



(51) International Patent Classification:

D21C 9/00 (2006.01) D21H 17/14 (2006.01)

D21H 21/22 (2006.01) D21H 11/18 (2006.01)

D21C 9/10 (2006.01) D21H 19/12 (2006.01)

(21) International Application Number:

PCT/EP2018/074427

(22) International Filing Date:

11 September 2018 (11.09.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1751099-1 11 September 2017 (11.09.2017) SE

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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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,

KR, KW, 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, 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))

(54) Title: PROCESS FOR TREATING PULP

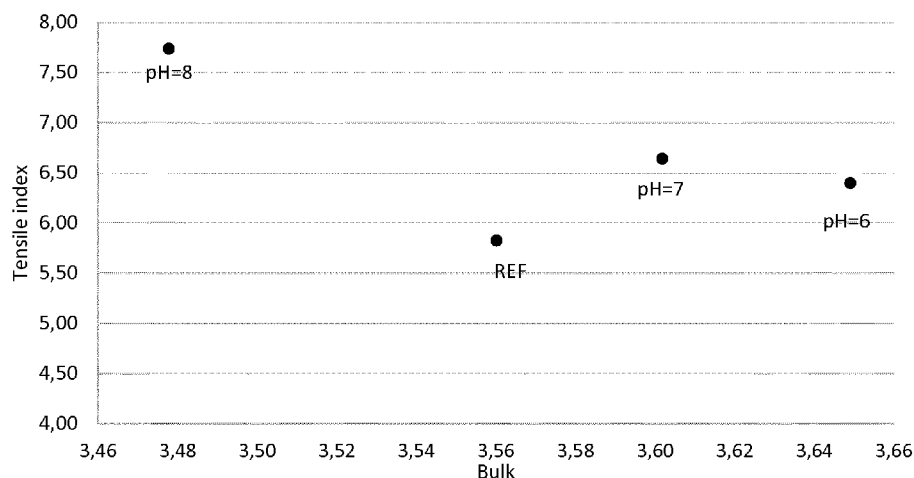


Fig 1

(57) Abstract: The present invention relates to a method of treating pulp to increase bulk, which comprises addition of distilled and/or equilibrium percarboxylic acid to a pulp obtained by converting at least 75 wt% of wood used to provide said pulp. The present invention further relates to cellulosic articles, pulp, and uses of pulp.

PROCESS FOR TREATING PULP

Field of the invention

The invention relates to a method for treating pulp, and pulps and cellulosic articles obtained therefrom.

5

Background

A purpose of bleaching of pulp is to bring to completion, after the digestion, the removal of residual lignin from the pulp. Bleaching does not only provide positive effects to the pulp but influences also in a negative
10 manner. Bleaching often provide a decrease in bulk of the pulps. This decrease in performance is known to be irreversible.

Peracetic acid (PAA) is a compound which forms when acetic acid and hydrogen peroxide react in the presence of a catalyst. There are various products commercially available, for example, 38 % distilled peracetic acid
15 (dPAA) and an equilibrium mixture of peracetic acid (ePAA), which typically contains peracetic acid approximately 20 % by weight. The equilibrium mixture of peracetic acid (ePAA) is connected to usage problems as the material has a bad odor and need to be kept refrigerated to be storage stable.

In view of the problems and decrease in properties obtained during
20 bleaching it would be desirable to find new ways to overcome such issues.

Therefore, there is a need for new ways to improve the bulk of pulps, especially if they have been subjected to a bleaching process.

Summary of the invention

25 The present invention provides a method to increase the bulk of pulp. If the bulk of the pulp is increased also the bulk of the finished paper will increase. This is done by addition of percarboxylic acid to the pulp, preferably at the last stages of the pulp preparation. By such an addition negative influences on bulk of e.g. bleaching are at least partially recovered and thus
30 provide improved overall performance.

In one aspect, the present invention relates to a method of treating pulp to increase bulk, which comprises addition of distilled and/or equilibrium percarboxylic acid to a pulp obtained by converting at least 75 wt% of wood used to provide said pulp.

5 In one embodiment the distilled and/or equilibrium percarboxylic acid is added to said pulp during and/or after bleaching of said pulp.

 In one embodiment the distilled and/or equilibrium percarboxylic acid is added at least one point selected from the group during the last and/or second to last stages of bleaching, after bleaching, before storage, during
10 storage, during disintegration of pulp, after disintegration of pulp, and before the pulp is introduced into the papermaking process.

 In one embodiment the distilled and/or equilibrium percarboxylic acid is distilled and/or equilibrium performic acid (dPFA, ePFA), distilled and/or equilibrium peracetic acid (dPAA, ePAA), distilled and/or equilibrium
15 perpropionic acid (dPPA, ePPA), or any combination thereof; preferably distilled and/or equilibrium peracetic acid (dPAA, ePAA), preferably distilled peracetic acid (dPAA).

 In one embodiment the pulp is wood pulp; preferably mechanical pulp; preferably CTMP pulp.

20 In one embodiment the distilled and/or equilibrium percarboxylic acid, as 100% distilled and/or equilibrium percarboxylic acid, is provided in an amount of from 2 kg to 10 kg per ton of pulp (as dry pulp), preferably from 2.5 kg to 9 kg per ton of pulp (as dry pulp), preferably from 3 kg to 9 kg per ton of pulp (as dry pulp), preferably from 4 kg to 8 kg per ton of pulp (as dry pulp),
25 preferably from 5 kg to 7 kg per ton of pulp (as dry pulp).

 In one embodiment the consistency of the pulp is from 2 % to 30 %, preferably from 5 % to 15 %.

 In one embodiment the pulp is treated at a temperature from 25 °C to 95 °C, preferably from 40 °C to 80 °C.

30 In one embodiment the treatment time is 30 sec to 120 h, preferably from 5 min to 24 h, preferably from 15 min to 15 h, preferably from 20 minutes to 6 h, preferably from 30 min to 2 h.

In one embodiment the brightness of the pulp before the treatment is at least 75 % ISO, preferably from 85 % to 95 % ISO.

In one embodiment the pH value of the pulp before the treatment is from 3 to 9, preferably from 5 to 7.

5 In one embodiment the method further comprises adding chemical pulp, optionally treated with distilled and/or equilibrium percarboxylic acid, to said pulp.

In one aspect the present invention relates to a pulp obtainable by the present method.

10 In one aspect the present invention relates to a cellulosic article comprising pulp obtainable by the present method.

In one aspect the present invention relates to use of a pulp obtainable by the present method, to provide a cellulosic article, preferably said cellulosic article is selected from the group paper, paperboard, and cartonboard.

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Short description of the drawing

Figure 1 is a graph showing the effect of pH on the present method.

Figure 2 is a graph showing the effect of addition amount of percarboxylic acid on the present method.

20

Detailed description

According to the present invention there is provided a process for treating pulp. More particularly there is provided a process for treating pulp wherein the pulp is treated with distilled and/or equilibrium percarboxylic acid.

25 The distilled version and/or equilibrium of percarboxylic acid has been found to perform better compared to standard percarboxylic acid in the present method. The distilled percarboxylic acid is especially preferred.

The distilled and/or equilibrium percarboxylic acid may be added to said pulp during and/or after bleaching of said pulp. Examples of suitable
30 addition points for the distilled and/or equilibrium percarboxylic acid in production of the present pulp are disclosed in the following. The acid may be added during the bleaching, e.g. before and/or during the last and/or second to last stages of the pulp bleaching. The acid may be added after bleaching,

such as before and/or during storage. Sometimes the papermaking process is not directly connected to the pulpmaking process. In such cases, dry or semi-dry pulp may be transported between the different facilities. Thus, the acid may be added during and/or after disintegration of pulp, e.g. dried pulp, as a
5 sort of wet disintegration step. The acid may be added before the pulp is introduced into the papermaking process. For example, the acid may be added at the stock preparation stage, at the latest. Any combination of the points of addition mentioned herein may be used alone or in any combination.

The percarboxylic acid may be added to pulp in storage or pulp being
10 forwarded to storage if the pulp is in wet form, which then may be forwarded to a papermaking process. Alternatively, percarboxylic acid may be added to pulp during the bleaching step. In such cases, said acid is added between different stages within a final bleaching step of the pulp manufacturing, such as before or during the final stage of the bleaching or the second to last stage
15 of the bleaching. The percarboxylic acid may be added to pulp being forwarded to a dewatering step after the bleaching step. Another alternative is that the percarboxylic acid may be added to dewatered pulp which e.g. may be forwarded to a drying step. If dry bales of wood pulp have been prepared, the percarboxylic acid may be added when the pulp is being
20 disintegrated before being forwarded to a papermaking machine, or it may be added to disintegrated pulp which is forwarded to a papermaking machine. Disintegration of pulp is done by action of mechanical interaction and addition of water. The acid may be added in the machine chest before the headbox of a paper making machine. In view of addition of percarboxylic acid to pulp
25 being disintegrated the acid may be added into a hydropulper which is disintegrating the pulp to provide a slurry.

The distilled and/or equilibrium percarboxylic acid may be any suitable distilled and/or equilibrium percarboxylic acid. In one embodiment the distilled and/or equilibrium percarboxylic acid is selected from the group distilled
30 and/or equilibrium performic acid (dPFA, ePFA), distilled and/or equilibrium peracetic acid (dPAA, ePAA), and distilled and/or equilibrium perpropionic acid (dPPA, ePPA), and any combination thereof. For example, the distilled

percarboxylic acid may be distilled and/or equilibrium peracetic acid (dPAA, ePPA), whereof the first mentioned is most preferred.

Distilled and/or equilibrium percarboxylic acids are commercially available. Distilled and/or equilibrium percarboxylic acids may also be
5 manufactured with any suitable method in the art. As an example, process for producing dPAA is disclosed in publication US 2002/0193626 A1.

Distilled peracetic acid is obtained from the equilibrium solution of peracetic acid and hydrogen peroxide and acetic acid. An advantage of the distilled pearacetic acid is the absence of acetic acid and hydrogen peroxide.
10 The absence of acetic acid is a certain advantage due to lower content of volatile organic compounds introduced into the process.

The amount of the distilled and/or equilibrium percarboxylic acid depends, for example on the grade of the distilled and/or equilibrium percarboxylic acid. In one embodiment the amount of the distilled and/or
15 equilibrium percarboxylic acid, calculated as 100% distilled and/or equilibrium percarboxylic acid, provided is in an amount of from 2 kg to 10 kg per ton of pulp (as dry pulp), such as from 2.5 - 9 kg per ton of pulp (as dry pulp), 3 - 9 kg per ton of pulp (as dry pulp), 4 - 8 kg per ton of pulp (as dry pulp), 5 - 7 kg per ton of pulp (as dry pulp), 5.5 - 10 kg per ton of pulp (as dry pulp), 5.5 - 8
20 kg per ton of pulp (as dry pulp), 5.5 - 7 kg per ton of pulp (as dry pulp), 5 - 7 kg per ton of pulp (as dry pulp), 5.5 - 6.5 kg per ton of pulp (as dry pulp), or 5.8 - 6.2 kg per ton of pulp (as dry pulp).

The pulp to be treated may be any suitable pulp. In one embodiment the pulp is wood pulp. The pulp may be ground wood pulp. For example, the
25 pulp may be a high yield pulp. By high yield pulp it is herein meant pulp obtained which has converted at least 75 wt%, such as at least 80 wt%, of the wood used to said pulp. Thus, a high conversion of the wood used into pulp provides a high yield pulp. Mechanical pulps are preferred high yield pulps according to the present process.

30 High yield pulps and mechanical pulps include also chemithermomechanical pulp (CTMP) and preferably CTMP pulp is used according to one embodiment of the present invention.

Mechanical pulp can be combined with chemical pulp (treated or untreated with distilled and/or equilibrium percarboxylic acid) e.g. at the paper machine. Even chemical pulp can be treated at the paper machine.

Chemical pulps are considered low yield pulps. A low yield pulp is
5 herein meant pulp obtained which has converted about 40-55 wt%, such as about 45-50 wt%, of the wood used to said pulp. Thus, a low conversion of the wood used into pulp provides a low yield pulp. Chemical pulp may be treated with distilled and/or equilibrium percarboxylic acid before the papermaking process, such as in the stock preparation, or during disintegration of pulp.
10 In one embodiment consistency of the pulp is from 2 % to 30 %, e.g. 5-15 %.

The pulp may be treated at any suitable temperature. The pulp is preferably treated at a temperature from 25 °C to 95 °C, such as from 40 °C to 80 °C.

15 The treatment time may be any suitable time. The pulp is preferably treated for a time period of about from 30 sec to 120 h, e.g. from 5 min to 24 h, from 15 min to 15 h, from 20 minutes to 6 h, or from 30 min to 2 h.

The pH value of the pulp before the treatment may be adjusted by any known method if needed. Preferably pH value of the pulp before the treatment
20 is from 3 to 9, such as from 5 to 7.

With the present invention there is provided a pulp with good performances.

The present invention further enables provision of cellulosic articles comprising pulp obtainable by the present method.

25 The pulp obtainable by the present method may be used to provide a cellulosic article, such as paper, e.g. tissue paper, fine paper, newspaper, printing and writing paper; paperboard; or carton board.

Examples

30 Example 1:

A treatment of pulp was conducted at 10% consistency and at 80 °C. The pulp was mechanical pulp. One pulp had a freeness of unbleached pulp of 715 ml (disintegrated at 20°C), the other pulp had a freeness of

unbleached pulp of 675 ml (disintegrated at 85°C) according to ISO standard 5263. Both the reference samples 1 & 2 and samples according to the present invention 1 & 2 were bleached using peroxide. The dosage of distilled peracetic acid (from Kemira) was 6 kg (as 100% dPAA) per ton of pulp (dry pulp). The used dPAA was fresh. The treatment was preformed for 30 min. Samples were taken on pulp being treated with dPAA and reference samples without such treatment.

The obtained bulk measurements are provided in Table 1.

Table 1.

	Pulp 1 (freeness 715)		Pulp 2 (freeness 675)	
	Reference 1	Sample 1 6 kg dPAA/ton	Reference 2	Sample 2 6 kg dPAA/ton
Bulk m ³ /ton	4.32	4.40	4.23	4.44

Table 1 discloses an increase of the bulk of about 2-5 % when dPAA has been used as a pulp treatment.

Example 2:

A treatment of pulp was conducted at 10% consistency and at 60 °C. The pulp was mechanical pulp. One pulp had a freeness of unbleached pulp of 715 ml (disintegrated at 20°C), the other pulp had a freeness of unbleached pulp of 675 ml (disintegrated at 85°C) according to ISO standard 5263. Both the reference sample and samples according to the present invention were bleached using peroxide (3 kg). The dosage of distilled peracetic acid (from Kemira) was 1 and 3 kg (as 100% dPAA) per ton of pulp (dry pulp). The used dPAA was fresh. The effect of pH was also tested. Start pH values of 6, 7 and 8 were provided. The treatments were performed for 60 min. Samples were taken on pulp being treated with dPAA and reference sample without such treatments.

The obtained measurements are provided in Figure 1 and 2.

Figure 1 discloses the results of different initial pH values. 3 kg dPAA was used as treatment of the CTMP. The treatment was performed on never dried CTMP pulp. The reference without the dPAA had a pH of 6. From the graph it is clearly shown that at this addition amount of dPAA pH 7 and 6 provides both an increase in tensile index (N/mg) and bulk (m^3/ton).

Figure 2 discloses results of different acid addition amounts. 1 kg and 3 kg dPAA, respectively, was used as treatment of the CTMP. The treatment was performed on never dried CTMP pulp. All samples including the reference without the dPAA had a pH of 6. From the graph it is clearly shown that at an addition amount of 1 kg dPAA provides an increase in bulk, i.e. bulk density (kg/m^3), compared to the reference. This an improvement during production. If the addition amount is increased further both an increase in tensile index (N/mg) and bulk (m^3/ton), is obtained. Thus, providing even better performance.

The bulk values disclosed herein relates to bulk of paper, and is within the industry referred to as bulk. The bulk values of the finished paper have been influenced by the pulp used to prepare the paper.

In normal pulp, tensile strength and bulk are dependent but contrary. This means that an increase in bulk usually means a decrease in tensile strength. It is to be noted that both properties are very important within the pulp and paper industry, e.g. for board producers. It would be very desirable to avoid a decrease of any of these properties for producers. To give an example, a 5 % increase in bulk and at the same time maintaining the tensile strength on the same level would be a very important improvement because it means that the board producer can make huge savings. They may save 5% of fibers which today correspond to 25-35 €/ton of board, and board machines are big and processes about 3-500 000 tons/year. So small changes in bulk with unchanged tensile contributes to an improved economy of the manufacturing.

CLAIMS

1. A method of treating pulp to increase bulk, which comprises addition of distilled and/or equilibrium percarboxylic acid to a pulp obtained by converting
5 at least 75 wt% of wood used to provide said pulp.
2. The method according to claim 1, wherein the distilled and/or equilibrium percarboxylic acid is added to said pulp during and/or after bleaching of said pulp.
10
3. The method according to claim 2, wherein the distilled and/or equilibrium percarboxylic acid is added at least one point selected from the group during the last and/or second to last stages of bleaching, after bleaching, before storage, during storage, during disintegration of pulp, after disintegration of
15 pulp, and before the pulp is introduced into the papermaking process.
4. The method according to any one of claims 1-3, wherein the distilled and/or equilibrium percarboxylic acid is distilled and/or equilibrium performic acid (dPFA, ePFA), distilled and/or equilibrium peracetic acid (dPAA, ePAA),
20 distilled and/or equilibrium perpropionic acid (dPPA, ePPA), or any combination thereof; preferably distilled and/or equilibrium peracetic acid (dPAA, ePAA), preferably distilled peracetic acid (dPAA).
5. The method according to any one of claims 1-4, wherein the pulp is
25 mechanical pulp, preferably CTMP pulp.
6. The method according to any one of claims 1-5, wherein the distilled and/or equilibrium percarboxylic acid, as 100% distilled and/or equilibrium percarboxylic acid, is provided in an amount of from 2 kg to 10 kg per ton of
30 pulp (as dry pulp), preferably from 2.5 kg to 9 kg per ton of pulp (as dry pulp), preferably from 3 kg to 9 kg per ton of pulp (as dry pulp), preferably from 4 kg to 8 kg per ton of pulp (as dry pulp), preferably from 5 kg to 7 kg per ton of

pulp (as dry pulp), preferably 5.5 kg to 7 kg per ton of pulp (as dry pulp), preferably 5.5 kg to 6.5 kg per ton of pulp (as dry pulp).

7. The method according to any one of claims 1-6, wherein the consistency of
5 the pulp is from 2 % to 30 %, preferably from 5 % to 15 %.

8. The method according to any one of claims 1-7, wherein the pulp is treated at a temperature from 25 °C to 95 °C, preferably from 40 °C to 80 °C.

10 9. The method according to any one of claims 1-8, wherein the treatment time is 30 sec to 120 h, preferably from 5 min to 24 h, preferably from 15 min to 15 h, preferably from 20 minutes to 6 h, preferably from 30 min to 2 h.

10. The method according to any one of claims 1-9, wherein the brightness of
15 the pulp before the treatment is at least 75 % ISO, preferably from 85 % to 95 % ISO.

11. The method according to any one of claims 1-10, wherein the pH value of the pulp before the treatment is from 3 to 9, preferably from 5 to 7.

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12. The method according to any one of claims 1-11, further comprising adding chemical pulp, optionally treated with distilled and/or equilibrium percarboxylic acid, to said pulp.

25 13. A pulp obtainable by the method according to any one of claims 1-12.

14. A cellulosic article comprising pulp obtainable by the method according to any one of claims 1-12.

30 15. Use of a pulp obtainable by the method according to any one of claims 1-12, to provide a cellulosic article, preferably said cellulosic article is selected from the group paper, paperboard, and cartonboard.

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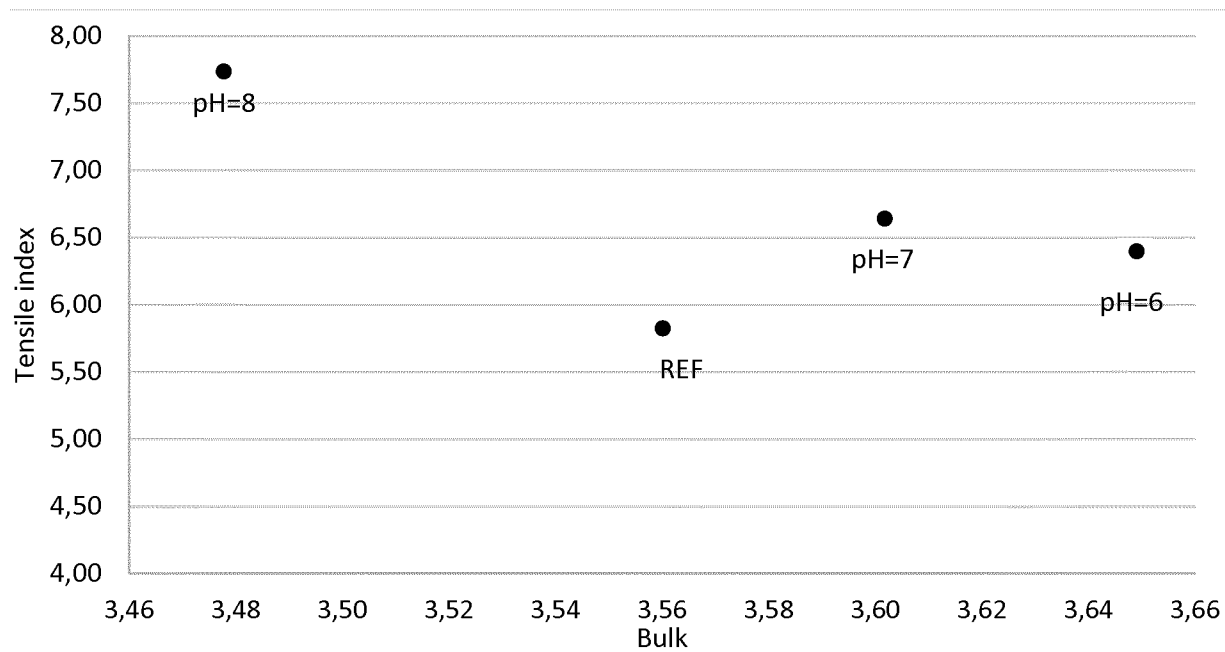


Fig 1

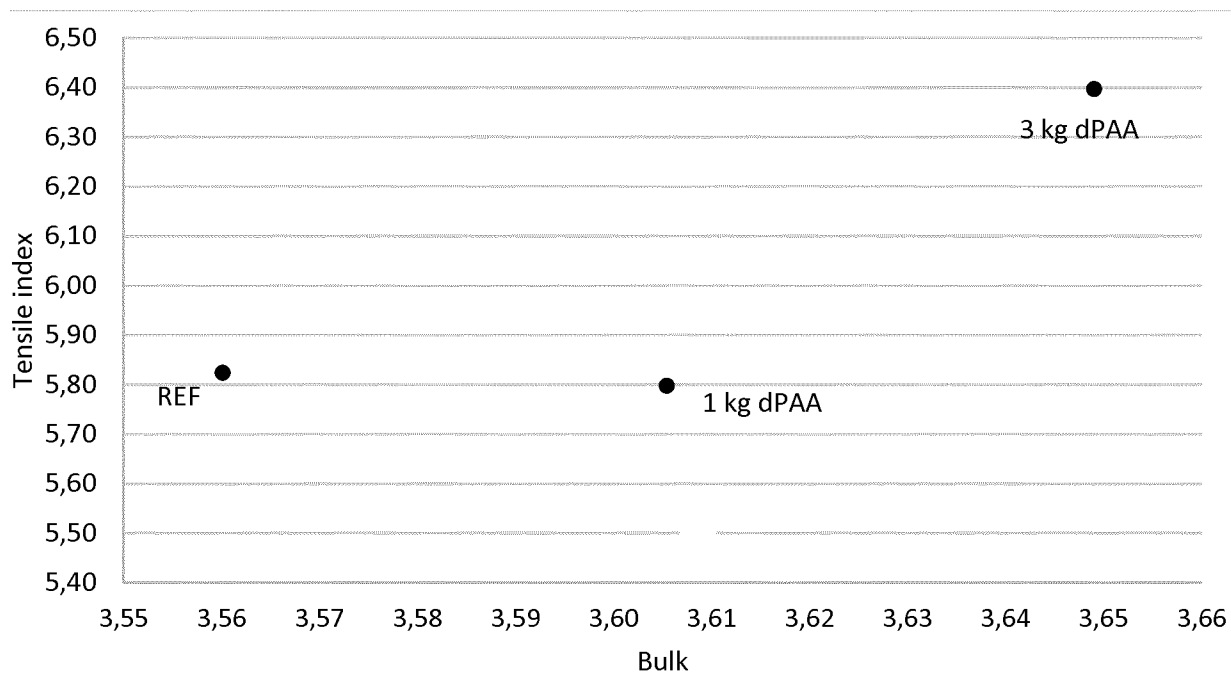


Fig 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/074427

A. CLASSIFICATION OF SUBJECT MATTER INV. D21C9/00 D21H21/22 D21C9/10 D21H17/14 D21H11/18 D21H19/12 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) D21C 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 <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">Category*</th> <th style="width: 70%;">Citation of document, with indication, where appropriate, of the relevant passages</th> <th style="width: 20%;">Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>WO 00/77301 A1 (KEMIRA CHEMICALS OY [FI]; JAEKAERAE JUKKA [FI]; PAREN AARTO [FI]) 21 December 2000 (2000-12-21) claims 1-10 -----</td> <td style="text-align: center; vertical-align: top;">1-15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>US 2003/150574 A1 (PAREN AARTO [FI] ET AL) 14 August 2003 (2003-08-14) claims 1-11; examples 1,2 -----</td> <td style="text-align: center; vertical-align: top;">1-15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>WO 2005/064074 A2 (KEMIRA OYJ [FI]; KOTONEN PETTERI [FI]; VAEKIPARTA TONI [FI]; JAEKAERAE) 14 July 2005 (2005-07-14) claims 1-19; example 5 -----</td> <td style="text-align: center; vertical-align: top;">1-15</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">X</td> <td>WO 98/23811 A1 (KESKUSLABORATORIO [FI]; FUHRMANN AGNETA [FI]) 4 June 1998 (1998-06-04) claims 1-32 ----- -/-</td> <td style="text-align: center; vertical-align: top;">1-15</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	WO 00/77301 A1 (KEMIRA CHEMICALS OY [FI]; JAEKAERAE JUKKA [FI]; PAREN AARTO [FI]) 21 December 2000 (2000-12-21) claims 1-10 -----	1-15	X	US 2003/150574 A1 (PAREN AARTO [FI] ET AL) 14 August 2003 (2003-08-14) claims 1-11; examples 1,2 -----	1-15	X	WO 2005/064074 A2 (KEMIRA OYJ [FI]; KOTONEN PETTERI [FI]; VAEKIPARTA TONI [FI]; JAEKAERAE) 14 July 2005 (2005-07-14) claims 1-19; example 5 -----	1-15	X	WO 98/23811 A1 (KESKUSLABORATORIO [FI]; FUHRMANN AGNETA [FI]) 4 June 1998 (1998-06-04) claims 1-32 ----- -/-	1-15
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X	WO 2005/064074 A2 (KEMIRA OYJ [FI]; KOTONEN PETTERI [FI]; VAEKIPARTA TONI [FI]; JAEKAERAE) 14 July 2005 (2005-07-14) claims 1-19; example 5 -----	1-15															
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Date of the actual completion of the international search 22 October 2018		Date of mailing of the international search report 04/12/2018															
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Karlsson, Lennart															

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2018/074427

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