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(54) ANTIMICROBIAL PAPER COATING

(57) The biocidal coating of paper for printing according to this invention, containing titanium oxide nanoparticles, salts of mono-, bi- and trivalent metals, polyvinyl alcohol, starch, aliphatic polyamine and sodium aluminosilicate characterises by their proportions expressed in percentages by mass: titanium oxide 3.92% (+-40%), Salts of metals (I, II and III- valent) 14.68% (+-40%), starch with polyvinyl alcohol 68.86% (+-40%), aliphatic polyamine 6.27% (+-40%) and sodium aluminosilicate 6.27% (+-40%). The biocidal activity of this mixture does not require activation by UV rays.

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Description

[0001] The present invention relates to a biocidal coating of paper for printing.

[0002] The problem of limiting the spread of microorganisms, namely those pathogenic to a human being, has became extremely important at the end of the twentieth century as there is increase of bacteria population resistant to many antibiotics and as a result of faster and more often contacts of the human beings from remote corners of the planet. Control of microorganisms growth on a paper is of high importance as on the one hand a paper is still a base of many documents (including banknotes), and - on the other hand - material of which paper is made is a medium for many microorganisms.

[0003] One of method of microorganisms control is utilization of characteristics of nanomaterials (nanoparticles) of various compounds, most often oxides of metals (zinc oxide, titanium oxide, magnesium oxide, copper, copper oxide, cadmium selenide, cadmium telluride) or metals (silver, gold). In the state of art there are well known many solutions based mainly on nanosilver. Starch content in a paper coating mixture is often avoided or decreased to enhance effectiveness. Maintenance of printability on such paper is crucial.

[0004] In the patent literature there is Japanese description JP1996337078, from which one can learn about antibacterial coating containing, admittedly, titanium white, but silver in form complexed salts is the chief anti-microorganisms ingredient. The Japanese description mentions a high content of starch in coating mixture. The US patent application description US20150086598 reveals a solution utilizing nanoparticles of titanium oxide to achieve anti-microorganisms activity, where the oxide content must be 5 or more percentages by mass of a paper coating mixture. In the description starch is not cited.

[0005] The biocidal coating of paper for printing according to this invention, containing titanium oxide nanoparticles, salts of mono-, bi- and trivalent metals, polyvinyl alcohol, starch, aliphatic polyamine and sodium aluminosilicate characterises by that their proportions are as follows:

Ingredient	Percentage by mass of each ingredient [%]	Tolerance
Titanium oxide	3.92%	+-40%
Salts of metals (I, II and III- valent)	14.68%	+-40%
Starch + PVOH	68.86%	+-40%
Aliphatic polyamine	6.27%	+-40%
Sodium aluminosilicate	6.27%	+-40%

and biocidal activity of this mixture does not require activation by UV rays.

[0006] Unexpectedly, the paper coating containing starch and titanium white nanoparticles with other components added at proper ratio, is as good as antibacterial papers using silver salts, maintaining excellent characteristics for offset, laser or inkjet printing.

[0007] In studies on biocidal effectiveness of paper coatings basing on challenge with *Escherichia coli* the following findings of bacterial growth revealed:

- paper coated with standard adhesive layer utilized by Arctic Paper Kostrzyn - 40% (minus indicates that number of bacterial colonies grew, not reduced during the experiment - it means that it was a culture medium for them);
- paper coated with ammonium chloride +8% - reduction of *E. coli* bacterial vitality by 8%
- paper coated with a mixture NaCl+$CaCl_2$+ 22%
- paper coated with N-vinyle amine (Catiofast) +13%
- paper coated with PAX +19%
- paper coated with PVA + 5%
- paper coated with starch and 1.5-% TiO_2 +30%.

[0008] In the undermentioned embodiment of preparation of the biocidal coating of paper for printing shows only one of the possibilities, without limiting protection range: Composition of coating mixture:

Ingredient	Commercial name	Amount of dry substance in g/100g of the mixture	Percentage by mass of each ingredient [%]	Tolerance
Titanium oxide	Titanium white	0.53	3.92%	+-40%
Sodium aluminosilicate	Zeolit (Zeocros PF)	0.84	6.27%	+-40%

(continued)

Ingredient	Commercial name	Amount of dry substance in g/100g of the mixture	Percentage by mass of each ingredient [%]	Tolerance
Sodium chloride	Sól warzona [Evaporated salt]	0.18	1.31%	+-40%
Ammonium chloride	Ammonium chloride	0.18	1.31%	+-40%
Calcium chloride	Calcium chloride	1.58	11.76%	+-40%
Polyvinyl alcohol	PVOH BP-05	1.25	9.31%	+-40%
Aliphatic polyamine	Catiofast 160	0.84	6.27%	+-40%
Native and cationic starch	Merizet 120	8.00	59.55%	+-40%
Polyaluminum chloride	PAX 18	0.04	0.31%	+-40%

Biocidal activity of the coating according to the invention extends on bacteria, bacteriophages and viruses.

[0009] The coating according to the invention is applied one- to both sides on a sheet with standard technologies used by paper industry. Paper covered with the coating maintains excellent characteristics for offset laser and inkjet printing. It can be used for printing of books, prospectuses, prescription pads, labels, office printings and everywhere where there is recommended to brake infection transmission chain, that is when many persons contact with the surface of printed paper coated according to the invention. Possibility of application of the coating on surfaces contacting with food is an additional advantage. The ingredients of the coating disintegrate without contamination of environment.

[0010] Not without significance is economic factor - majority of antibacterial papers utilises nanosilver, which is more expensive than titanium white.

Claims

1. The biocidal coating of paper for printing according to this invention, containing titanium oxide nanoparticles, salts of mono-, bi- and trivalent metals, polyvinyl alcohol, starch, aliphatic polyamine and sodium aluminosilicate **characterised in that** their proportions are as follows:

Ingredient	Percentage by mass of each ingredient [%]	Tolerance
Titanium oxide	3.92%	+-40%
Salts of metals (I, II and III- valent)	14.68%	+-40%
Starch + PVOH	68.86%	+-40%
Aliphatic polyamine	6.27%	+-40%
Sodium aluminosilicate	6.27%	+-40%

and biocidal activity of this mixture does not require activation by UV rays.

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 5742

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 108 930 197 A (YIXIAN RUIWANG AGRICULTURAL TECH SERVICE CO LTD) 4 December 2018 (2018-12-04) * claims 1-9 *	1	INV. D21H19/38 D21H19/40 D21H19/54 D21H19/60
A	EP 2 871 283 A1 (ARCTIC PAPER KOSTZYN SPÓLKA AKCYJNA [PL]) 13 May 2015 (2015-05-13) * claims 1-2 *	1	D21H21/36

TECHNICAL FIELDS SEARCHED (IPC)

D21H

2 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 March 2022	Ponsaud, Philippe

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 21 20 5742

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11-03-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 108930197 A	04-12-2018	NONE	
EP 2871283 A1	13-05-2015	EP 2871283 A1	13-05-2015
		PL 228357 B1	30-03-2018
		PL 2871283 T3	28-09-2018

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 1996337078 B **[0004]**
- US 20150086598 A **[0004]**