(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 811 068 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.12.2014 Bulletin 2014/50

(21) Application number: **13170730.9**

(22) Date of filing: **06.06.2013**

(51) Int Cl.:
D21H 23/48 *(2006.01)* ***B05C 5/00*** *(2006.01)*
D21H 19/00 *(2006.01)* ***D21H 21/16*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Valmet Technologies, Inc.**
02150 Espoo (FI)

(72) Inventor: **Nurmiainen, Timo**
FI-04430 Järvenpää (FI)

(74) Representative: **Berggren Oy Ab**
P.O. Box 16
Antinkatu 3 C
00101 Helsinki (FI)

(54) Method and arrangement for degassing treatment substance of a fiber web

(57) The invention relates to a method for degassing a treatment substance of a fiber web, in which method the treatment substance is degassed in a degassing unit (15). Temperature of the treatment substance is adjusted to temperature below 35 °C by cooling the treatment substance in a temperature control unit (12) before degassing of the treatment substance in the degassing unit (15). The invention also relates to an arrangement for degassing treatment substance of a fiber web, which arrangement comprises a degassing unit (15). The arrangement comprises a temperature control unit (12) before the degassing unit (15) for adjusting temperature of the treatment substance is to temperature below 35 °C before degassing.

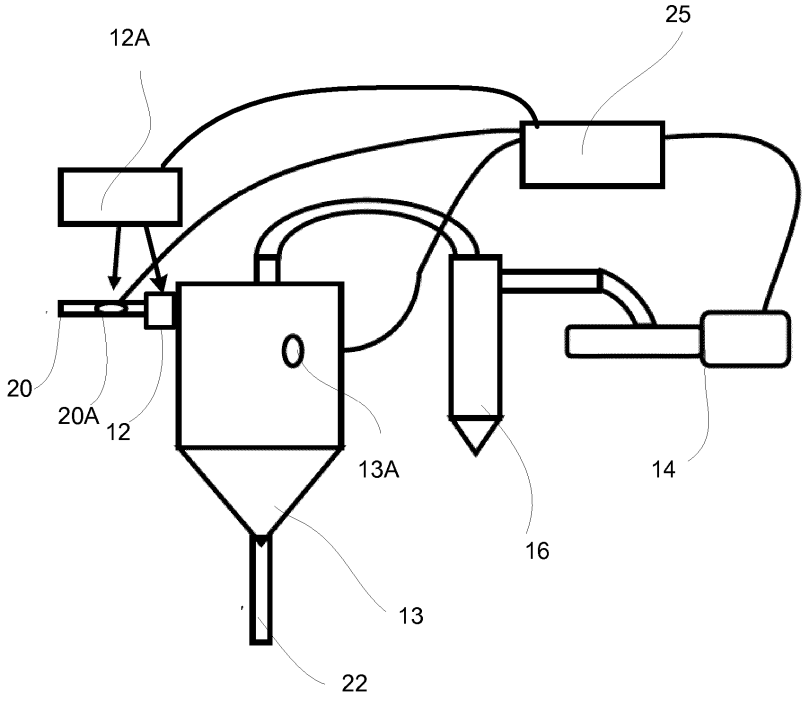

Fig. 2

EP 2 811 068 A1

Description

[0001] The invention relates to a method and to an arrangement for degassing treatment substance, especially for degassing a coating color or a sizing agent, of a fiber web. More especially the invention relates to a method according to the preamble of claim 1 and to an arrangement according to the preamble of claim 8.

[0002] As known from the prior art in fiber web producing processes typically comprise an assembly formed by a number of apparatuses arranged consecutively in the process line. A typical production and treatment line comprises a head box, a wire section and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and sections for finishing the fiber web, for example, a sizer, a calender, a coating section. The production and treatment line also comprises at least one winder for forming customer rolls as well as a roll packaging apparatus. In this description and the following claims by fiber webs are meant for example paper and board webs.

[0003] In production of fiber webs, for example of paper or board webs, treatment substances are added onto the fiber web. Sizing is used to alter the properties of a fiber web by adding sizing agents (sizing medium), for example glue chemicals onto the surface of the fiber web at the fiber web machine. In coating onto surface of a fiber web, is added a layer or layers of coating color (coating medium) at a coating station followed by drying.

[0004] The coating or the sizing of a fiber web typically utilizes a coating device - a coater - or a sizing device - a sizer. In connection with the coaters and sizers different kinds of application technology for application of the coating medium or the sizing medium on the fiber web are employed, for example curtain technology or blade coating technology or film transfer technology or rod coating technology or air brush coating technology or spray coating technology.

[0005] In the process industry, the mixing of gases, such as air, with the liquids and compounds used in the process typically causes many problems. Particularly in the coating or sizing of fiber web material, the gas and gas bubbles in the treatment substance cause unevenness on the surface of the web. Depending on the treatment substance the seriousness of the problems varies for example due to their different tendency to bind with gases. In addition, the significance of the problem depends also on the coating or sizing technology used.

[0006] It is known from prior art to degas treatment substance by vacuum de-aerators comprising a rotating drum arranged inside a vacuum tank, inside which the treatment substance is conducted, whereupon due to the centrifugal force, the coating material rises up the inner wall of the drum and discharges from the drum as a thin film colliding with the wall of the vacuum tank. One problem with prior art vacuum de-aerators is their insufificient de-aeration efficiency, especially with high-viscosity treatment substances. In WO publication 2006/128963 is disclosed a method and an arrangement to provide an improvement for vacuum-operated degassing of coating material. In the method the coating substance is arranged to rise stepwise up the wall of the drum, so that the coating substance will form a thin veil-like film on at least two different step levels, whereupon the gas bubbles in the coating substance will break and discharge. In the apparatus the inner surface of the drum is designed to be stepped, comprising at least two step levels so that the coating substance rising upwards due to the effect of the rotating motion will form a thin veil-like film on the said at least two step levels, respectively.

[0007] In EP publication 0517223 A1 is disclosed manufacturing of a coated paper to be used for a usual printing and using a curtain type coating method, in which is enabled by de-aerating a coating substance having a high concentration and a high viscosity is de-aerated under a degree of vacuum of a saturated vapor pressure or less and under a condition of applying shear to the coating substance, which is formed as a free-falling curtain in a vertical direction and a printing base paper is coated with the de-aerated coating liquid so that the free-falling curtain of the coating substance collides with the coating base paper running continuously in a direction crossing the free-falling curtain.

[0008] In DE 102005017952 is disclosed a method for degassing a coating substance, which substance is passed through a vacuum degassing unit at a temperature close to its boiling point and especially 40-60 °C under a pressure of 20-100 mbar for degassing the treatment substance in temperatures near boiling temperature. Heat is supplied by a heat exchanger or heated walls of the vacuum degasser. One disadvantage of this known method is that heating of the coating substance increases solubility of gases into the substance liquid and increases amount of steam that must be removed by the vacuum degassing unit from the system and therefore more powerful and bigger unit is needed and the energy consumption is increased.

[0009] In some cases heating of the treatment substance might, for example due to chemical reactions initiated by the heat or due to non-tolerance of heat of some components of the treatment substance, deteriorate properties required from treatment substance. For example thermal coatings will lose brightness already at temperatures 50 °C and some latex coatings will suffer instability in temperatures over 45°C in longer run.

[0010] The heating of the treatment substance, which typically is already in rather, even too high temperatures, for example 40 - 50 °C, when passed to the degassing, creates more steam into the substance. In degassing the gases and the steam is typically removed by a suction pump of the degassing unit from the treatment substance, which might in some cases be problematic since some suction pump types, for example dry screw vacuum pumps, which are operable in vacuums over 22 mbar, and liquid ring vacuum pumps, which are operable in

vacuums over 35 mbar, do not function well when steam is present.

[0011] An object of the invention is to create a method and an arrangement for degassing treatment substance of a fiber web in which the above problems and disadvantages are eliminated or at least minimized.

[0012] Another object of the invention is to provide a method and an arrangement for degassing treatment substance of a fiber web in which high temperatures of the treatment substance are avoided.

[0013] A particular object is to prevent harmful chemical reactions in treatment substance during degassing.

[0014] A further particular object is to provide a method and an arrangement for degassing treatment substance of a fiber web in which the temperature of the treatment substance is controlled during degassing.

[0015] A further particular object is to provide a method and an arrangement for degassing treatment substance of a fiber web in which the suction pump type of the degassing unit choice is not limited by steam tolerance.

[0016] In order to achieve the above objects the method for degassing treatment substance of a fiber web according to the invention is mainly characterized by the features of claim 1 and the arrangement for degassing treatment substance of a fiber web according to the invention is mainly characterized by the features of claim 8.

[0017] According to the invention in the method for degassing a treatment substance, in particular a coating color or a sizing agent, of a fiber web the treatment substance is degassed in a degassing unit and temperature of the treatment substance is adjusted to temperature below 35 °C by cooling the treatment substance in a temperature control unit before degassing of the treatment substance in the degassing unit. According to the invention the arrangement for degassing treatment substance of a fiber web comprises a degassing unit and a temperature control unit, advantageously a cooler or a heat exchanger, before the degassing unit for adjusting temperature of the treatment substance to temperature below 35 °C before degassing.

[0018] According to an advantageous aspect of the invention temperature changes of the treatment substance are evened out in the temperature control unit before degassing of the treatment substance in the degassing unit.

[0019] According to an advantageous feature in the method the temperature control unit maintains the temperature changes of the treatments substance slow, for example about 1°C/15 min.

[0020] According to an advantageous feature in the method when the treatment substance is cooled in the temperature control unit, steam in the gas of the treatment substance is condensed and vacuum is created, since the steam volume decreases due to cooling and condensing of the steam.

[0021] According to an advantageous feature the treatment substance is cooled to temperatures 20-30 °C before degassing.

[0022] According to an advantageous aspect of the invention the temperature of the treatment substance, in particular the temperature of a coating or a sizing substance, is controlled before degassing the substance in the degassing unit by cooling the substance by a cooler, for example by a heat exchanger. The cooler advantageously maintains the temperature changes of the treatments substance as slow as possible by which best environment and best conditions for degassing and for functions of the degassing unit and the vacuum system are provided. Thus improved degassing effect is achieved.

[0023] According to an advantageous aspect of the arrangement according to the inventions the temperature of the treatment substance is controlled by a heat exchanger, advantageously by a cooler.

[0024] According to an advantageous feature of the invention the arrangement comprises a droplet separator between the degassing unit and the vacuum system. According to an advantageous feature of the invention the arrangement comprises a dry screw vacuum pump for providing vacuum 20 - 40 mbar in the vacuum system. Advantageously there is a droplet separator before the dry screw vacuum pump. In the following the invention is described in more detail with reference to the accompanying drawing, in which

figure 1 is a schematic process chart of treatment substance flow,

figure 2 is a schematic example of one advantageous aspect of the invention and

figure 3 is an air-saturation vapor pressure diagram.

[0025] According to figure 1 the process of treatment substance flow the treatment substance is delivered to a feed tank 11. From the feed tank 11 the treatment substance is passed to temperature control unit 12, which is for example a heat exchanger or advantageously a cooler. The temperature controlled, advantageously cooled treatment substance is then passed to degassing unit 13, which comprises a vacuum system 14 with a suction pump (not shown) for removing gas from the treatment substance. The degassed treatment substance is the passed to a working tank 15, from which the treatment substance is passed to a coating device or to a sizing device (not shown). The degassed treatment substance may also be passed directly to a coating head / an applicator of a coating device or to a sizing head / an applicator of a sizing device (not shown).

[0026] In the example of figure 2 treatment substance is delivered via feed channel 20 to the temperature control unit 12 from the feed tank 11 (fig. 1). Temperature of the treatment substance is measured by a temperature sensor 12A and pressure of the treatment substance in the feed channel 20 is measured by a pressure sensor 20A. Measurement information from the temperature sensor 12A and the pressure sensor 20A is transmitted

to a control unit 25. From the temperature control unit 12 the treatment substance is passed to degassing unit 13, in which the gas is separated from the treatment substance and removed by the vacuum system 14. The gas flow is passed to the vacuum system via a droplet separator 16, in which the steam in the substance is cooled to condensate and moisture is separated from the gas flow. Pressure in the degassing unit 13 is measured by a pressure sensor 13A and its measurement information is transmitted to the control unit 25. The control unit 25 controls operation of the system and especially controls the pressure created by the vacuum system and temperature conditions of the treatment system by adjusting the operation of the temperature control unit 12. From the degassing unit the degassed treatment substance is fed via a feed channel 22 to the working tank 15 (fig. 1). The degassed treatment substance may also be passed directly to a coating head / an applicator of a coating device or to a sizing head / an applicator of a sizing device (not shown).

[0027] As shown in figures 1 and 2 temperature of the treatment substance is adjusted by the temperature control unit 12 and temperature changes of the treatment substance are evened out before degassing of the treatment substance in the degassing unit 13. Temperature control unit 12 is advantageously a cooler or a heat exchanger, which maintains the temperature changes of the treatments substance as slow as possible and thus best environment and best conditions for degassing and for functions of the degassing unit 13 and the vacuum system 14 are provided.

[0028] In figure 3 is an air-saturation vapor pressure diagram, which provides basic information for the control unit 25 (fig. 2) for creating required pressure level in view of the temperature of the treatment substance for desired degassing conditions. When the temperature of the treatment substance is controlled in the temperature control unit 12, a vacuum is created as the steam volume in the gas flow decreases due to cooling and condensing of the steam. The steam condensate is removed in the droplet separator 16.

Reference signs used

11	feed tank
12	temperature control unit
12A	temperature sensor
13	degassing unit
13A	pressure sensor
14	vacuum system
15	working tank
16	droplet separator
20	feed channel from feed tank
20A	pressure sensor
22	feed channel to working tank
25	control unit

Claims

1. Method for degassing a treatment substance of a fiber web, in which method the treatment substance is degassed in a degassing unit (15), **characterized in that** temperature of the treatment substance is adjusted to temperature below 35 °C by cooling the treatment substance in a temperature control unit (12) before degassing of the treatment substance in the degassing unit (15).

2. Method according to claim 1, **characterized in that** temperature changes of the treatment substance are evened out in the temperature control unit (12) before degassing of the treatment substance in the degassing unit (15).

3. Method according to claim 1 or 2, **characterized in that** in the method the temperature control unit (12) maintains the temperature changes of the treatments substance slow below about 1 °/15 min.

4. Method according to any of claims 1-3, **characterized in that** in the method as the temperature of the treatment substance is cooled in the temperature control unit (12) steam in the gas of the treatment substance is condensed and vacuum is created the steam volume decreases due to cooling and condensing of the steam.

5. Method according to any of claims 1-4, **characterized in that** the treatment substance is cooled to temperatures 20-30 °C before degassing.

6. Method according to any of claims 1-5, **characterized in that** the treatment substance is a coating color or a sizing agent.

7. Method according to any of claims 1 - 6, **characterized in that** the treatment substance is delivered from a feed tank (11) via a feed channel (20) passed to the temperature control unit (12), that the temperature controlled, advantageously cooled treatment substance is then passed to the degassing unit (13) for removing gas from the treatment substance and that the degassed treatment substance is the passed to a working tank (15) from which the treatment substance is passed to a treatment device, in particular to a coating device or to a sizing device.

8. Arrangement for degassing treatment substance of a fiber web, which arrangement comprises a degassing unit (15), **characterized in that** the arrangement comprises a temperature control unit (12) before the degassing unit (15) for adjusting temperature of the treatment substance to temperature below 35 °C before degassing.

9. Arrangement according to claim 8, **characterized in that** the temperature control unit (12) is a cooler or a heat exchanger.

10. Arrangement according to claim 8 or 9, **characterized in that** the arrangement further comprises a feed tank (11) and a feed channel (20) for passing the treatment substance to the temperature control unit (12) and another feed channel for passing the treatment substance from the degassing unit (13) to a working tank (15) from which the treatment substance is passed to a treatment device, in particular to a coating device or to a sizing device.

11. Arrangement according to any of claims 8-10, **characterized in that** the arrangement comprises a control unit (25) receiving measurement information from a temperature sensor (12A), from a pressure sensor (20A) in the feed channel (20) and from a pressure sensor (13A) in the degassing unit for controlling the temperature of treatment substance in the temperature control unit (12) and the pressure of the degassing unit (13).

12. Arrangement according to any of claims 8-11, **characterized in that** the arrangement comprises a droplet separator (16) and a vacuum system (14) connected to the degassing unit (15).

13. Arrangement according to any of claims 8-12, **characterized in that** the treatment substance is a coating color or a sizing agent.

14. Arrangement according to any of claims 8-13, **characterized in that** the arrangement comprises a dry screw vacuum pump for providing vacuum 20 - 40 mbar in the vacuum system (14).

15. Arrangement according to any of claim 14, **characterized in that** the arrangement comprises a droplet separator (16) before the dry screw vacuum pump.

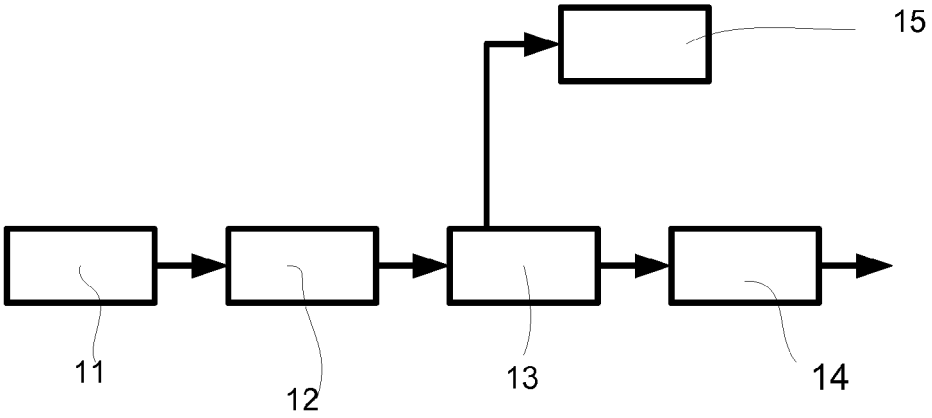

Fig. 1

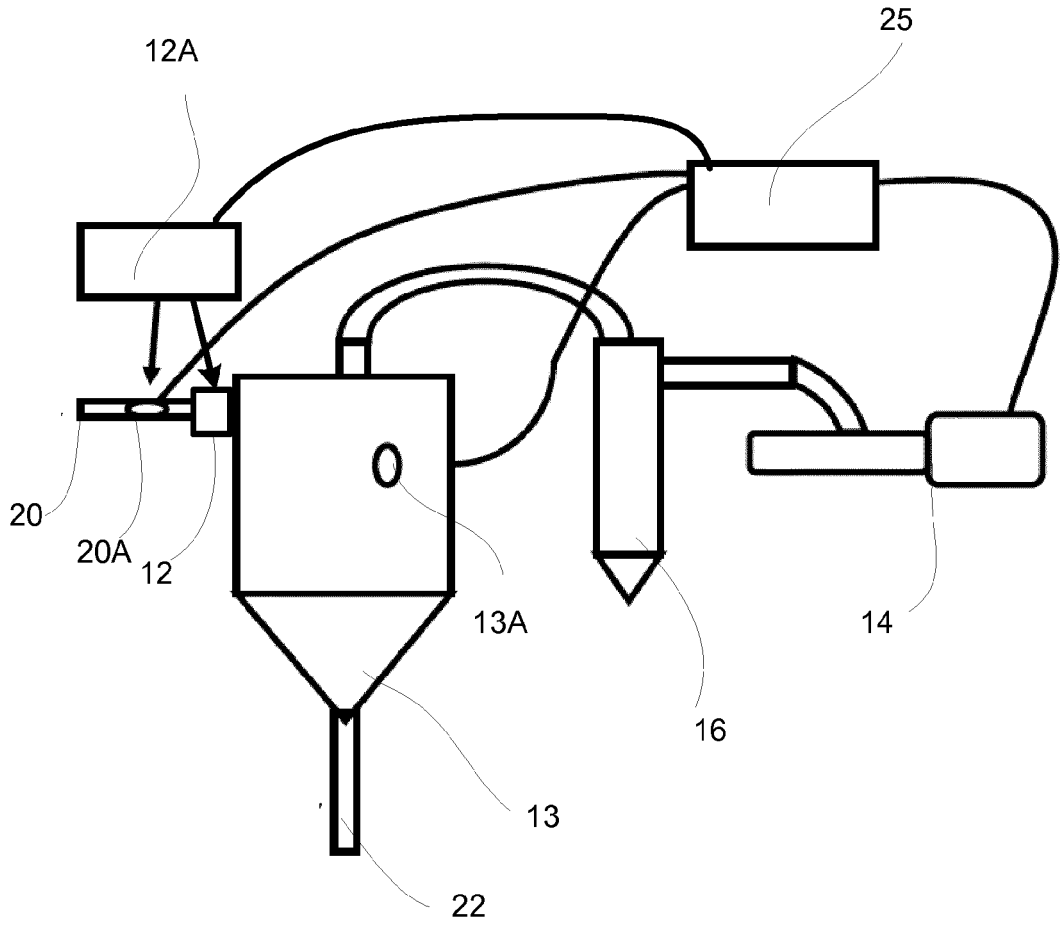

Fig. 2

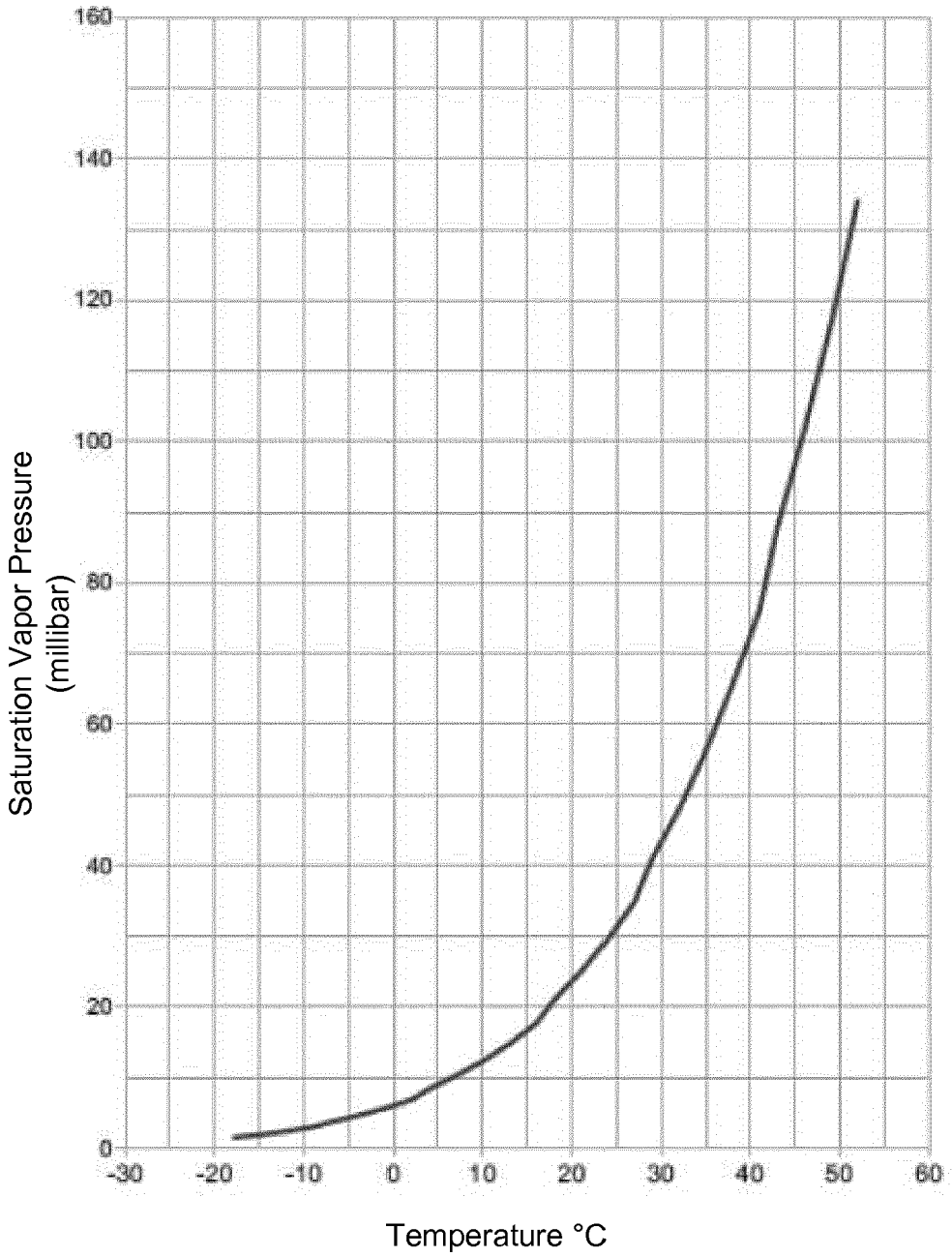
160
140
120
100
80
60
40
20
0
Saturation Vapor Pressure (millibar)
-30
-20
-10
0
10
20
30
40
50
60
Temperature °C

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 17 0730

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	WO 2012/041662 A1 (VOITH PATENT GMBH [DE]; HENNINGER CHRISTOPH [DE]; FISCHER FRANZ [DE];) 5 April 2012 (2012-04-05) * claims 1-10; figure 1 *	1,5,6,8, 9,13	INV. D21H23/48 B05C5/00 D21H19/00 D21H21/16
X	EP 0 517 223 A1 (JUJO PAPER CO LTD [JP]) 9 December 1992 (1992-12-09) * paragraph [0054]; claims 1-5 *	1,5,6,8, 12,13	
X	EP 2 474 369 A1 (VOITH PATENT GMBH [DE]) 11 July 2012 (2012-07-11) * paragraph [0016]; claims 1-6 *	1,5,6,8, 9,13	
X	DATABASE WPI Week 200133 Thomson Scientific, London, GB; AN 2001-314591 XP002714688, & JP 2001 087698 A (ISHIKAWAJIMA HARIMA HEAVY IND) 3 April 2001 (2001-04-03) * abstract *	1,8	
X	EP 1 498 544 A1 (AIR PRODUCTS POLYMERS LP [US]) 19 January 2005 (2005-01-19) * claims 1-18; examples 1,2,4 *	1,8	TECHNICAL FIELDS SEARCHED (IPC) D21H B05C
A	WO 02/066739 A1 (VOITH PAPER PATENT GMBH [DE]; BECKER INGO [DE]; BOHNENKAMP BERND [DE];) 29 August 2002 (2002-08-29) * the whole document *	1-15	
A	EP 1 518 962 A2 (VOITH PAPER PATENT GMBH [DE] VOITH PATENT GMBH [DE]) 30 March 2005 (2005-03-30) * the whole document *	1-15	

-/--

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 October 2013	Karlsson, Lennart

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

EPO FORM 1503 03.82 (P04C01)

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 17 0730

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2008/037843 A1 (METSO PAPER INC [FI]; HAAVISTO JOUNI [FI]; LUOMI SEPPO [FI]; NURMIAINE) 3 April 2008 (2008-04-03) * the whole document *	1-15	
A	GB 1 246 806 A (BURLINGTON INDUSTRIES INC [US]) 22 September 1971 (1971-09-22) * the whole document *	1-15	
A	WO 97/10387 A1 (HERCULES INC [US]) 20 March 1997 (1997-03-20) * the whole document *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 October 2013	Karlsson, Lennart

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 17 0730

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-10-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012041662 A1	05-04-2012	CN 103140628 A	05-06-2013
		DE 102010041706 A1	05-04-2012
		EP 2622136 A1	07-08-2013
		WO 2012041662 A1	05-04-2012
EP 0517223 A1	09-12-1992	CA 2070613 A1	08-12-1992
		DE 517223 T1	16-12-1993
		DE 69213828 D1	24-10-1996
		DE 69213828 T2	30-01-1997
		EP 0517223 A1	09-12-1992
		JP 2841923 B2	24-12-1998
		JP H04361696 A	15-12-1992
		US 5447753 A	05-09-1995
EP 2474369 A1	11-07-2012	CN 102574147 A	11-07-2012
		EP 2474369 A1	11-07-2012
		JP 2011050817 A	17-03-2011
		WO 2011024637 A1	03-03-2011
JP 2001087698 A	03-04-2001	NONE	
EP 1498544 A1	19-01-2005	AT 355411 T	15-03-2006
		CA 2473356 A1	16-01-2005
		CN 1576461 A	09-02-2005
		DE 602004004951 T2	28-06-2007
		EP 1498544 A1	19-01-2005
		ES 2278247 T3	01-08-2007
		JP 5032412 B2	26-09-2012
		JP 2005097547 A	14-04-2005
		JP 2009041014 A	26-02-2009
		KR 20050009205 A	24-01-2005
		MY 140172 A	30-11-2009
		SI 1498544 T1	31-08-2007
		TW I261541 B	11-09-2006
		US 2005014013 A1	20-01-2005
WO 02066739 A1	29-08-2002	AT 368149 T	15-08-2007
		EP 1368538 A1	10-12-2003
		JP 2004520496 A	08-07-2004
		US 2004106716 A1	03-06-2004
		US 2004226674 A1	18-11-2004
		WO 02066739 A1	29-08-2002
EP 1518962 A2	30-03-2005	DE 10343022 A1	07-04-2005
		DE 20321832 U1	30-12-2010
		EP 1518962 A2	30-03-2005

EPO FORM P0459

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

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 17 0730

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-10-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008037843 A1	03-04-2008	AT 509528 A1	15-09-2011
		CH 698158 B1	30-12-2011
		DE 112007002171 T5	06-08-2009
		FI 20065613 A	30-03-2008
		JP 2010504851 A	18-02-2010
		WO 2008037843 A1	03-04-2008
GB 1246806 A	22-09-1971	BE 720148 A	03-02-1969
		CH 1322368 A4	29-06-1973
		CH 1740169 A4	29-06-1973
		ES 357854 A1	01-04-1970
		FR 1597516 A	29-06-1970
		GB 1246806 A	22-09-1971
		NL 6812700 A	10-03-1969
WO 9710387 A1	20-03-1997	AU 7155496 A	01-04-1997
		US 5853542 A	29-12-1998
		WO 9710387 A1	20-03-1997

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2006128963 A **[0006]**
- EP 0517223 A1 **[0007]**
- DE 102005017952 **[0008]**