food polysaccharide by a reaction with a carboxymethyl reagent, **characterized** in that said method comprises the steps of

i. providing a suspension of the non-food polysaccharide comprising xylan or arabinogalactan or a mixture thereof and an alcohol;

ii. introducing aqueous base solution to the mixture of step i., and stirring the resulting mixture;

iii. introducing carboxymethyl reagent to the mixture of step ii., and stirring the resulting mixture at elevated temperature; and

iv. washing and filtering the resulting anionically charged derivative of the non-food polysaccharide before recovery.


Cobb60 [g/m2]
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25,5
25
24,5
Cationized Starch (ref)
Xylan (ref)
Carboxymethylated Xylan (DS 0.06)
Carboxymethylated Xylan (DS 0.12)
Carboxymethylated Xylan (DS 0.31)

FIG. 1

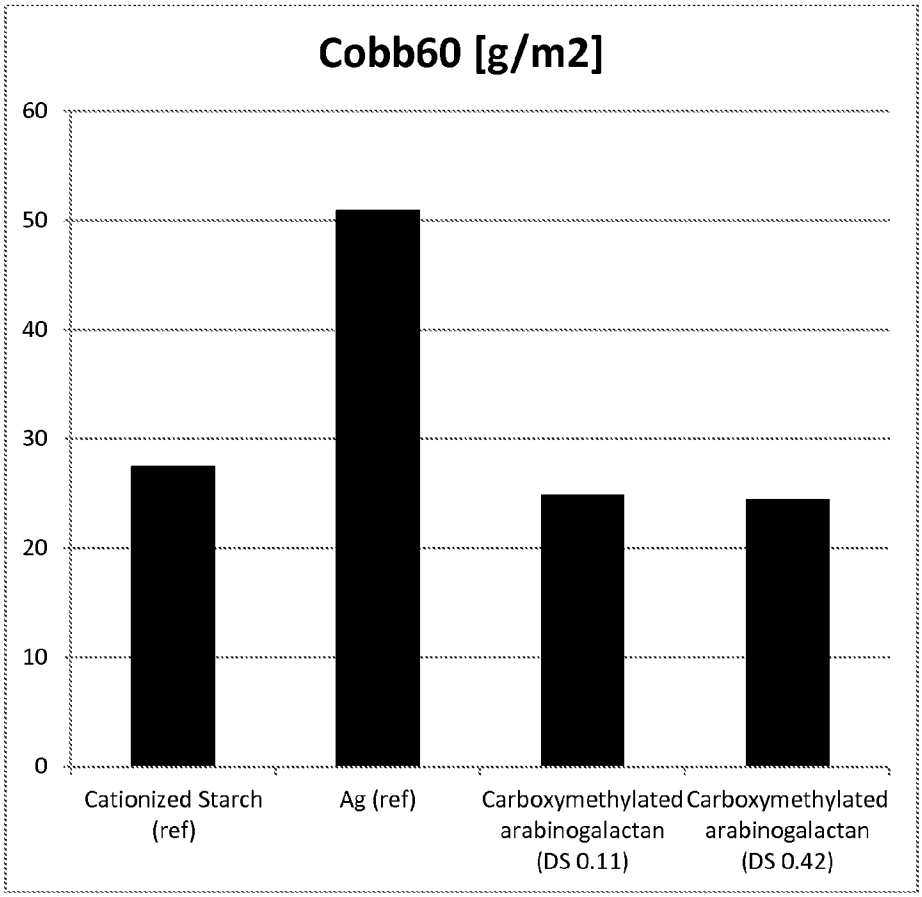
Cobb60 [g/m2]
60
50
40
30
20
10
0
Cationized Starch (ref)
Ag (ref)
Carboxymethylated arabinogalactan (DS 0.11)
Carboxymethylated arabinogalactan (DS 0.42)

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2015/050075

A. CLASSIFICATION OF SUBJECT MATTER
INV. D21H17/16 D21H17/17 D21H17/24 D21H17/31 D21H21/16
ADD.

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)
D21H

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 2009/188054 A1 (DYLLICK-BRENZINGER RAINER [DE] ET AL) 30 July 2009 (2009-07-30) the whole document	1-12
A	WO 2008/103123 A2 (XYLOPHANE AKTIEBOLAG [SE]; GROENDAHL MARIA [SE]; ERIKSSON LISA [SE]; G) 28 August 2008 (2008-08-28) the whole document	1-12
A	EP 1 314 822 A1 (AKZO NOBEL NV [NL]) 28 May 2003 (2003-05-28) the whole document	1-12

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 April 2015	27/05/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Karlsson, Lennart

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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